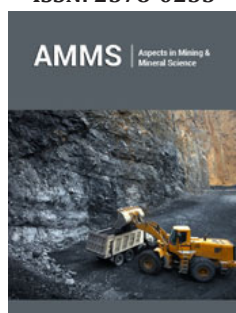


Changing Social Perceptions on Mining-Related Activities: A Key Challenge in the 4th Industrial Revolution

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Opinion

We are living in a period of multiple and accelerating changes where new uncertainties emerge constantly. Guidelines for economic growth are changing, social demands and environmental concerns are growing, and technological advancements are succeeding at rates never seen before. The main drivers of these changes are mostly related to digitization, decarbonization and dematerialization processes of economies, which follow the recent improvements achieved in biotechnology, digital networks, software design, and information and communication technologies. The ongoing technological (r)evolution includes continued linear progressions of solutions of widespread use along with innovations of exponential increase that will significantly shape the future and have potential to influence the current social and cultural patterns. However, all these transformations stimulate the reliance on a large number of minerals and metals whose increasing demand cannot be fulfilled on the basis of reuse, recycling and/or substitution practices. In other words: the full development of digital, eco-efficient and low-C intensity economies with higher levels of automation will require considerable inputs of raw materials derived from primary resources to balance the demand/supply ratio, filling the gaps of material stocks and flows in the economy that are not provided by secondary sources, even when suitably managed. So, mineral exploration and mining will remain fundamental in the completion of pathways to the future, as occurred throughout the history of human civilization. Notwithstanding this evidence, clearly demonstrated in many studies, the access to mineral resources are becoming increasingly difficult worldwide and mining-related activities are even more perceived negatively by society.

Why is so hard to change the social perception?

The generalized levels of social distrust that subsist in many regions about mineral exploration and mining reflect mostly a spiral of sensations resulting from the addition of historical real facts and biased opinions. Therefore, the easier attitude in many social/political circles is to show strong reluctance or to be against, even without offer a rational explanation to justify it. Objective, technical-supported, arguments used to rebut this behavior are often ignored, because social perceptions rely mainly on subjective appraisals and fears on foreseen environmental damages and negative impacts on communal infrastructures. Some premises of such rejection are not unwarranted, but the modern mining industry has to develop new ways of communicate, proving that serious errors made in the past are no longer acceptable and that it will be of its foremost interest to implement transparent measures towards a fully responsible industrial activity. Concurrently, much work has to be done to convince all the political actors of the need to ensure coherent and long-term stable policies on the access and management of mineral resources. The same is valid to demonstrate the importance of have continuous public investments in scientific research, technological and innovation programs aiming the expansion of present-day geological knowledge on mineral resources, as well as on new methodologies to efficiently use them. Without these concerted efforts it will be impossible to suitably overcome the emergent problematic inconsistency: the society requires more

and more mineral-derived products used in an increasingly larger number of conventional and innovative technological applications; the societal consumption advances at increasing rates; but, influential social movements do not appreciate the way how these goods are produced neither the industrial activities implicated in that production. Therefore, a cultural change is needed to definitely overcome the social rejection of activities related to the mining industry, particularly felt in some advanced economies.

What can be done to promote effective and educated social engagements?

Innovative approaches to understand and address the social acceptance of mineral exploration and mining activities are being developed in many regions, and reported in a wide number of studies published in various journals. Some of them are promising, particularly if complemented with modern marketing/communication schemes where other stakeholders, especially governmental organizations, are actively involved. Possible solutions may include: (i) offering the access and influence of mining-sceptical actors (individuals or organizations) to policy formulation or implementation; (ii) the reinforcement of dense networks of interaction, fostering reciprocity and trust and enhancing collaborative procedures; and (iii) the establishment of conditions to conceptual evolution of the risk concept (combining techno-scientific with social perspectives) and the corresponding search of the best method to deal with it. All these possibilities are valid and should be viewed as supplemental approaches that need to be properly weighed in a common strategy. Nevertheless, further research remains essential to: (i) evaluate the best pathways aiming at further developments in transparency and accountability needed to enhance (integrity-based and competence-based) trust; and (ii) identify the adequate means to overcome the major road-blocks in communication management able to improve and trigger insightful changes in all the relevant players (companies, authorities and public in general). By doing so it will be possible to support the design of practice-oriented roadmaps towards high-quality levels of social acceptance/approval embedded within a sustainability transition framework, i.e. considering rapid changes in technologies, market demands, environmental regulations, and social expectations. These practice-oriented roadmaps will allow guiding performance and monitor the effectiveness of novel measures/actions in communication between all the players, also encouraging the achievement of suitable collaborative platforms, thus improving procedural fairness, and educated scrutiny. This represents a significant step forward beyond the unilateral actions companies typically adopt to embrace concerted modes of social engagement.

What questions should guide the intended innovative approaches?

The assessment of relationships between society and mining-related activities is a complex and inherently transdisciplinary issue. Material benefits coming from these industrial activities are, for sure, important, promoting social and territorial cohesion, besides increased employment, and economic wealth. Yet, tensions

usually developed between communities, (national, regional, or local) authorities and companies rely mostly on contradicting views about the intensity of benefits and drawbacks of mining. These views are frequently entwined with subjective perceptions that will require methodological improvements in common procedures to regain levels of mutual trust and, on this basis, develop collaborative work. A kind of "soft system analysis" able to decompose gradually the problems and provide alternative solutions, complementing the usual "hard system approach" based on technical arguments. The challenge is huge and should not be confined to communities directly implicated in mining operations. In fact, the current access to information is fast and simple, and mobilization of social movements for these causes should not be misjudged. Accordingly, the intended innovative approaches should consider the answers to a long list of questions, namely: (i) how to communicate with society and prepare the forthcoming generations for the importance of minerals and metals to current and future models of sustainable growth, desirably relying on low-C intensity, optimized material flows and energy consumptions, and eco-efficient technologies; (ii) how to convince the public in general and the authorities for the need of intensify mineral exploration activities and properly safeguard the future access to relevant mineral resources; (iii) how to reconcile (and deal with) the risk concept from techno-scientific approaches and social perceptions; (iv) how to assess and overcome new (operational, reputational and regulatory/political) risks that may impact the company's cash flow or license to operate, reducing their willing to invest in new projects and pursue transformational innovations; (v) how to demonstrate that the best way to promote further sustainable socio-economic developments is to keep/expand investments in domestic mineral exploration and responsible mining operations, reducing as much as possible the dependence on imports and international trade agreements (often favoring producing countries/companies not so receptive to social and environmental high-demanding codes and practices); (vi) how to deal proactively with an ever more decisive public stances around Corporate Social Responsibility, transforming the relationships with stakeholders and communities; (vii) how to manage and conciliate the Social License to Operate with regulatory/political and actuarial licenses that, being interdependent, can easily conflict; (viii) how to implement innovative programs based on long-term territory-oriented projects and suitable multi-stakeholder control parties whose constitution consider the so-called "political opportunity structures"; and (ix) how to evolve from tacit acceptance/approval to effective collaboration, improving a culture of shared value and responsibility in future paths of progress and wellbeing (building collaborative governance frameworks).

Concluding remark

The current accelerated technological progress signs the transition to a new wave of economic prosperity, following the neo-Schumpeterian perspective and the Kondratiev cyclical evolution, largely convergent with the mainstays of the 4th Industrial Revolution as recently defined by Klaus Schwab. Increases in productivity and efficiency are expected along with rapid application and diffusion of innovative (disruptive) technologies which will cause significant

changes in society. However, the foreseen expansion of this “new world” requires an increasing diversity and growing amounts of specific metals, reinforcing the trends towards (high-tech) metal-intensive economies. According to current knowhow, technical procedures, and economic criteria, $\approx 60\%$ of the raw materials used in high-growth and high-tech industries have low ($<5\%$) recycling rates and are of difficult or impossible substitution. So, mineral exploration and mining-related activities will continue to play a vital role in this transforming, technological-driven, era. The performance of these activities will be subjected to unprecedented social scrutiny, requiring substantial improvements in communication between all the players, transparency, and procedural fairness. Collaborative

work is necessary to gradually change common social perceptions about the mining industry, dismantling biased and prejudiced judgments. It is also time to definitively end industrial practices with unacceptable environmental and social impacts. Only then the mining industry may shift from a “triple-D” (Dirty, Dangerous and Difficult) to a “triple-A” (Accountable, Advantageous and Advanced) rating level at the eyes of the public in general.

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