

Viña del Mar, Chile, 03-21-2021

### WEEKLY REFLECTION GLOBAL TRENDS AND THE MINING OF THE FUTURE

Global trends reflect the evolutionary behavior of certain high-impact variables -macro-variables- over time, and are indeed the subject of studies, analysis, research and reflection, given the implications of various kinds that they represent. Another way of defining them is to point them out as those responsible for the emergence and empowerment of great forces that induce and shape a set of transformations in the following dimensions: human, social, cognitive, economic, environmental, technological, territorial, political, cultural, patrimonial and others whose occurrence and manifestation is disparate, with dissimilar scopes at the "micro" (local: company, city), "meso" (intermediate: province-region) and "macro" (global: national-international) territorial levels.

In this reflection, the main trends on a global scale are mentioned, the impacts of which in some cases can be evidenced, given the availability of means of verification such as data, laboratory records, photographs, videos, graphs and reports of various kinds. However, it is necessary to point out that the process of collecting and generating information is frequent and therefore, there are many topics in which the scientific world ignores the potential impacts that could be achieved. This suggests the imperative of carrying out scenario studies that do not exclude other equally valid tools, using for this purpose the discipline of foresight<sup>1</sup> in terms of constructing futures, whether they are of the trend, possible, probable, desirable, disastrous, unexpected or omitted type.

The global trends on which the author has focused his greatest dedication are:

- Climate change,
- Production and consumption patterns,
- Technological convergence,
- The rise of the middle class,
- The multipolarity of power.
- The increase in world population.

Mining is no stranger to the ups and downs of all kinds, much less is it immune to the great transformations that go beyond the disruptive change in the dimensions mentioned above. In particular, it requires a greater understanding and comprehension of the mining business value chain and, on the other hand, it deserves a worldview of the context where mining operations

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<sup>1</sup> Oportus P. (2020) , blog reflection: "Prospective in the organizations of the XXI century"  
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are located, thus allowing an adequate and ideally assertive interpretation of the signals provided by the environment and driving changes, many of them of an exponential nature at local, national, regional and global scale.

In the constant exploration of knowledge, the author has created acronyms that reflect to some degree what is happening and affecting humanity, keeping in mind the long term view<sup>2</sup>:

- GLOVICOM: Global Virtual and Complex.
- HPRS Vision: Holistic, Prospective, Resilient and Sustainable.
- TCVC: Turbulence, Complexity, Volatility and Exponential Change.

The use of agile methodologies in modern companies and the transit towards a digital-cultural transformation, which promotes the acquisition, development and application of technologies such as cloud storage, processing of high volumes of data, cybersecurity, 3D printing, augmented reality, artificial intelligence, process automation, robotics, blockchain, creation of mathematical models and algorithms, machine learning, the internet of things (IoT), quantum computing, are some examples of technologies that managers and professionals must know, learn and apply in order to lead in the face of new challenges, if there is a genuine and authentic commitment to add value and reach higher levels of innovation, labor productivity, safety, systemic efficiency and human development.

When analyzing from the point of view of the various difficulties - problems - whether endogenous and/or exogenous to the mining-metallurgical industry, the main ones are identified, not excluding other equally relevant ones: the aging and deepening of the mining deposits, the existence of a more competent rock mass, that is to say, of greater hardness, which translates into an increase in the consumption of drilling steels and explosives, the distance from the extraction points to the dumps and ports is increasingly longer, due to the location of the mining districts and the dynamics of the exploitations, being a direct consequence of the increase in transportation and logistic expenses. In addition, there is an increase in the mineral ballast ratio, an increase in operating costs with a significant impact on the price of inputs: In addition, there is an increase in the ratio of mineral ballast, an increase in operating costs with a significant impact on the price of inputs: steel, water and energy, the long and difficult treatment of mining liabilities, greater demands in terms of environmental regulations, special and complex negotiations with workers' unions, technological obsolescence due largely to the high cost of investment in new machinery, the tortuous administrative procedures and their close relationship with the unnecessary loss of time, the lack of planning to account for the training and formation of human capital in line with Industry 4.0 industry, the change in the legal rules of the game for mining in the 21st century, the fall in metallurgical recoveries, the contamination of the most economically valuable species, the complex commercial relationship between the United States and China, the high volatility of commodity

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<sup>2</sup> Oportus P. (2020), blog reflection “Industry ”, [www.consultoriasoportus.cl](http://www.consultoriasoportus.cl)

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prices, the gradual and sustained fall in mineral grades, the natural depletion of mineral resources on the face of the earth.

In short, the various difficulties mentioned above only reaffirm the hypothesis of lower productivity, higher costs and reduced Economic Value Added (EVA).

The world class challenges and opportunities for tomorrow's leaders will be to solve these endogenous and exogenous issues, seeking to act with HPRS vision, GLOVICOM view in TCVC contexts.

Bearing in mind the above, the mining of the future requires the incorporation of a series of measures, many of them of an urgent nature if we really wish to be leaders in terms of costs, safety, productivity, competitiveness, corporate social responsibility and environmental care. Within this framework, the emphasis on the integral modernization of the mining industry of the future must imperatively be based on five strategic axes:

AXIS A: Human capital of excellence.

Imagining, creating, designing and implementing new jobs, promoting multifunctionality and the definition of new competency profiles, in addition to carrying out ambitious training and education programs at all levels of the organization, being highly recommended the mastery of languages and collaborative work in a hybrid way, i.e., the combination of face-to-face and virtual for the development of human relations.

AXIS B: Digital transformation.

Incorporate disruptive technologies to mining organizations, the use and application of robotics, autonomous equipment, artificial intelligence, data storage in the cloud, blockchain, the internet of things (IoT), big data, machine learning, process modeling, etcetera.

AXIS C: Cultural change.

Preparing organizational teams for tomorrow, providing them with the necessary knowledge and tools within the framework of a continuous, iterative and sustained process, role-playing and leadership in the face of crisis situations, being desirable to know how to read and interpret the signals of the environment, concerning multiculturalism, respect for universally accepted standards, codes and others, non-discrimination and promoting policies that incorporate the participation of women and inclusion in all its meanings.

AXIS D: Disruptive innovation:

To have the resources in quantity and quality that facilitate the processes of creation, economic value addition and disruptive innovations.

Create Project Management Offices (PMO) as instances exclusively dedicated to the study of future events, understand global holdings and study a range of scenarios for subsequent decision making, being necessary to eliminate those activities that do not add value, reducing

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unnecessary time and generate new products and/or services that contribute to mining organizations, suppliers, customers and business partners.

AXIS E: Circular and green mining.

The tripartite integration of an alliance involving private companies, public organizations and higher education institutions is essential to advance in the consolidation of mining 4.0.

Circular mining proposes the use of non-polluting energies and the reuse of waste, which is conducive to green mining.

The following are approaches that are necessary to reflect with a prospective vision and try to answer the questions raised without losing sight of the time frame, i.e., analysis for the years 2030 and 2050 respectively.

Comprehensive intervention of the mining business value chain.

Carry out a set of interventions that translate into continuous improvements to the value chain of the mining business from the general point of view and in the singular area, intervene in the processes of each of the mining unit operations that can be operated and monitored in an automated and remote way, thereby increasing the productivity and safety of workers, assuming a leadership in the economic, technological and environmental level, contributing in this way to the addition of economic value and excellence.

Creation of experimental laboratories for advanced research.

The creation of experimental laboratories with the necessary and sufficient resources to carry out applied and advanced research in the mining industry. Opportunity to study, manage and promote research addressing the five axes proposed by the author of this article, generating products and services for the mining industry with a long-term vision. Plausible examples to cite in this area would be the development of green hydrogen and eco-innovation, the latter understood as the various ways to innovate with technological and not necessarily technological assistance, whose main mission is the care of the environment, preventing harmful impacts, which reinforces the idea of promoting green mining.

It is also interesting to explore new opportunities in the development of intelligent evolution models for Industry 4.0, characterized by innovation ecosystems, machine learning environments and predictive analytics.

Questions with a prospective vision for the years 2030 and 2050.

What skills profiles will Mining 4.0 require to meet the world-class challenges that the mining industry will require?

-How significant will be the impact of global trends in the development of Mining 4.0?

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To what extent will we have to produce and consume mineral resources, bearing in mind the maintenance of terrestrial and marine eco-systemic balances?

-Will there be political will to modernize Chile's mining legal framework and in particular to incorporate a chapter destined to the exploration and exploitation of metallogenic resources of the ocean floor within 200 nautical miles?

-Has it been seriously considered to carry out collaborative research with the United States leading to the materialization of analysis, studies and research of rocks, minerals and other elements from the universe?