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On the Sources of Complexity in Contemporary and Future Mining Projects

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ABSTRACT

Below-ground technical complexity remains a traditional source of project challenge. Above-ground challenges then augment this complexity, including in the domain of commodity marketing. All challenges must be solved to produce quality, saleable, ex-mine product. The situation is further complicated in that technical complexities are not independent of each other, so complexity is best regarded as a system rather than a series of isolated factors. Additional above-ground challenges to mining projects are also increasingly sourced from societal and environmental factors, locally and globally. These challenges not only confer project complexity, but have their source in larger, global wicked problems. Finally, financing and resourcing of projects represents an ever-present challenge for all but the highest-quality mineral deposits.

A business-level complexity framework is mapped to project risk; one in which all mining projects are not created equal. The critical success factors for different projects are systematically different, based on location, geometry, commodity, mineralogy and finally economics in its broadest sense. Remarkably, Agricola, in his *De Re Metallica* of 1556, foresaw many factors that cause contemporary complexity in mining projects.

For readily-marketable mainstream commodities, project criticality typically lies in two places – firstly in the traditional technical parameters of geology, mining and processing as they map on to project capital and operating costs, and secondly, especially for bulk-commodities, in above-ground societal and environmental acceptance. Project complexity is commonly found in the latter, above-ground, domain. By contrast, for boutique and emerging niche mineral commodities, both projects criticalities and complexity more often relate to a combination of mineral processing and market-related issues, and less so to mining and geological factors. Interestingly, the small footprint of projects in niche commodities may represent one factor that can assist in mitigating above-ground complexity.

Finally, even the ownership of the project, whether for example by a large mining company capable of withstanding project-level financial distress, or else by a junior explorer 'betting the company' on a first mining project adds a further level of project complexity. It seems the days of a 'simple' mining project are gone – although Agricola would argue simple projects were already extinct some 500 years ago.