CDO Extractive Industries Note

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The Research Question

Across extractive industries, there is a pervasive expectation that ICT-led innovation, particularly AI and robotics, will be key features in the future for industries with chronic challenges of volatile prices and declining grades of resource assets. The research question is how new and relatively small Canadian IT firms can find entry points and scale within industries that are dominated by huge global operating companies with long established vertical supply chains.

In summary, the conclusion is that, assisted by targeted procurement and policy assistance, the opportunities are substantial. They will be deep but not necessarily broad.

Extractive Industries: Mining and Oil and Gas

Industries based on extractive resources, primarily minerals and oil and gas resources, are important to the Canadian economy in terms of their contributions to employment, gross domestic product (GDP), capital expenditure, construction-related investment, revenues to governments, export value, and investment in Canadian companies.

As more accessible resources are fully exploited, there are technical and scientific challenges to be overcome to dig deeper or extract lower grade minerals and to drill in more remote or challenging areas. There are also challenges arising from the complexity of the underlying economics of extractive industries such as valuation of reserves, which are exacerbated by protracted commodity price variability, interspersed with occasional and surprising price shocks

ICT represents new opportunities for automation through digitization and robotics. In a common metaphor, mining executives commonly state that they are looking to data structures to 8lift the lid off the mine and run underground operations like it was a 4.0 auto factory. These technologies include advanced robotics, big data and analytics, artificial intelligence, mobile computing, wearable technology, internet of things (IoT), and autonomous and near-autonomous vehicles. While there is a widespread belief that digitalization will transform extractive industries, the timing and consequences for such a transformation are less clear.

Digitization of Resource Assets

For both mining and oil and gas companies, the future will include heavily digitalized assets (i.e., oil rigs, mining equipment), capable of high levels of autonomy and inter-asset

cooperation, operating within challenging natural environments (e.g., a deep or remote mine or far offshore oil field) managed by using advanced embedded and remote intelligent sensor technology. These digitalized assets and intelligent sensor technologies can be connected via innovative communication systems to monitor production operations remotely, interact via ICT technology with a limited number of field workers at production sites, and perform computational analysis on data collected from remote operations to optimize production, equipment maintenance, and asset utilization, while simultaneously ensuring regulatory compliance.

In summary, extractive industries in Canada will be employing disruptive digital technologies to expand and enhance their traditional exploration and development functions. In the broadest sense, traditional extractive industries are being 'normalized' along the lines of the new advanced manufacturing model where the value chain is being extended beyond the operating companies to the supply chain. This will create opportunities for transfer of digital technologies from other fields not previously considered as associated with mining and petroleum, plus an entry point for new firms. However the points of entry and the pathways for digital technology development will be heavily influenced by the existing industry structures and inter-firm relationships.

Methodology

It is common to hear AI and robotics used in the same sentence to summarize the potential impact of new disruptive technologies across the economy. In fact, AI and robotics are separate variables that impact specific industries in different way.

Broad forecasts of the employment impacts of the new technologies either from Frey & Osborne or from McKinsey, apply probabilities of elimination of tasks and occupations. This research takes a different approach. The hypothesis is that the implementation of the new technologies will first have an impact on work flow and this in turn will impact tasks, jobs and employment. To answer the question requires building work flow models of the exploration, development and production processes for each industry.

Transfer of the Advanced Manufacturing Model to Other Industries

The advanced manufacturing model is also becoming a model for a new form of industrial organization and innovation in Extractive Industries. It represents the emergence at the frontier of production in all sectors of the economy—in the production of resource-based commodities as well as industry and services—of a model of collaborative innovation. This model takes as its starting point a world in which the speed and uncertainty of technological and market change make it impossible for even the most capable actors to master by themselves the skills needed to remain at the forefront of development. Given this uncertainty even the leading firms come to depend on shifting constellations of suppliers, large and small, to deploy and develop technologies changing so rapidly that their strengths and weaknesses can only be determined in use.

In this new model of production the master skill is the capacity to collaborate in adjusting general technologies to particular contexts, and then learning from those adjustments to advance general understanding. Because this model of production is inherently collaborative, its development goes hand and hand with the creation of new forms of contract that facilitate joint innovation among rapidly changing groups of partners.

Digital Opportunities for SMEs in Extractive Industries

In both upstream petroleum and mining, the Canada's industries are dominated by global companies who are conservative about innovation and whose first resort is to established procedures and processes. Their reaction to a new challenge is to look to proven processes and procedures internally and if needed to look for solutions from traditional international Tier 1 suppliers. Within the current challenge of digitization, the imperative is to standardize in order to automate. This industrial culture and hierarchy of suppliers are a major barrier for new technologies and SMEs wanting to grow.

Conclusions

In the case of upstream petroleum, in the Newfoundland Offshore, the dominant operating companies rely on international technology and knowledge flows for the most part. The common reference is 'call Houston' where their global innovation centres are located. The exception is where there are unique conditions such as the harsh conditions of the NL offshore with deep, cold water and icebergs. Within this niche, small SME technology firms have found new opportunities. They have been significantly assisted by the mandate of the Atlantic Accord for operating companies to spend $500 million on R&D within Newfoundland. This has proved to be an effective device for new Canadian digital firms to gain entry into the market. However, given the niche character of the market segment, it is not clear that they can scale to the global supply chain.

In the mining case, there has been a huge surge of ICT activity in mining, primarily in the exploration and development stage of activity. This has been assisted by the unique financing mechanism of Flow Through Shares. However the latter are limited to these upstream activities and do not apply to the downstream production and processing stages. In the latter stages, innovation is largely driven by the Equipment OEMs. The numerous IT SMEs of the Sudbury mining services cluster have, like the NL Offshore services sector, difficulty in getting sustained access to markets where they can scale. Canada has a major under-utilized opportunity to link its huge mineral resource base to its manufacturing base. The linkages between digitization of ore bodies, metallurgy, structural metallurgy to design and manufacturing have yet to be made.