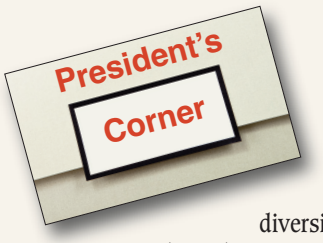

Southern Africa is a complex place; the many cultures and languages, the breadth of landscape, biodiversity and weather, the amazing mineral endowment, let alone history and politics, make it so. Therefore 'we do complexity', it is in the fabric of our lives and nurtures our ability to succeed in difficult times.

Inherent to complexity are four broad interactive dimensions: diversity, ambiguity, change, and interdependence. I have previously commented on diversity, ambiguity, and change, so this month my perspective is on interdependence; where there is mutual dependence between the components that comprise a system. Interdependence exists in a myriad of contexts, but what I will comment on now is interdependency in the mining value chain.

The mining value chain is a complex system of highly interdependent parts. We need to acknowledge this and understand the impact of changes in one part of the system on the remainder. As engineers and scientists we have a tendency to approach complex matters from a reductionist perspective, but given the complexity of business and society we must not lose sight of system interdependencies and their impact.

A conceptual model I often use to map and understand system complexity considers activities in terms of elements of people, processes, and technology operating in a social and business context. The people element talks to the human capital side of business and covers aspects such as capability, capacity, motivation, and equity. Processes refer to, for example, the policies, procedures, and standards that are put in place to execute work. Technology is the science applied to our work. It can be anything from advanced rock-cutting machinery to software applications. The operating context, the world in which we operate our businesses, covers aspects from attitudes to personal safety through to the relationship with organized labour and communities. Choices that we make around processes, people, and technology interact in the operating context to create the businesses that we operate.

A simple example for narrow tabular underground mining can demonstrate these interdependencies. The introduction of double-drum scrapers as the primary means of in-stope rock handling in narrow tabular stopes revolutionized the underground mining industry after the Second World War. Let's briefly look at the system interdependencies and implications. Steel wire rope construction and materials place a limit on practical winch power, length of pull, and productivity. These in turn impact maximum raise length and cross-cut spacing, which dictates layouts. Layouts impact level spacing, output per level, and sustainable shaft production rates. Safety risk is a specific outcome of this production system – for example, how many lives have been lost in the scraper 'danger triangle' underground since the introduction of scrapers? I shudder to think. In order to operate this system effectively, we then established operating protocols, standards, and training requirements for scraper operators whose skills are specific, limited, and largely non-transferable, thus creating a system dependency which is attractive to organizers of labour. From an operating cost perspective we now have a system with limited opportunity for productivity improvement in an environment of escalating input costs. If metal prices do not rise faster than the input cost escalations when the system productivity has plateaued, then … well, then we don't have a business.

While the choice of rock-handling technology determines system potential and viability in the mining production environment, choices in dependent processes and technologies further along the value chain are driven by outputs of that mining activity. Concurrently the people, processes, and technology in parallel value chains that support the primary value chain, such as engineering services, human capital, and occupational health are being shaped by the original choice of rock-handling technology in the mining activity. Simply put, the choice of technology for rock handling, in this simple example, double-drum scrapers, defines the overall system potential for the business; from safety to productivity to economic performance.

Interdependence is a harsh reality of systems, and value chain optimization must therefore be considered from a holistic systems perspective – people, processes, technology, and operating context – if a sustainable benefit is to be realized from change.

The reality is that the South African minerals industry, a complex system, is at a point of inflexion where the relationship between business, organized labour, government, and communities – the context in which it operates – has changed and simply will not be the same again. We, as technical and business leaders, must therefore carefully consider the interdependencies between the system elements as we optimize our businesses to weather the current challenges.

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