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Case studies of technology roadmapping in mining

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ABSTRACT

Mining is a long established art with legacy processes and institutional structures that face rapidly changing technological environments. The perception is that technology planning and forecasting receives priority attention only as far as they may be linked to making production tonnage in the short term, thus giving the impression that new technology may be introduced without developing a culture and operational requirements that influence successful implementation of new technologies. With depleting ore grades of existing mines, and the prevailing global financial crisis making it prohibitive to develop richer sources, mining is considered to be short-term risk averse and this accentuates a more conservative approach towards technology planning and forecasting. Based on surveys and interviews with practicing miners, this paper discusses three case studies on the practice of technology planning and forecasting in mining firms. It is evident that technology planning and forecasting, and particularly the use of the roadmapping approach, is not a 'culture' common to mining firms.

Introduction

The magnitude and speed of technological change are increasing as well as the scale, dynamics and complexity of the global market place. Sustainable management of an asset over its entire life cycle is vital to firms searching for ways to improve business performance. Changing technology affects the decision making process for sustainable asset management whether the asset is a resource like coal or

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platinum, or even an engineered equipment such as a continuous miner. It is important for an asset-intensive organization to apply a structured approach with effective processes and systems to acquire, adopt and align technological innovations with its strategic objectives so as to achieve improved business performance in both the short- and long-terms.

Mining has played, and continues to play a pivotal role in the growth and development of nations. For instance, coal mining provides a basic raw material for energy supply. Global demand of coal is projected to rise by 1.4% a year, with this demand expected to be strongest in the developing world where the requirement for electricity power generation is expected to account for the bulk of this increase in demand (Dyk, 2008).

Mines tend to be relatively large operations in numerous underground sections as well as in big open pits depending on the resource and its geology. Mining methods such as drill and blast, continuous, and longwall, are carried out using engineered assets that involve large earthmoving equipment such as bucket-wheels, continuous miners, conveyor systems, draglines, feeder-breakers, excavators, roof bolters, shovels, shuttle cars, and trucks. The reliability and availability of the production equipment, the workforce, and the support systems have a large impact on mine performance. Preventative, predictive and proactive maintenance are essential strategies that should increase production uptime, and when correctly implemented, they could result in substantial savings, since the maintenance cost in the mining industry can be as high as half of the production cost (Campbell and Reyes-Picknell, 2006).

Extrapolating from a Mandate Framework Document for the South African Coal Roadmap (1998), depleting ore grades and new legislation have wide ramifications and provide impetus for the adoption of new business drivers, hence, mining firms need to channel their capabilities towards new strategic directions. Although production tonnage has been a key driver, however, health, safety and energy efficiency issues have taken on more significance, resulting in many new legislative requirements that also impact on cost and competitiveness. Safety is a major issue in mining and does attract stringent statutory regulations. Varying, often hazardous, confined work space, and poor man-machine interface impact on productivity and cost. Environmental protection through 'green technologies' is also at premium cost to miners (Limpitlaw, 2004). The challenge is to improve ergonomic conditions by reducing exposure to hazards and minimizing recordable accident case rates towards zero. To achieve such targets requires training and the deployment of advanced technologies in production equipment and business systems, including automation, satellite communications, smart sensors, and robotics (Willis et al., 2004). Remote, real-time monitoring, diagnostics and prognostics are becoming essential technological features of modern-day coal mining operations (Peterson et al., 2001).

With mining operations increasingly dependent on the application of various technologies, so also has technology management become an essential business activity for miners. Mining is a long established art with legacy processes and institutional structures that are not immune to technology changes but, there is a perception that miners tend to approach technology planning and forecasting in an adhoc manner (Garcia and Bray, 1997). Changes in technology may be abrupt and discontinuous, thus presenting significant uncertainties in mining environments characterized by traditional inertia and conventionally high resistance to change. For some miners, the implication is that they may have to rapidly abandon conventional techniques in favour of adopting potentially disruptive technologies, irrespective of whether the technological resources are in the form of physical artefacts (such as hardware or firmware), or in the form of technological processes, i.e., business procedures that encompass 'new ways of doing things'. An unstructured approach to the introduction of technology without adequate consideration of the rigours of the mining environment could be premature to mining culture (Hung et al., 2001; Warhurst and Bridge, 1996; Lee and Kang, 2008).

Firms recognize that technology can be a driver for growth and development, and many managers are aware that technology can be deployed to sustain strategic business objectives. Identifying, selecting and implementing the most suitable technologies from different alternatives invoke serious decision-making around value creation and competitive advantage. From the point of view of delivering value, many managers are, at least, aware of the strategic importance of technology because of increasing costs, complexity, and rate of change of technology, and these issues are compounded by competition for, and the globalization of, the sources of technology. The management of technology