

Information Technology in Mining Services Applications

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1. INTRODUCTION

Information technology (IT) can play a significant role in mining industries by driving continual improvements in efficiency and safety, reducing the cost of extraction of coal and minerals and maximizing profits. Mining, being hazardous in nature, is one of the oldest and most important industries (Agricola & Hoover, 1950). Coal and minerals extracted from mining industries always take part in driving growth and steering progress across various aspects of the economy of the nation. Energy is collectively acknowledged as one of the most significant contributions for economic growth and human development (Dialogues at the Economic and Social Council, 2008). The growth of the nation, taking into account the all segments of the economy and all sections of society, is dependent on meeting its energy requirement adequately. Coal is the most important component of energy matrix for a long time and still contributing a reasonable amount of energy supply to the nations (Yuan et al., 2018; Melikoglu, 2017; Tiewsoh, Sivek, & Jirásek, 2017; Garg, 2012). On the other hand, minerals are important contributors for the production of metals/alloys, fertilizers, ceramics, electronic items and an extensive range of other products (Rankin, 2011). It is worth mentioning that business existence in the present scenario is dependent upon the ability of the management to update with real-time information, make decisions and execute timely. Now the question arises, how to do it? The answer is the adoption of information practices and automated technology. Further, in order to stand parallel in the market with other industries, the mining including oil and gas industries is also taking up the state-of-the-art technology in its operations. Mine safety is in general based on the use of geotechnical and environmental information to make suitable and timely decisions in order to prevent hazards. The continuous involvement of IT applications in mining industry can i) improve the mechanism of information dissemination, ii) enhance safety, iii) provide remote operations and excel towards mechanization, iv) improve fleet management, v) analyze environmental impact of mining operations, vi) map the exploration data and estimate the ore reserves, vii) improve the approach from material extraction and marketing to sales and transportation and viii) overall increase efficiency to improve productivity, reduce cost of production and maximize profits. On the other hand, in the oil and gas sectors, information technology helps to optimize the processes and simultaneously enhances the efficiency of upstream and downstream operations (Anthony and Abdulkareem, 2013; Petersen, Doyle, Carlsen, van der Linden, Myhre, Sansom, Skavhaug, Mikkelsen and Sjong, 2008)

2. BACKGROUND

Earlier researchers have developed and even proposed a number of IT based systems for improving the overall efficiency of mining operations. Golosinski (2001) recapitulated the IT-related developments and their impacts on the mining industry. Further, Chaulya, Bandyopadhyay, & Mishra (2008) proposed

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futuristic development of IT-based systems by highlighting the existing problems and their respective solutions by proposing a web-based information and decision support system for coal mining industry. Gupta, Mukerjee, & Singh (2013) presented various scopes of application of IT for the Indian mining industry. A comparison between traditional and modern design techniques of mining methods using computer and IT has been illustrated by Miladinović, Čebašek, & Gojković, (2011). A number of applications of Radio Frequency Identification (RFID) as well as wireless sensor network (WSN) for information dissemination including tracking and tracing of miners, equipment and explosives have been discussed for mining sector (Bandyopadhyay, Chaulya, & Mishra 2010; Mishra, Bolic, Yagoub, & Stewart, 2012; Mishra, Mandal, Kumar, & Sinha, 2013; Mishra, Stewart, Bolic, & Yagoub, 2014; Singh & Mishra, 2016, Mishra, Pratik, & Kumar, 2017; Minhas et al., 2017; Kumar, Chand, & Kumar, 2018). Virtual reality i.e simulation of real-world and imaginary environments and situations with a high degree of realism is a fast growing technology based on information and communication technology. Virtual reality-based training tools can provide simulated exposure to real-world working conditions without the associated risks. However, the training outside the direct working environment provides only limited real-life opportunities. Van Wyk and de Villiers (2009) discussed regarding the virtual reality applications including its appropriate requirements and limitations. Further, Singh & Mishra (2016) presented the need for radar-based systems and virtual reality system in mining industry. A wireless real-time sensing platform using vibrating wire-based sensor has been developed to communicate the geotechnical information wirelessly by means of Zigbee based sensor network to a remote and safer place or even at the surface (Mishra, Pratik, Kumar, Kumar & Mandal, 2018). The developed sensing platform has been integrated with the Internet of Things (IoT) to make the data available to anyone and everyone authorized for the same (Mishra, Kumar, Pratik, Kumar, and Kumar, 2019). They developed a Zigbee based wireless sensor network (WSN) and further extended to IoT with IP enabled gateway. An android based application has been designed for retrieving the data using the corresponding IP address. Further, the display of data on web browser has also been incorporated. Ike, Anthony and Abdulkareem (2013) presented the core application of information and communication technology (ICT) in oil and gas industries for upstream and downstream operations. They presented a case study for the application of ICT in oil and gas sectors. A reliable Internet of Things based architecture for oil and gas industry was presented by Khan, Aalsalem, Khan, Hossain and Atiquzzaman (2017). They proposed a novel IoT based architecture for Oil and gas industries and suggested the methodology for applying the same to upstream, midstream and downstream operations.

Keeping in view of the above, the attempts have been made in the present chapter to discuss the potential applications of IT in the mining industry in the present strategic business scenario. The section 3 of the present chapter deals with the various mining activities and methods as well as key issues to be faced by IT-based systems during implementation. Section 4 discusses the various application sectors of IT in mining industry and section 5 illustrates the application of IT in oil and gas industries followed by future prospects and conclusions in section 6.

3. THE WORLD OF INFORMATION TECHNOLOGY IN MINING

Information is a core component of globalization. However, information is not communication. Communication involves the provision of information in a format and manner that can be used by the beneficiary. Information technology can become an integral part of information dissemination, safety, remote operations, mine mechanization, fleet management, environmental impact due to mining operation,

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