

Advanced Analytics in Mining Engineering

Aim

The book aims to provide practical help for executives, managers, and research and development teams to identify where and how to apply advanced data analytics in their enterprises. The use of advanced data analytics can support Their goals of improving energy efficiency, productivity, and reducing the associated costs of maintaining their mining operations.

The book is aimed at providing mining executives with an understanding of the business value and applicability of different analytic approaches and helping data analytics leads by giving them a business framework in which to assess the value, cost, and risk of potential analytic solutions. In addition, the book will provide the next generation of miners - undergraduate and graduate students of IT and mining engineering - with an understanding of data analytics applied to the mining industry. By providing a book with chapters structured in line with the mining value chain, we will provide a clear, enterprise-level view of where and how Advanced Data Analytics (ADA) can best be applied. In particular, we highlight the potential to interconnect activities in the mining enterprise better. We explore the opportunities for optimization and increased productivity offered by better interoperability along the mining value chain – in line with the emerging vision of a creating a Digital Mine with much-enhanced capabilities for modeling, simulation and the use of digital twins – in line with leading “digital” industries like automotive and aerospace.

Objectives

The Objective of the book is to provide a concise overview of the state of the art of advanced data analytics for mining executives and managers. They will value a book that helps them position the emerging capabilities of advanced data analytics in their businesses and provide an assessment of where and how these new capabilities can help to optimize the end to end operations of their mining enterprises.

For data analysts, geologists, mining engineers, operators, and specialists along the mining value chain, the book will explain how to implement advanced data analytics, using case studies and worked examples, and will help prepare students and graduate engineers to apply new advanced analytics in practice. For critical supporting functions like the IT and OT teams, the book will provide guidelines on how data needs to be collected, stored, and managed and what supporting architectures and infrastructures are needed to enable different advanced data analytics methods to be applied effectively in practice.

Mining companies are transforming how they mine, seeking to take advantage of operating a digital mine in which decisions are guided by analysis of operational data and decision support tools can present minute by minute advice to guide and trade-off risk, value, and cost. Increasingly a “whole of mining enterprise” view is being taken, driven by the need to optimize the business at an enterprise rather than a functional level.

This book is a timely reference source that mining enterprises can use to guide their digital mining journey and, at the same time, create some immediate value as part of their wider business transformation.

Scope

The book describes the key challenges facing the mining sector as it transforms into a digital industry able to fully exploit process automation, remote operation centers, autonomous equipment, and the opportunities offered by the “Industrial Internet of Things.”

The book will guide the application of advanced data analytics by considering each of the major activities undertaken along the mining value chain of typical, operating surface and underground mines.

Each of the first eleven chapters focuses on one of these major activities, starting with exploration and ending with material transportation. The final two chapters are devoted to two specific, increasingly important dimensions of mining: Health and Safety followed by Environmental aspects – each an essential aspect of a mine’s social license to operate.

Each chapter describes one of the major mining value chain processes, the inputs required, and the deliverables created. The overall process dependencies and the upstream and downstream connectivity are highlighted, with particular reference to the levels and types of interoperability required so that advanced data analytics techniques can be applied to improve functional performance while driving wider, enterprise-level optimization.

A key objective of this book is to help readers understand where advanced data analytics (ADA) can be applied most successfully along the mining value chain, how to build practical ADA applications and, most importantly, how to develop optimization capabilities along the mining value chain, using ADA tools that link multiple Level 1 mining activities to create value chain optimization – a step towards the digital mine vision of Enterprise Level Optimisation.

The book provides an analysis of ADA Exploration techniques with a study of ADA in Deposit Assessment, Mine Management, and Mining Methods Selection – all areas in which traditional high-performance computing (HPC) and large data sets (Big Data) have been the norm for T1 miners, and areas in which ADA is making inroads. This is followed by ADA studies of mining methods: Rock Breaking, Ground Mechanics, and Infrastructure Services. The latter includes aspects like power and water usage, asset management, and mine communications – high-cost drivers with significant environmental impacts.

Chapters 8 and 9 consider the use of ADA in surface and underground mining development and extraction, respectively. These activities involve the use of complex, high value, high recurring cost assets, many of which are the target for automation or full autonomy and are therefore essential candidates for the application of ADA technologies. Significant progress has been made in this area in mining, and adjacent sectors (e.g., agri-business) and increased use of ADA will take place to squeeze increased returns from the high-value assets deployed.

Chapter 10 considers mineral processing – an area in which sophisticated levels of process control have been deployed for many years. The capability to better connect mineral processing operations to upstream and downstream activities, enabled by improved communications and IIoT developments, is explored and ADA opportunities described and detailed through case studies.

In Chapter 11, the opportunities for using ADA to improve material transportation – at mine site as well as from pit-to-port and beyond, is presented, with applications in road, rail and shipping areas considered. The connectivity of material logistics to product blending and marketplace “pull” systems is considered, and role

ADA will play in optimizing these activities, along with the potential for Blockchain to manage extended, connected supply chains is assessed.

Chapters 12 and 13 exclusively will explain the role of ADA in health, safety, and environment. All of these subjects are interesting topics for mining companies globally.

Each chapter includes a high-level summary and provides case studies for executives and managers as well as technical details for ADA technologists.

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