

Advanced Analytics in Mining Engineering

UNCORRECTED PROOF

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3 Editor

4 **Advanced Analytics**
5 **in Mining Engineering**

6 **Leverage Advanced Analytics in Mining**
7 **Industry to Make Better Business Decisions**



8 **Springer**

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1 Preface

2 As an author on business and advanced analytics management, I have many ideas
3 in my mind. I think all of them are great, of course, but it is always challenging to
4 know which theoretical concepts can reach a practical result in advance.

5 After writing some papers and chapter books about advanced analytics and the
6 mining industry's machine learning application, I found much demand for speaking
7 and consulting on the subject. In that work, I talked with hundreds of managers and
8 analytical professionals in countries worldwide. I also worked with many profes-
9 sors in different universities in America, Europe, Asia, and Australia to extend my
10 knowledge of applied analytics in the mining industry.

11 Moreover, I have worked as an AI program leader with technology developers
12 such as IBM, Accenture, Deloitte, and Oracle to develop suitable products for pres-
13 tigious mining companies based on AI. These applications now play a critical role
14 in predicting, optimizing, and making decisions for operation and maintenance in
15 mining companies such as BHP, Rio Tinto, Vale, Angelo America, and Peabody
16 Energy. After many years working in this area, I decided to write a comprehen-
17 sive book to guide the researchers and industrial managers to find the analytical
18 opportunities better and making the best decision to deploy the new science in their
19 work.

20 In front of the research and development group in mining companies, there are
21 some barriers to use practical advanced analytical approaches to solve their business
22 problems.

23 The first barrier is the lack of bright and trained people who need to design innova-
24 tive analytical solutions for the problem. There are two different groups of graduates
25 who are looking for job positions in mining companies. The first group is mining
26 engineers who do not have any data analysis experience. The second group is the IT
27 and computer engineers who do not have any mining background. Therefore, each
28 mentioned group cannot provide the mining companies' requirements individually.
29 The digital mines need people familiar with the mining operations and have enough
30 knowledge and experience to use the data analytical approaches.

31 The second barrier is the lack of valuable collected data to develop advanced
32 analytical solutions. In the last decades, many new companies and start-ups have been

33 established to make and use different tools for data collections in mine sites. However,
 34 there is no validated guideline to help the mine managers collect the necessary and
 35 correct data from equipment and process. As a result, a massive amount of noisy
 36 data is collected from mine site equipment, and the main part is not useable.

37 The third barrier is developed specific analytical applications to solve the unique
 38 business challenge. The mining operations are linked together, and any change in any
 39 particular process can dramatically affect the upstream and downstream activities.
 40 The main part of developed analytical tools for the mine sites focused on a specific
 41 operation. However, we need the use the integrated approached to minimize the
 42 harmful side effects overall.

43 The fourth barrier is the maturity level of analytics in the mining industry. The
 44 traditional mine managers' mindsets need to be changed. In the digital mine era, we
 45 should predict and optimize instead of scene and response. AI and machine learning
 46 models can help us predict failures and avoid them, and the optimization models will
 47 support the management decisions.

48 The advanced analytics for mining engineering book has been designed to tackle
 49 the barriers mentioned above. The book can be used as a reference book to teach
 50 at universities, and students can use it as a reference in their research. The book
 51 covers the students and research requirements to get familiar with the analytical
 52 approaches in mining engineering. This book also can help the technology developers
 53 and companies to identify the essential parameters in the mine sites and providing
 54 suitable tools to collect valuable data for the mining operations. The book chapters
 55 have been designed based on the mining value chain operations, and there is a logical
 56 connection between the chapters to help the readers make integrated solutions. Many
 57 practical examples are designed for the chapters that help mine managers get familiar
 58 with the benefits and limitations of advanced analytics in future digital mines. The
 59 prediction, optimization, and decision-making tools introduced in the book can give
 60 a clear vision of the future of mining to managers and researchers in the mining
 61 industry.

62 I believe that we are at the beginning of an exciting journey to apply advanced
 63 analytics, AI, and machine learning approaches to solve the mining companies'
 64 challenges. Digital mines will be developed, and we need to support the young
 65 generation who will be the future digital revolution leaders in the mining industry.
 66 This book aims to share the knowledge and experience of authors who have worked
 67 in the analytics field in mining as executives, managers, specialists, and researchers.

68 I hope this book can help the people who dream of making future mining safer,
 69 more creative, and more productive.

70 Vale, Australia
 July 2021

Ali Soofastaei

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19 with me closely to complete a comprehensive book for the mining industry. In this
20 way, I am grateful for the help of Milad Fooladgar, a buddy that I could not finish
21 the project successfully without his technical and management support.

1 About This Book

2 Most mining companies have a massive amount of data at their disposal. However,
3 they cannot use the stored data in any meaningful way. The powerful new business
4 tool-advanced analytics enables many mining companies to aggressively leverage
5 their data in key business decisions and processes with impressive results.

6 In this book, Dr. Soofastaei and his colleagues reveal how all mining managers can
7 effectively deploy advanced analytics in their day-to-day operations—one business
8 decision at a time.

9 From statistical analysis to machine learning and artificial intelligence, the authors
10 show how many analytical tools can improve decisions about everything in the mine
11 value chain, from exploration to marketing.

12 Combining the science of advanced analytics with the mining industrial business
13 solutions, introduce the “Advanced Analytics in Mining Book” as a practical road
14 map and tools for unleashing the potential buried in your company’s data.

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1 About the Editor

2



Dr. Ali Soofastaei is an artificial intelligence (AI) scientist and an industrial global project leader. He leads innovative industrial projects in AI applications to improve safety, productivity, and energy efficiency and reduce maintenance costs.

He holds Bachelor of Engineering in Mechanical Engineering and has an in-depth understanding of energy management (EM) and equipment maintenance solutions (EMS). In addition, the extensive research he conducted on AI and value engineering methods while completing his Master of Engineering also provided him with expertise in applying advanced analytics in EM and EMS.

He completed his Ph.D. at The University of Queensland in AI applications in mining engineering. He led a revolution in using deep learning and AI methods to increase energy efficiency, reduce operation and maintenance costs, and reduce greenhouse gas emissions in surface mines. As Postdoctoral Research Fellow, he has provided practical guidance to undergraduate and post-graduate students in mechanical and mining engineering and information technology.

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Chapter

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