Business Intelligence (BI) is a solution to modern business problems. This book will discuss the relationship between BI and Human Resource Management (HRM). It will also discuss how BI can be used as a strategic decision-making tool for the sustainable growth of an organization or business. BI helps organizations generate interactive reports with clear and reliable data for making numerous business decisions. This book covers topics spanning the important areas of BI in the context of HRM. It will also discuss the aspects, tools, and techniques of BI and how it can assist HRM in creating a successful future for organizations. Some of the tools and techniques discussed in the book are analysis, data preparation, BI-testing, implementation, and optimization on GR and management disciplines. It will include a chapter on text mining as well as a section of case studies for practical use. This book will be useful for business professionals, including but not limited to, HR professionals and budding business students.
Business Intelligence and Human Resource Management
Concept, Cases, and Practical Applications

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Foreword

The capacity to use information to achieve a competitive advantage over competitors is referred to as business intelligence (BI). Businesses all over the world consider BI as the most desired technology. Even in these difficult economic times, when IT expenditures are being slashed, BI remains a top priority for executives. BI brings together people skills, technologies, applications, and business processes to help make better strategic and tactical decisions. Data management methods for planning, collecting, storing, and structuring data into data warehouses and data marts, as well as analytical tasks such as querying, reporting, visualizing, generating online active reports, and running advanced queries for clustering, classification, segmentation, and prediction, are among the activities and applications. Data marts are limited to a specific process or department, such as the Human Resources (HR) department, while data warehouses focus on enterprise-wide data.

At this juncture, this research book *Business Intelligence and Human Resource Management: Concept, Cases, and Practical Applications* is timely and will play a vital role in examining the managerial aspects of BI systems in various domains. It creates a set of rules for generating value via the use of BI systems and technology. The book focuses on BI as a process for serving complex information demands in creating insights and providing decision support driven by a combination of human and technological skills. This book covers everything from the definition of BI, its value creation, its meaning and quality, its depiction and management of both internal and external data, its presentation and visualization, and analytical strategies and future predictions. The author provides practical views on the increasingly popular “big data” theme for the future. This book unearths all the key variables in great detail that must be examined to successfully harness the value of intelligence for both novices and professionals.
This book isn’t just for BI professionals but also for the data community in general. The explanations of data requirements identification, data modelling and design, data quality, integrity, mining, warehouses, and other important issues are clearly presented and valuable. In general, it is readable, comprehensive, and exhaustive for practitioners and presents a wealth of ideas that can be used by enterprises.

The contributions of the book’s editors, Dr. Deepmala Singh, Dr. Anurag Singh, Dr. Amizan Omar, and Dr. S.B. Goyal are commendable.

My best wishes for your book! Happy reading!

Dr. Mani Venkatesh

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Preface

Business intelligence (BI) can be thought of as a prediction tool that makes use of both current and historical data. It is a methodology, a set of processes that analyze raw data in order to produce meaningful information that may be used to develop an effective plan for gaining a competitive edge over competitors. BI enables businesses to make informed decisions. It consists of the following components: analysis, data preparation, data architecture, BI testing, implementation, and optimization.

BI might be viewed as a panacea for contemporary business challenges. Global business trends are always evolving as a result of cultural change and technical improvement. Organizations are likewise altering themselves to keep up with the pace in order to obtain a competitive edge over their competitors. To adapt to any change, comprehensive analysis and data-driven procedures are required. BI enables organizations to develop interactive reports that contain accurate and reliable data that can be used to make multiple business choices. This book compiles a variety of approaches to BI in human resources and other management domains. It will assist readers in developing a knowledge of the movement of business decisions from old approaches to more analytical and applied management strategies. Additionally, it will provide insight into the use of business information as a tool for strategic decision-making in order to ensure the organization’s long-term viability. It covers a wide range of human resource and other management-related issues. This book discusses BI approaches and technologies such as analysis, data preparation, data architecture, BI-testing, implementation, and optimization in the human resources and management disciplines.

This book is organized into well-structured chapters written by academic and industry researchers from around the world who are all experts in their respective fields of study. Each chapter focuses on a single topic, namely how to leverage BI tools and methodologies in HR and other management
areas to create a projected future for the firm. Today’s managers benefit from having a competitive edge over their competition. Its application is visible in the day-to-day planning of manpower, the differentiation of product offerings, the knowledge of consumer behaviour, and the development of policies to ensure the organization’s viability.

Deepmala Singh, Anurag Singh, Amizan Omar, S.B. Goyal
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The editors of Business Intelligence and Human Resource Management: Concept, Cases, and Practical Applications appreciate the writers’ efforts in submitting their excellent chapters to our edited text book on time. We would also like to express our gratitude to Michael Sinocchi, Publisher – Business Improvement, for his unwavering support and direction throughout the book’s production.

I would like to acknowledge with gratitude the love and support of my family: my father, Krishna Murari Singh; my husband, Santosh Singh; my daughter, Ritisha; and my sisters, Manisha and Anamika. I wish to thank all reviewers for providing constructive feedback to the writers in order to improve the chapters’ quality, coherence, and content presentation. This publication would not have been possible without the input of reviewers. Also, I would like to thank my co-editors, Dr. Anurag Singh, Dr. Amizan Omar, and Dr. S.B. Goyal, for their unwavering support and belief in me. I thank everyone who assisted us directly or indirectly in the completion of this edited book.

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Dr. S.B. Goyal has peerless inquisitiveness and enthusiasm to get abreast with the latest development in the IT field. He has excellent command over industry revolution (IR) 4.0 technologies, such as Big Data, Data Sciences, Artificial Intelligence, Block Chain, etc. He is the first one to introduce IR 4.0 including Blockchain technology in the curriculum in Malaysia. He had participated as a speaker in the Bloconomic 2019 event on Blockchain. He had participated in many panel discussions on IR 4.0 technologies in academia as well as industry platforms. He has more than 18 years' experience in academia at national and international level. Currently, Dr. Goyal is associated as a Director-IT with City University, Malaysia.
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Chapter 1

An Introduction to Business Intelligence

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1.1 Introduction

Business intelligence (BI) is a high-tech procedure to analyze information along with display applied and relates to a machine-readable storage medium that helps business professionals, enterprise leaders as well as consumers to improve their knowledge and understanding of corporation economic decision-making. In other words, BI software signifies the term computing, operations, as well as implementation with the aim of gathering, combination, and interpretation, including awareness about enterprise datasets. It is a group of applied science or computing that supports discovery, sloop, as well as analyzing leading information of significant numbers for better judgment or decisions. BI is an assimilation of plans, techniques, procedures, and structural frameworks, along with automation or robotics, which alter unprocessed data significantly, including beneficial information, with the aim of enterprise goals. It is the technique that includes procedures for improvement over enterprise economic decision-making in utilizing the intelligence of various references as well as carrying out information, including acceptance for improvement and correct insights into driving enterprises.

BI involves collecting, managing, as well as interpreting business data for generating information particularly shared by individuals all over the company and business for the betterment of complicated and unplanned as well as strategic judgment. BI constitutes a variety of mechanisms, usage, as well as program/scheme that allows corporations to collect, organize, monitor, and display relevant information for the business system.

1.2 Concept

BI software implementation supports businesses to get hold of data-driven analyzing promptly with more effective use as well as deliver information drawing out internally and externally for businesses. Consequently, BI is an evolving category of computerized usage since it utilizes data inventories to promote improvement in the adoption of the resolution. Various mechanisms, as well as methodologies of BI, such as data mining, data visualization, and predictive analysis, can be used to facilitate helpful information. BI software plays a major role in the achievement and effectiveness of operations, comprehensive schemes or plans, cooperation, as well as control. The application of BI is connected with the areas of selling, advertising, retailing, trading corporations, as well as customer support companies.
1.3 Literature Review

BI is an umbrella term (Levinson, 2006) and is structured to support the decision-making process (Gibson, Arnott & Jagielska, 2004). It is a relatively newly coined term by Howard Dresser in the early 1990s (Watson & Wixom, 2007). BI generally refers to a broad collection of software platforms, applications, and technologies that helps decision-makers to take an effective and efficient decision (Gibson, Arnott & Jagielska, 2004). It aids in taking better decisions (Clark, Jone & Armstrong, 2007) by facilitating the extraction of data and manipulating these data into information useful for making better business decisions (Bagale et al., 2021). BI enables to gain an understanding of capabilities available in an organization, future trends, or directions in the markets and technologies, competitors’ actions, and the operating regulatory environment (Negash, 2004). The integration of operational data with analytical tools helps in taking timely and rational decisions (Kautish, 2008, Kautish & Thapliyal, 2013). BI system consists of tools, programmed products, and technologies that enable the collection, aggregation, integration, and quick availability of data (Yeoh & Koronios, 2010). The BI system helps in providing actionable information at the right time (Negash, 2004).

BI system consists of hardware solutions along with expensive software, on one hand, and specialized software, on the other (Olszak & Ziemba, 2006). The study further revealed that the requirement of a particular BI system depends on the needs of the business; however, any BI system requires a minimum of four specific components: Data warehouses, Extract, Transform, and Load (ETL) Tools, Online Analytical Processing (OLAP) Techniques, and Data Mining. The components of the BI system help in facilitating managerial decision-making and taking necessary actions (Golfarelli, Rizzi & Cella, 2004). Actions can further be described as acquiring information mainly with the support of the data warehouse component; gathering data with the help of extract–transform–load component; analyzing data with the support of online analytical products, and reporting of data supported by the data-mining components (Olszak & Ziemba, 2007). A critical factor on which the success of BI depends in any organization is the ability of an organization to take benefit of the available information for making an efficient decision (Cody, Kreulin, Krishna & Spangler, 2002). BI system is mainly used by organizations for proper management; monitoring of business-related activities; and planning, reporting, and decision-making, as well as maintaining customer relationships.
Business Intelligence and Human Resource Management

(Olszak & Ziembba, 2007). More than ever, information supports all critical business decisions and BI seeks to provide the capability to access and analyze information (Matei, 2010).

BI systems can be used by different managerial levels for monitoring and improving strategic, tactical, and operational decisions (Stefan, Duica, Coman & Radu, 2010). BI facilitates senior-level management in getting inputs required for making strategic and tactical decisions, and at the lower managerial levels, it assists individuals in doing their routine jobs (Negash, 2004). At the strategic level, BI systems generate information that can be used for forecasting future results; at the tactical level, BI systems assist in decision-making for improving the company’s performance; and at the operational level, they provide departmental performance based on just-in-time analysis (Olszak & Rziemba, 2007). Administrative choices of adopting BI are affected by enterprise information requirement, recovery, examination, and clarification (Nofal & Yusof, 2013). BI is the most preferred technology by CIOs because of its ability to facilitate improved decision-making (Watson & Wixom, 2007). Although BI systems are used widely by organizations, very limited research work has been done in this field (Negash, 2004). Numerous examples of BI can be witnessed that demonstrate the role of BI in overcoming adversity, but very little work has been done in research highlighting BI abilities (Schlegel & Sood, 2007). BI comprises numerical and methodological models for extracting data and valuable information from the available raw information. BI broadly consists of application, technologies, and processes for collecting, assimilating, accessing, and analyzing data that help users to make better decisions (Wixom & Watson, 2010). BI application in an organization enables the upgradation of knowledge by utilizing information through simulations and modeling. BI enables administrators in breaking down information from different sources to better leadership at both tactical and strategic levels (Rasoul & Mohammad, 2016). BI is a framework that transforms information into data and afterward into learning, consequently enhancing the company’s basic decision-making process (Singh & Samalia, 2014). BI is categorized as a framework that collects, changes, and presents organized information from different sources lessening the required time to obtain noteworthy business data and enable their efficient use in management decision-making processes (Hamer, 2004). An organization that has made progress with their BI usage has stated that their BI is steady with their corporate business targets and much research on BI achievement concentrates on the alignment among BI and business targets (McMurchy, 2008).
1.4 Purpose and Significance of BI

1.4.1 Purpose

The ultimate goal of BI is to support and facilitate a corporation's economic performance. It allows an organization to access information or facts particularly crucial for its accomplishment. BI is applicable in various domains comprising selling, advertising, retailing, trading, financial institutions, including other domains as well as divisions/wings. Collecting facts or information is quite straightforward in recent times with the use of smart technology. BI intends to evaluate and interpret the collection of information as well as the following retrieved data. The retrieved data represent further changes toward understanding. Utilization of the recently collected information makes better enterprise. The objective of BI in enterprise is to help corporate executives, corporate leaders, as well as operational personnel to improve, including enhancing knowledge in economic business decision-making (Singh, Singh & Karki, 2021). Corporations too utilize BI for reducing expenditure, recognizing recent corporation's perspectives as well as marking ineffective corporation methods. BI comprises contributing information as well as management of the working mechanism, thereby facilitating organizations to increase their productivity. BI software regulates high-tech techniques, which comprise various connected operations and actions involving predictive analytics, benchmarking, text mining, process mining, prescriptive analysis, dashboard development, reporting, data visualization, OLAP, SQL, etc.

1.4.2 Significance

Every organization has to renew the datasets of consumer choices so that organizations are rapidly adjustable for altering requirements. BI software enables business executives to get timely information that aids them in taking the right decision at the right time. BI supports business executives as well as analysts to find out and meet the evolving new patterns. It supports and assists corporate executives as well as analysts in figuring out the adjustments to meet the evolving new patterns. BI enables the enterprises to go along with enhanced reasonable and functional information, facilitate better understanding of business patterns, and provide better business plan-furnished adoption of resolution replica.

BI is significant to understand the increase in current capacity as well as interpreting recent consumer-purchasing patterns. BI software applications
enable business growth and development by enhancing the customer base. It helps and supports the organization’s seller/salesman by providing virtualization of data of buying process and aids in investigating overall income assessment. Additionally, BI promotes seller/salesperson in recognizing functions involving detecting the cause of the problems, thereby providing outcomes immediately to improve sales. Besides, BI is utilized for the development of commodity/byproducts to meet their expectations and needs. Also, it enables the collection of facts for generating byproducts for enterprises. It helps in increasing income for those enterprises that have low productivity. Generally, selling and retailing personnel observe their consumers or clients for monitoring or trailing their needs, and for this purpose they use customer relationship management (CRM) technology. CRM facilitates end-users to access databases online to predict the needs of consumers with the use of the operating system, virtual fascia, as well as routine chat messages or electronic messages.

BI allows enterprises in contributing facts concerning the present action database during computerized or automated information extraction, as well as comprehending facts. Most appropriate techniques to deliver datasets involve better-improved methods that allow companies to remove unnecessary functions and responsibilities, enabling personnel to highlight their functions rather than be concerned about the information-handling process. The personnel/HR division is also adopting BI software for productiveness, interpretation, income trailing, payment and remuneration, and perception toward personnel happiness. Fiscal reports are more crucial for any organization in the finance division for better understanding as well as for better insights. Moreover, BI supports for periodical reports, which include yearly balance sheets and recognize future difficulties (Kautish & Thapliyal, 2013). BI allows companies better forecast revenue, cost-effective cutting, as well as increase sales, including market expansion, and also provide chances for the continuous development of enterprises or entrepreneurship (Kautish, Singh, Polkowski, Mayura & Jeyanthi, 2021). Finally, BI provides feasibility to amalgamate datasets through various references or resources, interpretation of database toward the layout as well as spread it for the intelligence of pertinent team members. Presently, it enables companies to have an overall approach as well as create smart line judgment.

1.5 Features of BI

Organizations have a huge volume of data and managing these data becomes a tedious task. BI tools help in easy accessibility of data and this leads to better decision-making in an organization. Several features of BI
make it user-friendly and easy to operate. The features associated with BI are categorized into High-level, Safety, and Essential.

1.5.1 High-Level Features

1.5.1.1 Management of Metadata

The crucial feature of BI is Metadata management. Metadata management denotes activities involved in the efficient management of data and outcomes related to it. It is mainly categorized into three activities, namely technical, business, and operational. Metadata management includes policies, processes, responsibilities, and roles that ensure that data-based information is obtainable, reachable, supportable, and sharable across an organization. Metadata management mainly concentrates on indicators, organization, measures, and other aspects of data desired for business analysis. The use of BI in metadata ensures the quality, completeness, and consistency of the data in use.

1.5.1.2 Data Visualization

In today’s technological era, data visualization has become an important aspect of BI. Data visualization helps in presenting bulk data in a more simplified and significant manner. Data visualization through BI has more advantages in comparison to traditional visualization (Tunowski, 2015). Data can be significantly visualized with the help of conventional charts and special charts. Special charts refer to visual special effects, such as flow maps, heat maps, rectangular treemaps, etc. This enables us to visualize complex data and understand it at a glance. BI-generated conventional and special charts help in properly exploring and analyzing data.

1.5.1.3 Analytics Dashboards

Dashboards have become an important feature of the BI platform because they help in displaying, analyzing, comparing, customizing, and sharing data. These dashboards help in the management of information and also provide data visualization solutions. Snapshot overviews can be generated by applying filters along with interactive chart components. Key performance indicators (KPIs) can be revealed with the help of analytics dashboards. Companies can achieve greater success by monitoring their dashboards regularly.
1.5.1.4 Mobile Support
Mobile BI helps anytime and anywhere in accessing data. It helps in accessing BI data, such as KPIs, customized dashboards, and business metrics on mobile devices. The users of BI software can easily access, sort, administer, and visualize relevant data at any time. According to the Mobile BI Market Report (2020), the mobile BI market size is forecasted to grow at a compounded annual growth rate of 22.2% from 2016 to 2021.

1.5.1.5 Real-Time Data
Real-time data can be easily and timely delivered using BI tools. Real-time data help in gaining full knowledge and facilitate in making the best decisions. The real-time feature of a business system enables an enterprise to store data related to business transactions as and when they occur. It also supports in taking quick actions as real-time data are available for making a strategic decision.

1.5.2 Safety Features

1.5.2.1 Alternative Authentication Sources
Advanced BI software provides alternative authentication sources. With the help of alternative authentication sources, a manager can use the existing authentication method and can also add alternative authentication sources for different internal systems.

1.5.2.2 Security at the Application Level
Application access in BI is usually based on the needs and preferences of the user. Based on the requirements of a particular business, effective filters can be applied and thereby internal security can be tightened. Effective security helps in ensuring that only relevant business applications go into the hands of the members of the organization.

1.5.2.3 Row-Level Security
Row-level security allows data to be safely stored for multiple users. The security policy of row-level allows filtering a row that does not belong to a particular user/tenant. Row-level or multi-tenant security mitigates security errors.
1.5.2.4 Activity Auditing

Activity auditing allows operators to monitor the activity of an end-user after each session. This feature gives an assurance to the end-user that the IT operator can check the log-in time, applications accessed, and time duration of each session.

1.5.3 Essential Features

1.5.3.1 Ad Hoc Reports

Ad hoc reports are one of the important features of BI that facilitate business developers to generate reports on the go. Relevant data can be chosen as per the requirement and users can produce reports in their desired format. The generated report can be directly mailed to the concerned party from the Web.

1.5.3.2 Ranking Reports

This particular report option enables users to view the best and worst aspects of a particular business. This feature in the BI solution helps in creating ranks across multiple business dimensions. Various selection criteria can be taken into consideration and ranking reports can be prepared accordingly.

1.5.3.3 Executive Dashboards

Personalized Dashboards give business leaders real-time data in the form of summaries, graphs, charts, etc. The availability of relevant and easy-to-understand data helps organization leaders to make better decisions and increases the organization’s effectiveness. Executive Dashboards by displaying the KPIs of an organization help in the smooth running of an organization.

1.5.3.4 Pivot Tables

Pivot tables are significant tools that provide views of multidimensional data in a tabular form. They extract substantial data from large, messy data and enable data consolidation, comparison, and summarization. Pivot tables, on
the one hand, aid in calculations, such as counting, sorting, and averaging data in one table, and, on the other hand, present summarized reports on the other table. Pivot tables are important tools for examining information and predicting trends.

1.6 Importance of BI

1.6.1 Fast and Precise Reporting

BI systems help in the faster understanding of data and therefore enables quicker and faster decisions in an organization (Luminita & Magdalena, 2012). The customized reports generated through BI software enable people of an organization to monitor their KPIs using data sources related to production, sales, and finance. Real-time reports can be produced and accordingly actions can be quickly taken. Visualizations, such as charts, graphs, and tables, make reports easy to read.

1.6.2 Better Data Quality

Data generated in a business are bulk in nature. These data need to be organized and presented effectively. BI software helps in collecting and generating quality data. It aids in combining various data sources, thereby enabling management to get a clear picture of their business.

1.6.3 Ascertain Market Trends

In this competitive era, businesses need supportive data to identify new opportunities and formulate new strategies to enhance their profitability. Organizations can have access to external data and can relate that data with their internal data to detect new market trends and market conditions.

1.6.4 Enhanced Customer Satisfaction

Customer feedback is taken by most companies in real-time, and this helps companies in retaining and reaching new customers. BI software provides tools that help in identifying purchasing behavior of the customers. With the help of available tools of BI, companies can determine customer needs and deliver better services.
1.6.5 Increased Functional Efficiency

Multiple data sources can be unified with the support of BI tools, and this helps in reducing the tracking time of relevant information by managers and employees. BI software produces accurate and timely reports that help employees to focus on their goals.

1.6.6 Gain Business Insights

Employee productivity and department-specific performance can easily be gauged with the use of BI tools. Businesses can know their strengths and weaknesses. Alerts can easily be installed and performance metrics can be traced through them.

1.6.7 Competitive Analysis

BI software helps in planning, budgeting, and forecasting data. Organizations can analyze their data and can easily check competitors’ performance. Competitive strategies can be designed by taking into consideration the available information.

1.6.8 Real-Time Data

BI system delivers real-time data that can be accessed through dashboards, worksheets, and scheduled emails. BI tools aid in the assimilation, interpretation, and distribution of real-time data.

1.6.9 Improved Visibility

Visibility of the functions of a business can be enhanced with the use of an improved BI system. Organizations can examine the areas for improvement and can have better control over their processes.

1.6.10 Data-Driven Business Decision

Better business decisions can be taken because of the availability of timely and accurate data. Nowadays, customized mobile dashboards are available for the functional team, which helps in the availability of real-time data.