

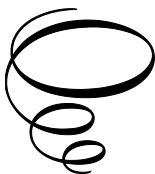
Human Resources Analytics for Business Managers

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By

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**In Honour of
and
Dedicated to**

Late Amal Kumar Mukhopadhyay (Baba)
Late Jharna Mukherjee (Ma)

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PREFACE

During my professional journey, the course that excited me the most has been HR Analytics. I missed this course during my MBA but got the opportunity to explore it while teaching in an autonomous B-School. I was brought up in a family which often discussed sports and politics over the dinner table. The pros and cons of the various initiatives taken by political leaders to run the state, or the country were analysed and often compared to the promises made by them to the society. The same applied to the sports fraternity. I have seen my dad engrossed in discussing and analysing the results of football matches held between local football clubs with our uncles and even suggesting how to improve the players' performance in the next attempt... although those findings, and suggestions, never reached the club owners or coaches, nevertheless, that triggered my interest in discussing and analysing the situations happening around me and deriving meaningful insights out of analysis for my improvement.

When I was asked to teach *HR Analytics* for the first time, I was clueless about where to start. Simultaneously, I was teaching Strategic Human Resource Management, which drew my immediate attention not only to unfold HR's contribution in creating value for the business but also to the way their contribution can be measured and improved. This perspective helped me in exploring how human contribution can be quantified.

I was tempted to write this book to express some of my excitement about HR Analytics, a subject that I felt any person with an interest in business management would love to explore, learn, and execute. The objective of this book is to convey the way in which people are perceived within organizations, how their contributions are channelized into productivity, and their potential utilized to produce differences in this competitive world with analytics interventions.

This book is devoted to applications of different tools and techniques in analysing HR issues with sample datasets. Although the applications of Analytics are timeless, with the applications of certain Machine Learning tools, the performance of the HRM operative functions can be enhanced to a great extent and the same has been established in this book in a step-by-step manner.

How is this book organized?

I attempted to write a crisp and user-friendly book with a data-driven approach. The contents of the book, I believe, will help the user to understand how the pieces fit together.

Introduction

Chapter 1, “*HR*”, introduces to the user the HR Value Chain and shows how HR can create value for the organization that competitors are unable to duplicate. Proper HR enablers, streamlined HR processes, and commensurate HR strategy, as well as measuring the HR outcomes and channelizing them to business goals, can be the success mantra for a company in a competitive environment. The chapter previews some of the critical HR issues that bother business leaders, such as a high attrition rate, high attrition cost, low employee engagement, high employee cost, insufficient employee utilization, and their impacts on effectively accomplishing the promised business goals.

Creating the HR Analytics platform

The next three chapters provide an explanation of how to create the scope and platform for the successful implementation of Analytics in business, to derive critical and meaningful insights to support decision-making.

Chapter 2, “*Why is HR Analytics Important?*”, examines how HR Analytics is a facilitating tool for data-driven decision-making. This is explained in a question-and-answer manner.

Chapter 3, “*Employee Life Cycle and HR Analytics*”, presents how in different parts of the Employee Life Cycle viz, acquisition, development, and retention, with the right HR measures such as renege cost, cost of employee turnover, performance appraisal, right training interventions, etc., the contribution of human resources can be controlled and enhanced.

Chapter 4, “*HR Analytics Maturity Model*”, explains the different phases of the analytics maturity model and how the company’s analytic maturity can be assessed to make it a useful tool for business growth.

HR Measurement

Having examined how to do the right things right for HR, the book considers the yardsticks with which it is to be ensured that the HRM activities are being performed as decided.

Chapter 5, “*HR Metrics*”, explains the importance of implementing HR metrics (HRM) in ensuring HR goal accomplishments. The HR metrics are discussed and explained with a formula for each HRM operative function. The chapter helps the user to understand how to execute the HR metrics and derive meaningful insights to support HR decisions with sample datasets.

HR Data Visualization

A dashboard is a facilitating tool for understanding the situation and hidden patterns among the concerned variables represented in terms of pictures, graphs, or charts.

Chapter 6, “*Creating HR Dashboard using Microsoft Excel, TABLEAU, Power BI, and Looker Studio*”, unfolds data visualization with dashboards using different tools. A step-by-step approach is adopted in this chapter to explain how to create a dashboard to derive extensive insights for better decision-making.

HR Analytics Applications

Chapter 7, “*Applications of Machine Learning Tools in HR Problems*”, orients the user to different tools and techniques of Machine Learning (ML)

and their applications in solving HR problems. Most of the ML tools are theoretically explained with examples and a few are explained with sample datasets and R Studio code. The interpretations of models like Logistic Regression, Decision Tree, and Naïve Bayesian Classifier are explained with tables and visuals.

Supplements

This book provides a lot of supplements for users, instructors, and students. A lot of sample datasets are given in Chapter 5, “*HR Metrics*”, for understanding and practice. The datasets and the related R codes used in Chapter 7, “*Applications of Machine Learning Tools in HR Problems*”, have been uploaded to GitHub to be used by readers for reference.

ACKNOWLEDGMENTS

I am indebted to Prof. Prithwis Mukerjee, who inspired me to write this book and has kindly written the foreword of this book. I am grateful to Prof. Jaydip Sen for guiding me in this process of book writing. I am thankful to all my colleagues for the perspectives they have brought from time to time during our lunchtime discussions and to the students with whom I had a lot of interactions in which valuable perspectives were brought. I am obliged to my family for the cooperation and support rendered.

Kankana Mukhopadhyay

Program Codes: The program codes associated with the chapters of this book are available at the following GitHub link:
<https://github.com/kankana1976/HR-Analytics>

FOREWORD

In the feudal era, when the economy was entirely dependent on agriculture, wealth was a function of land and labor. With the advent of the industrial revolution, wealth became a function of man, machine, and materials. Now in the transition to a post-industrial society, the concept of men embracing women, gender nonconformity, and other forms of intelligence, information becomes an important material to work with and machines mutate to reflect this new reality. Nevertheless, till the advent of the singularity when man and machine will converge and will be seen as two aspects of the same phenomenon – as in the convergence of mass and energy – humans remain central to the success of any commercial enterprise. Hence managing people – it is rather demeaning to refer to them as human resources – continues to be a key function in the process of managing a business.

Historically, people have been managed or controlled by coercion. The process was initially physical, as in slaves and whips, but later became mental or circumstantial where the termination or lack of employment was felt to be as traumatic as physical abuse. But today, because of the diversification and expansion of employment opportunities beyond traditional areas, we see an increase in the mobility of the working population and the ability of people to deliver services remotely over the Internet. In this rapidly evolving economy, coercion as a means of control loses its effectiveness and needs to be replaced with something consensual, convenient yet cost-effective. Managers must find and retain people who are competent at a price point that the company can afford, and employees must find employment to be lucrative enough to join and remain in. This may sound obvious, and it is, but it leads to the next and not-so-obvious issue. How to make this happen? The *what* is always easy if you do not have to do anything about it. It is the *how to* that is the real challenge in today's business environment. *How to* locate, recruit and retain useful employees without busting the company's bottom line?

Dr. Kankana Mukhopadhyay's short and peppy book on HR Analytics offers interesting insights into how managers can control their employees in today's world. What you cannot measure, you cannot control and so the starting point is to locate data that can be used to delineate the employee and define the environment in which they operate. Unlike in the past, this data is not just numeric. One simply cannot have a simple set of metrics to measure the productive output of an employee and connect it to a single financial reward. The world is much more complicated, the data is multidimensional and the process of analysing this data and arriving at actionable insights, calls for tools and techniques that need to be borrowed from other disciplines of management.

Management literature has never been found lacking in buzzwords like quantitative techniques (QT), mathematical models of management (3M), and data-driven decisions (3D). While it may be easy for practicing managers to be condescending towards such jargon, they would be ignoring these developments to their utter peril. While intuitive approaches to managing people might have worked in the past, the volatility, uncertainty, complexity, and ambiguity (jargonized as VUCA) of the new world, calls for a dramatically different approach. This is where we need to add disciplines like data science and techniques like machine learning (ML), deep learning (DL), and eventually artificial intelligence (AI).

The prerequisite for this approach is a set of software tools that can capture, store, analyze, and report on vast amounts of data that are being churned out on a plethora of platforms and in a range of structured and unstructured formats. But what is more important is the ability to understand *how to* apply these tools to manage people in a manner that meets the goals of the organization. This *how to* is explained very elegantly, yet concisely, in this book.

Prithwis Mukerjee, PhD

Engineer | Programmer | Teacher | Author

Director, Praxis Business School

December 2022

WHY READ THIS BOOK?

The three broad dimensions of human resource management are acquisition, development, and retention. The concern is how to perform these broad functions and sub-functions efficiently and effectively to contribute to organizational goals in a better way. HR Analytics is a facilitating tool that ensures the effectiveness of HR operative functions by measuring the contribution of the workforce. This helps the company in formulating the right HR strategies to achieve the desired business outcomes more effectively than its competitors.

HR Analytics enhances the ability of managers to handle HR data in a more structured way which previously they were not exposed to. This helps them in making data-driven HR decisions to derive better performance advantages through human resources.

This book takes a step-by-step approach to unfold the implementation of HR Analytics tools in the operative functions of HRM to enhance the throughput of each function by linking them to business outcomes. Furthermore, lots of sample datasets are used to make readers conversant with the relevant HR measures.

The HR measures help in doing a gap analysis of expected performance and actual performance to derive critical insights to enhance workforce contribution to business goals.

The data-driven approach of the book helps readers relate the execution of HR measures with parameters that are required to be considered for future HR prediction and prescription to HR issues like, how to control attrition, reduce HR cost and improve workforce performance, etc.

The outcomes of HR measures are explored further with visualization tools like Tableau, Power BI, etc., to understand the hidden patterns and interrelationships among variables.

The book also covers the applications of Machine Learning Tools in HR issues with relevant examples. A few ML tools are discussed in which analysis of HR data shows how to derive critical and valuable insights to support HR decision-making.

Overall, this book enables the reader to practice how HR Analytics can be useful to support business managers in taking superior data-driven workforce decisions and linking the same to business deliverables.

Kankana Mukhopadhyay

ABOUT THE AUTHOR



Kankana Mukhopadhyay is currently a professor of Human Resources Management at Praxis Business School, Kolkata, India, she earned a bachelor's degree in Physics from University of Calcutta, a master's degree in Human Resources Management from Indian Institute of Engineering Science and Technology, Shibpur, another master's degree in Computer Science from Indira Gandhi National Open University, and a Ph.D. in Management Science from Indian Institute of Engineering Science and Technology, Shibpur. Her doctoral dissertation examined the use of IT-Enabled Competency Management with the application of Artificial Neural Networks in assessing employee competencies. She has guided one doctoral thesis in return-to-work initiatives for facilitating the women talent pool from Bharathiar University, Coimbatore.

Since joining the faculty of the School of Management Sciences at the Indian Institute of Engineering Science and Technology, Shibpur in 2005, she has taught all levels of organizational behavior and HRM courses.

She has published several articles in national and international journals of repute. She has also authored a few book chapters.

Her research interests include HR Analytics, Digital HR, HRIS, Strategic HR, Competency Mapping, Performance Management, etc.

Kankana Mukhopadhyay and her husband have a son, Sourish. Her hobbies include singing and painting.

CHAPTER 1

HR

Human Resources are acquired by organizations to utilize their potential and performance in exchange for compensation and other rewards for the successful accomplishment of organizational goals. Human Resource Management is a comprehensive set of activities or functions to acquire the right talent, developing and retaining them to utilize their contribution to accomplish business goals in a faster and more effective way. The contribution of human resources in an organization is vital and critical since it makes other resources functional and operational.

HR Management sets a solid foundation for the vision, mission, values, goals, and objectives of a firm with a focus on people, processes, and performance. With VRIO analysis, several pieces of literature on resource-based theory establish that Human Resources have a strategic impact (Essenberg, 2017). HR creates Value that is appreciated by the stakeholders, and this provides competitive equality; if Human Resources are Valuable and Rare in strategic thinking, talent, and implementation, the combination provides a competitive advantage. If resources are Valuable, Rare, and Inimitable in a way people think, perceive, behave and execute the business ideas in an Organized way and the combination is difficult for competitors to copy, this can provide a sustained competitive advantage.

To effectively manage the contributions of HR to achieve business goals, the leaders need to investigate the way the following three broad operative functions of human resource management are performed:

- a. Acquisition;
- b. Development; and
- c. Retention.

HR management starts with acquiring the right workforce; developing their ability, skill, knowledge, and performance to derive performance advantages that competitors are unable to duplicate (Grant, 2009). In acquiring strategic competitive advantage, the most challenging and critical human resource function is retaining high-performing talents and channelizing their competencies and contribution to expected business outcomes (Kankana, Jaya, & N.R., 2011).

Considering today's economic volatility and uncertainty, every aspect of the business is being re-visited and re-examined for its promised value and the way it contributes to the profitable growth of the organization. The first question needs attention is ***"How does HR add value to a business?"***

Traditionally, HR has been perceived with a cost center approach, i.e., the company incurs costs to acquire, develop, and compensate the human resources for accomplishing the business goals. With the advent of Big Data and Business Analytics, HR is being perceived with an investment center approach, with a focus on transforming the contribution of HR to a sustained competitive advantage by investing in the development of their skill sets, knowledge, and job-related behaviors.

In this endeavor, with HR Analytics interventions, the throughput of HRM operative functions can be measured and improved. The existing workforce can be classified better in terms of performance and potential and the right HR strategies can be formulated by deriving critical insights to improve their contribution to gain performance advantages which the competitors are often unable to copy (Kankana, 360-Degree Appraisal – A Performance Assessment Tool, 2006).

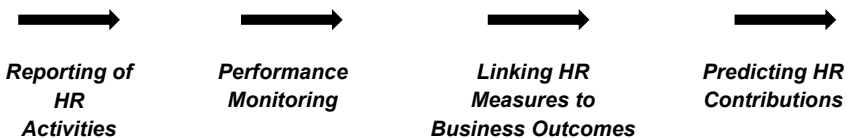


Figure 1.1: Change in the role of HR over time

We have seen in the past that the functioning of HR transitioned into different phases; starting from simple monitoring of human resources

activities to report generation to support managers' queries. It was later realized that only monitoring and report generation is not enough in improving the throughput of HR functions. **Measures** became the need of the hour with which the performance of HR operative functions can be analyzed and improved. Measures give results, identify problems, and create a platform for further investigation. With time, business managers realized that only diagnosing the problem by doing root-cause analysis will not lead them to predict what will happen next and how to control the adverse impact of their prediction. Business managers understood, to predict "*what will happen in future?*", they need to analyze past data to identify variables that may impact future performance. These impacting variables need focus and are to be accommodated in a model for predicting what will happen next and provide a solution to control the adverse effects of the impacting variables on HR issues (Uppal, 2021).

Let's take an example, suppose a company's employee cost is 70% of its total cost. This is a manager's nightmare. The management is desperate to reduce employee costs to increase profit margin. To do that, business managers need to carefully investigate the apportionment of the employee cost in various heads and come up with correct measures to reduce and control costs. This process will help business managers not only in predicting the future anticipated employee cost but also indicate how to control costs with proper regulations.

$$\textbf{Employee Cost} = \textit{Cost of Acquisition} + \textit{Cost of Development} + \textit{Compensation Cost} + \textit{other Overhead Costs}$$

Business managers need to understand how to leverage data and figure out the possible avenues of cost control with the help of analytical tools and methods to better utilize the workforce and get the best value for the business.

According to leading thinkers like Jac Fitz-enz, an HR organization will never be able to utilize its full potential unless it can describe the role of human resources in creating value and ensuring investment in return (Frangos, 2002). Hence, it is of prime importance for business managers to identify and understand the relationship between business outcomes and the

contribution of HR. This can be linked if we consider the following model (a concept adopted from the article *The HR Value Chain: An Essential Tool for Adding Value to HR* by Erik van Vulpen, 2018). The model depicts how HR outcomes are ultimately impacting business outcomes when measured from three dimensions of a Balanced Scorecard: financial, customer satisfaction, and processes (Vulpen, 2018).

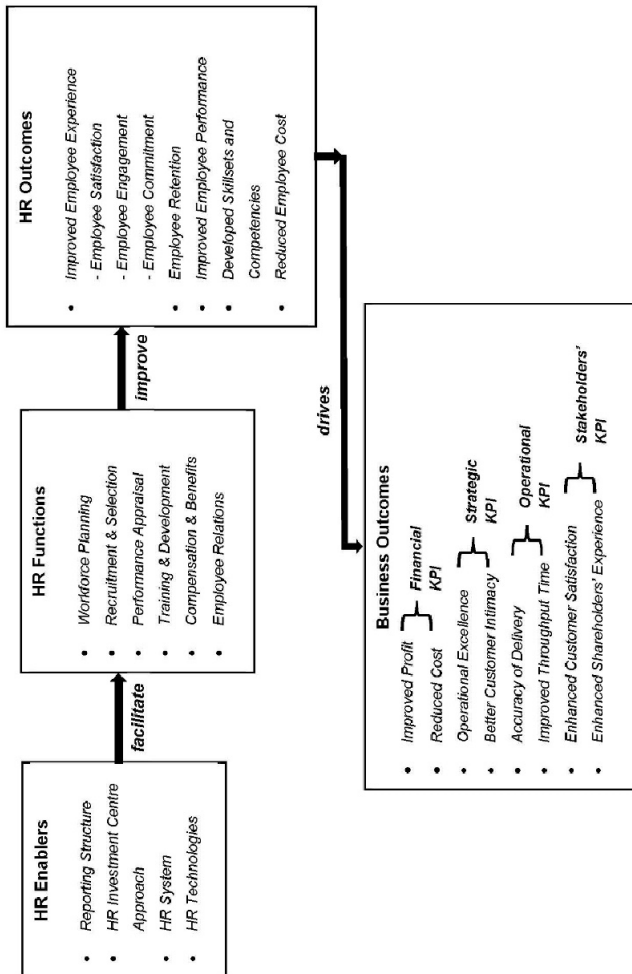


Figure 1.2: The HR Value Chain

HR enablers create a platform for the smooth functioning of HR activities. The proper execution of **HR activities with calculated measures** ensures better HR outcomes in terms of better employee engagement, employee retention, etc., and workforce cost is also reduced to a certain extent. The question remains.

“With a better level of HR outcomes can the company achieve business goals in a better way?”

HR outcomes can ensure that the company is earning higher profit and turnover by optimizing HR operating costs, with better employee engagement and retention. Furthermore, with a higher level of workforce competence and performance, the accuracy of delivery of product or service quality improves with reduced throughput time. This ultimately leads to higher customer and promoter satisfaction and experience. The same is explained with the following figure (a concept adopted from the article *How HR Can Boost Its Business Impact* by Wouter van Essenberg, 2017).

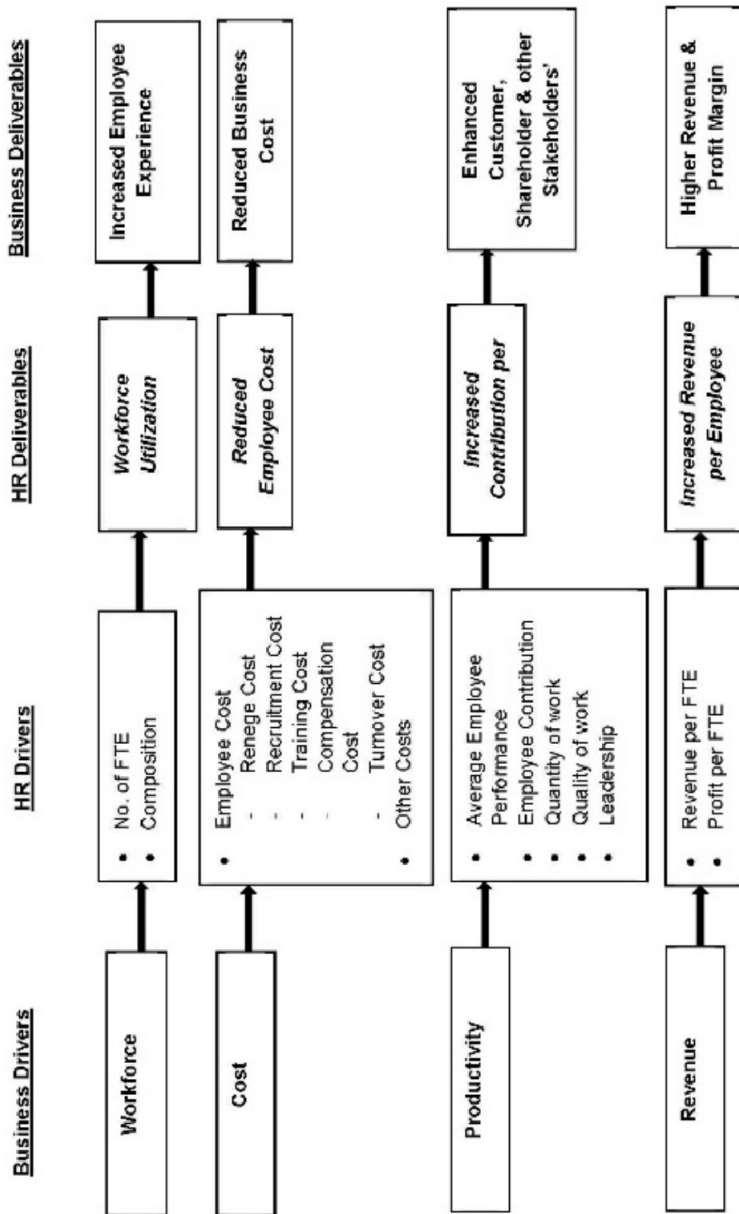


Figure 1.3: HR Impact Model

The business drivers like *Gross Margin*, *Productivity*, etc., are forcing business managers to check how *Cost Per Full-Time Employee* can be reduced further and better *Employee Utilization* can be assured (Nyberg, 2010). These measures are further triggering the questions like –

“Can we reduce our salary offer to a certain extent and increase the secondary benefits to control Attrition Costs?”

Or

“Can we have a relook at our Employee Productivity to check if our Employability is in question or if we are not utilizing human potential to the extent needed? If so, how to manage employee performance and develop them for leadership positions for better engagement?”

Or

“What percentage of our Total Cost is Employee Cost and how to reduce Cost per Hire, Cost of Training, and Cost of Compensation?”

To do that, HR must talk in quantitative terms and develop some measures and accountability tools.

CHAPTER 2

WHY IS HR ANALYTICS IMPORTANT?

Analytics plays a pivotal role in bridging the gap between promised outcomes and stakeholders' perceived expectations. It is a set of tools to analyze data to derive valuable insights for making decisions. It comprises:

1. Collecting data
2. Processing the collected data
3. Interpretation of processed data to derive meaning.

Analytics can be defined as a process that involves the use of statistical techniques (measures of central tendency, graphs, Regression Analysis, etc.), Information System software (Human Resource Information System, Decision Support System, etc.), and Operations Research tools (Markov Decision Processes, Linear Programming Problems, etc.) to explore, visualize, discover, and communicate patterns or trends in data. Put simply, analytics convert data into useful information.

Today's business decisions are data-driven. If data are properly analyzed and interpreted, they can be a source of competitive advantage that competitors may not be able to copy. HR data is no exception. Hence, HRM functions also need to talk in quantifiable terms. The better the analysis of HR data, the more effective the HR decisions are to improve the utilization of the workforce.

HR Analytics is a facilitating tool or a set of tools to analyze HR-related data to derive meaningful and valuable insights to effectively manage human resources for making better HR decisions to achieve business goals.

The business decisions are not solely based on leaders' intuition, experience, or expertise, but to a great extent are data-driven. It takes