A STUDY TO ANALYZE COST EFFECTIVE ADOPTION OF BUSINESS ANALYTICS IN MSMEs

Karthikeyan P, Sukhmani Sooch, Satyam

MBA student's

Lovely professional University

CHAPTER – 1

Abstract:

Adoption of business analytics has the potential to significantly benefit India's micro, small, and medium enterprises (MSMEs). This study investigates the difficulties and potential for cost-effective business analytics implementation in MSMEs. It takes a mixed-methods approach, integrating quantitative surveys with qualitative expert interviews. The study reveals a favorable relationship between business analytics adoption and technological competence, emphasizing the significance of infrastructure in enabling cost-effective implementation. Furthermore, the data show a favourable association between business analytics adoption and cost efficiency, with technological capabilities serving as a mediator. A culture of innovation inside MSMEs is also connected to the cost-effectiveness of analytics solutions. It outlined critical problems for MSMEs, such as limited personnel skills, financial restrictions, and a lack of a data-driven decision-making culture.

Summary:

MSMEs encounter obstacles in implementing business analytics because to limited staff skills, costs, infrastructure, and access to third-party service providers. There is a positive relationship between business analytics adoption and technological capabilities, implying that expenditures in technology can help with cost-effective analytics implementation. Business analytics implementation may lead to considerable cost savings for MSMEs. Technology plays an important role in managing this interaction. A culture of creativity and experimentation with new technologies among MSMEs can boost the cost- effectiveness of big data analytics solutions. A shortage of qualified labor and a data-driven decision-making environment are key barriers to business analytics adoption in MSMEs.

Introduction:

MSMEs stand for Micro, Small, and Medium Enterprises. These are businesses characterized by their size, scale of operations, and investment levels. The micro enterprises are the smallest entities among MSMEs. They typically have a very small workforce and low investment in plant, machinery, or equipment. Micro-enterprises play a crucial role in employment generation, especially in rural and semi-urban areas. Examples include small grocery shops, tailoring units, local food stalls, etc. Whilst the small enterprises are larger than micro-enterprises but smaller than medium-sized enterprises. They have a higher investment in plant, machinery, or equipment compared to micro-enterprises. Small businesses often have a slightly larger workforce and may operate on a slightly larger scale. Examples include small-scale manufacturing units, boutique clothing stores, small-scale IT service providers, etc. Lastly, the medium-sized enterprises are larger than both micro and small enterprises but are still smaller than large corporations. They have higher investment levels, a larger workforce, and may operate on a more substantial scale. Medium-sized enterprises often have more sophisticated operations and may have established themselves in the market. Examples include medium-sized manufacturing companies, software development firms, medium-sized restaurants or hotels, etc.

In India, MSMEs are defined based on their investment in plant and machinery or equipment for manufacturing units, and on investment in equipment for service enterprises. As per the Micro, Small, and Medium Enterprises Development (MSMED) Act of 2006, MSMEs are classified into two categories: manufacturing enterprises and service enterprises. Micro, Small, and Medium Enterprises (MSMEs) play a pivotal role in India's economy, contributing significantly to employment generation, industrial production, and GDP growth. These enterprises are the backbone of the Indian economy, embodying entrepreneurial spirit, innovation, and dynamism. In this introduction, we'll delve into the essence of MSMEs in India, highlighting their importance, challenges, and contributions.

Business analytics refers to the use of data, statistical analysis, quantitative methods, and predictive modeling to drive informed decision-making and improve business outcomes. It involves the exploration of data from various sources to uncover insights, trends, and patterns that can be used to optimize processes, enhance performance, and gain a competitive advantage. The key aspects of business analytics include:

Data Collection and Integration: Business analytics begins with the collection of data from diverse sources such as internal databases, transactional systems, customer interactions, social media, sensors, and other external sources. This data is then integrated and organized into a format suitable for analysis.

Descriptive Analytics: Descriptive analytics involves the exploration and analysis of historical data to understand what has happened in the past. It provides insights into past performance and trends using techniques such as data visualization, dashboards, and reports.

Diagnostic Analytics: Diagnostic analytics focuses on identifying the reasons behind past events or performance. It involves deeper analysis to uncover the root causes of issues or trends observed in the data. Diagnostic analytics often utilizes techniques such as correlationanalysis, root cause analysis, and hypothesis testing.

Predictive Analytics: Predictive analytics aims to forecast future outcomes or trends based on historical data and statistical modeling techniques. It involves the development of predictive models that can anticipate future events, behaviors, or trends. Predictive analytics enables businesses to make proactive decisions and take preventive actions to mitigate risksor capitalize on opportunities.

Prescriptive Analytics: Prescriptive analytics goes beyond predicting future outcomes to recommend actions or decisions that can optimize performance or achieve specific objectives. It combines predictive models with optimization and simulation techniques to provide actionable insights. Prescriptive analytics helps businesses identify the best course of action in complex and uncertain environments.

Data Visualization and Reporting: Data visualization plays a crucial role in business analytics by transforming complex data into easy-to-understand visuals such as charts, graphs, and dashboards. Visualization tools help stakeholders gain insights quickly and make data-driven decisions. Reporting capabilities allow businesses to communicate findings and insights effectively across the organization.

Machine Learning and AI: Business analytics increasingly leverages machine learning and artificial intelligence (AI) techniques to analyze large volumes of data, identify patterns, and make predictions automatically. Machine learning algorithms can learn from data without being explicitly programmed, enabling businesses to uncover hidden insights and opportunities.

In the ever-changing world of global business, using business analytics strategically has become really important. It's like a powerful tool that helps reshape how decisions are made and impacts the success of organizations. Our introduction is inspired by various important studies from around the world that look into the complex world of business analytics. These studies explore the challenges and opportunities in different industries, highlighting the need for advanced tools and a mix of automated analysis and human skills. The insights from surveys on scholarly data visualization show that there's a global need for effective techniques to handle complex data, something businesses and researchers everywhere are struggling with. As we look at the international scene, the exploration of how data visualization transforms information aligns with the global trend of using advanced technologies, especially AI, in analytics. This global perspective sets the stage for our exploration of cost-effective ways for smaller businesses, like Micro, Small, and Medium Enterprises (MSMEs), to adopt analytics successfully. Understanding the worldwide trends in analytics becomes crucial for making this happen.

Business analytics offers a multitude of benefits to organizations across various industries, empowering them to unlock the full potential of their data and make informed decisions that drive performance and competitiveness. Firstly, business analytics enables organizations to gain valuable insights from large volumes of data, helping them identify patterns, trends, and correlations that would otherwise remain hidden. These insights serve as a foundation for strategic planning, allowing businesses to anticipate market changes, identify growth opportunities, and mitigate risks effectively. Secondly, business analytics enhances operational efficiency by optimizing processes and resource allocation. Through analytics- driven optimization, organizations can streamline workflows, reduce waste, and improve productivity, leading to cost savings and enhanced competitiveness. Additionally, analytics enables organizations to personalize products, services, and marketing efforts to better meet the needs and preferences of their customers. By leveraging customer data and predictive analytics, businesses can tailor offerings, improve customer satisfaction, and foster long-term loyalty. Furthermore, business analytics plays a crucial role in risk management and fraud detection. By analyzing historical data and identifying anomalies or suspicious patterns, organizations can proactively mitigate risks, prevent fraud, and safeguard their assets and reputation. Finally, business analytics facilitates data-driven decision-making at all levels of the organization, from frontline operations to strategic planning. By providing actionable insights and evidence-based recommendations, analytics empowers stakeholders to make informed decisions quickly and confidently, driving business success and sustainable growth. Overall, the benefits of business analytics are extensive, encompassing improved decision- making, operational efficiency, risk management, customer satisfaction, and competitive advantage, making it an indispensable tool for organizations seeking to thrive in today's data-driven world.

While business analytics offers numerous advantages, it also presents certain disadvantages and challenges that organizations must navigate to leverage its full potential. One significant drawback is the complexity and cost associated with implementing and maintaining analytics infrastructure and capabilities. Building and managing robust analytics systems require substantial investments in technology, talent, and training, which may be prohibitive for smaller organizations with limited resources. Additionally, organizations may encounter challenges related to data quality and integrity, as inaccurate or incomplete data can compromise the accuracy and reliability of analytical insights. Furthermore, the sheer volume and variety of data available to organizations can overwhelm decision-makers, leading to analysis paralysis or misinterpretation of results. Another disadvantage of business analytics is the potential for privacy and security breaches, particularly when dealing with sensitive or personally identifiable information. Organizations must adhere to stringent data protection regulations and implement robust security measures to safeguard against unauthorized access, breaches, and data leaks. Additionally, the reliance on analytics-driven decision- making may inadvertently sideline human judgment and intuition, leading to overreliance on data and overlooking qualitative factors that are equally important in decision-making. Finally, there is the risk of unintended consequences or biases in analytical models and algorithms, which can perpetuate existing inequalities or produce flawed recommendations if not carefully monitored and addressed. Despite these disadvantages, organizations can mitigate risks and maximize the benefits of business analytics by investing in

robust governance frameworks, data management practices, and continuous learning and improvement initiatives. By addressing these challenges proactively, organizations can harness the power of analytics to drive innovation, efficiency, and competitiveness while mitigating potential pitfalls.

Business analytics finds wide-ranging applications across diverse industries, empowering organizations to derive actionable insights from data to enhance decision-making, operational efficiency, and strategic planning. In the retail sector, analytics facilitates customer segmentation, demand forecasting, inventory optimization, and pricing strategies. By analyzing customer data, retailers can tailor marketing efforts, predict future trends, and optimize inventory levels to meet demand while minimizing costs. In finance, analytics is instrumental in risk management, fraud detection, portfolio optimization, and customer lifetime value estimation. Financial institutions leverage analytics to assess risks, detect fraudulent activities, and personalize offerings to enhance customer satisfaction and retention. In healthcare, predictive analytics aids in patient outcomes forecasting, segmentation, operations management, and personalized medicine. By analyzing clinical data and patient profiles, healthcare providers can improve treatment plans, optimize resource allocation, and enhance overall patient care. Similarly, in manufacturing, analytics enables predictive maintenance, supply chain optimization, quality control, and production planning. Manufacturers leverage analytics to minimize downtime, streamline operations, and ensure product quality, ultimately driving cost savings and improving customer satisfaction. In marketing, analytics drives customer acquisition and retention efforts, social media monitoring, campaign optimization, and market basket analysis. By analyzing consumer behavior and engagement metrics, marketers can refine targeting strategies, optimize campaign performance, and maximize ROI. Overall, the application of business analytics across industries empowers organizations to harness the power of data to drive innovation, efficiency, and competitive advantage in today's dynamic business landscape.

Recent trends in business analytics reflect the ongoing evolution and maturation of analytical techniques, technologies, and applications, driven by advancements in artificial intelligence, machine learning, and data science. One prominent trend is the increasing adoption of augmented analytics, which integrates advanced analytics capabilities, such as natural language processing and automated insights generation, into analytics platforms to enable more accessible and intuitive data analysis for business users. Another significant trend is the growing emphasis on real-time analytics and streaming data processing, enabling organizations to derive insights from data as it is generated, facilitating faster decision- making and responsiveness to changing market conditions. Additionally, there is a rising focus on predictive and prescriptive analytics, leveraging machine learning algorithms to forecast future outcomes and recommend optimal courses of action, empowering organizations to anticipate trends, mitigate risks, and capitalize on opportunities proactively. Furthermore, there is a heightened emphasis on ethical and responsible AI, with organizations prioritizing transparency, fairness, and accountability in their analytics practices to address concerns related to bias, privacy, and data governance. Moreover, there is an increasing convergence of analytics with other emerging technologies, such as the Internet of Things (IoT), edge computing, and blockchain, enabling organizations to leverage data from diverse sources and drive innovation across

various industries. Finally, there is a growing recognition of the importance of data literacy and upskilling among employees to enable them to effectively leverage analytics tools and insights in their roles, driving a cultural shift towards data-driven decision-making and empowerment at all levels of the organization. Overall, these trends underscore the transformative potential of business analytics in enabling organizations to derive actionable insights, drive innovation, and achieve competitive advantage in an increasingly data-driven and dynamic business landscape.

In recent years, Micro, Small, and Medium Enterprises (MSMEs) have increasingly embraced business analytics to enhance their competitiveness and operational efficiency in a rapidly evolving business landscape. One notable trend among MSMEs is the adoption of cloud-based analytics solutions, which offer scalability, affordability, and accessibility, enabling smaller businesses to leverage advanced analytics capabilities without significant upfront investments in infrastructure or IT resources. Additionally, there is a growing focus on self-service analytics tools that empower non-technical users within MSMEs to perform data analysis and derive insights independently, democratizing access to data-driven decision-making across the organization. Moreover, MSMEs are leveraging predictive analytics to forecast market trends, customer behavior, and demand patterns, enabling them to anticipate changing market conditions, optimize inventory levels, and tailor products and services to meet evolving customer needs. Furthermore, there is an increasing emphasis on leveraging analytics for customer relationship management (CRM) and marketing automation, enabling MSMEs to personalize marketing campaigns, target high-value prospects, and nurture customer relationships effectively. Additionally, there is a rising interest in analytics-driven supply chain optimization among MSMEs, leveraging data analytics to optimize sourcing, procurement, inventory management, and logistics, thereby reducing costs, minimizing lead times, and enhancing overall supply chain resilience. Finally, there is a growing recognition of the importance of data governance and security among MSMEs, with a focus on implementing robust data management practices and compliance frameworks to safeguard sensitive information and ensure regulatory compliance. Overall, these trends underscore the growing significance of business analytics in enabling MSMEs to leverage data as a strategic asset, drive innovation, and achieve sustainable growth in today's competitive business environment.

The future of business analytics in Micro, Small, and Medium Enterprises (MSMEs) in India is poised for significant growth and transformation, driven by several key factors and emerging trends. Firstly, as the digital economy continues to expand and evolve, MSMEs are increasingly recognizing the value of data as a strategic asset and leveraging business analytics to gain actionable insights that drive growth and competitiveness. With the proliferation of affordable cloud-based analytics solutions and the availability of user- friendly analytics tools, MSMEs in India are overcoming barriers to adoption and embracing analytics to optimize operations, enhance decision-making, and capitalize on market opportunities.

Secondly, advancements in artificial intelligence (AI), machine learning (ML), and automation are reshaping the landscape of business analytics, offering MSMEs in India access to sophisticated analytical capabilities that were

previously inaccessible or cost- prohibitive. AI-powered analytics solutions are enabling MSMEs to automate repetitive tasks, uncover hidden patterns in data, and generate predictive insights, empowering them to anticipate market trends, personalize customer experiences, and optimize business processesmore effectively.

Moreover, the increasing availability of data and the rise of the Internet of Things (IoT) are generating vast volumes of real-time data from diverse sources, presenting both opportunities and challenges for MSMEs in India. By harnessing IoT data and implementing real-time analytics solutions, MSMEs can gain valuable insights into operational performance, supply chain dynamics, and customer behavior, enabling them to respond swiftly to changing marketconditions and drive continuous improvement across their value chains.

Additionally, the democratization of analytics and the growing emphasis on data literacy are fostering a culture of data-driven decision-making within MSMEs in India. As awareness of the benefits of analytics spreads and skill levels improve, MSMEs are increasingly integrating analytics into their strategic planning processes, empowering employees at all levels to leverage data insights to drive innovation, optimize resource allocation, and enhance customer satisfaction.

Furthermore, government initiatives and support programs aimed at promoting digital adoption and technology-enabled growth among MSMEs in India are expected to further fuel the uptake of business analytics in the sector. Initiatives such as the Digital India program, the MSME Act, and various financial incentives and subsidies for technology adoption are providing MSMEs with the necessary impetus and resources to invest in analytics capabilities and unlock their full potential in the digital economy.

Overall, the future of business analytics in MSMEs in India is characterized by rapid innovation, technological advancement, and increasing adoption, paving the way for enhanced competitiveness, sustainable growth, and economic development in the years to come. By embracing analytics as a strategic imperative and investing in the necessary infrastructure, talent, and skills, MSMEs in India can position themselves for success in an increasingly data-driven and interconnected business environment.

CHAPTER – 2 REVIEW OF LITERATURE

2.1 International Perspective

S.no	Title	Author	Year
1	Emerging trends in business analytics	Kohavi, R.et al.	2002
	Summary - Business analytics (BA) has emerged as a transformative force, particularly evident in the dynamic landscape of e-commerce where massive clickstream datasets pose challenges and opportunities. To navigate this data deluge, sophisticated analytical tools are imperative, demanding a synergy of automated analysis and human expertise. Effective communication of insights to non-technical users remains paramount for successful implementation. The evolving data privacy regulations underscore the importance of meticulous data governance and security practices. Looking ahead, the future of business analytics is poised to witness continued growth with the development and adoption of advanced analytics techniques such as AI and machine learning. Integration of BA with broader enterprise systems is anticipated to facilitate holistic decision-making across departments, while an increased emphasis on user-friendly interfaces and visualization tools reflects a commitment to broader accessibility and usability in the evolving field of business analytics.		
2	The Use of Data Visualization in E-Commerce: A Review.	Sanobar, Y.	
	Summary - Clickstream data will be visualised in a variety of ways such as flow charts, heatmaps, and funnel charts. Its visualisation will helps in the activities such as tracking of the user routes, analysing product engagement with users, and locating bottlenecks present in the conversation. For successful analysis, they will also take use of trends such as the real-time insights, interactive visualisations, and personalisation		
3	A management of technology framework for MSME Success and Sustainability.	Zamora	2010

	Management of Technology (MOT) is described as the strategic use of scientific, engineering, and management knowledge to find, acquire, develop, and safeguard technologies that enable the production and delivery of goods and services, hence increasing organisational competitiveness and growth. It is found that Philippine Micro, Small, and Medium Enterprises (MSMEs), focusing on major concerns such as competitiveness and finance. It investigates government programmes, such as the SMED Plan and DOST's SETUP. Three case studies of successful businesses highlight crucial success criteria. The recommendations are divided into two categories: businesses and government, with an emphasis on strategic technology management for MSMEs in the Philippines		
4	Changing the equation on scientific data visualization.	Fox et al.	2011
	It addresses the challenge scientists face in efficiently visualizing their data, despite the increasing ease of data generation. The article highlights the current imbalance between the decreasing costs of data generation and the persistently high costs of visualization, presenting it as a bottleneck in scientific progress. It emphasizes the limited use of visualization as an exploration tool rather than a final product, hindering its potential impact on guiding scientific inquiry. The suggested solutions involve leveraging new database technologies and web-based visualization approaches to reduce costs and complexity. The article advocates for integrating visualization throughout the research process, promoting more accessible and affordable tools to seamlessly incorporate data exploration into the scientific journey. Overall, it calls for a paradigm shift in scientists' approach to visualization to enhance understanding and streamline the scientific inquiry process		
5	Visual analytics for the big data era—A comparative review of state-of-the-art commercial systems	Zhang, L., Stoffel, A., Behrisch, M., Mittelstadt, S., Schreck, T., Pompl, R., ... & Keim, D.	2012
	Summary - In the early days of visual analytics (VA), academics took the lead, developing new visualisation techniques and open-source tools. Small software		

	companies, frequently university spin-offs, created customised programmes for specific application fields. But the landscape has changed. Some tiny VA firms have grown rapidly, while major companies such as IBM and SAP have bought successful players and integrated their VA capabilities into existing frameworks. This expansion correlates with an explosion in data volume and complexity, generating demand for VA solutions in a variety of industries".		
6	Data visualization: transforming numbers and figures into images, graphs, and videos that tell a story	Tukey, J.	2012
	Summary - This literature review underscores the vital role of data visualization as a transformative tool that translates numerical information into accessible images, graphs, and videos, providing a voice to data and facilitating comprehension. It elucidates the significance of visual representations in unlocking insights from complex data, simplifying intricate information, and enhancing communication by reaching broader audiences. The surge in demand for effective data visualization is attributed to the rise of "Big Data" and "Open Data," with researchers and analysts serving as translators, converting raw data into clear and accessible visual formats. The review identifies closely related fields such as Information Visualization, Information Design, and Data Storytelling, emphasizing their collective contribution to effective data communication. Ultimately, it emphasizes that data visualization has evolved from a luxury to a necessity, serving as a crucial bridge between complex data and human understanding, empowering individuals to make sense of the world around them.		
7	Mobile business intelligence and analytics	Stodder	2012
	Summary - The businesses has been been transforming thrugh the mobile computing by employ the Business Intelligence (BI) and analytics.A comprehensive survey have been mase to identify the existing practices and futuristics view to adopting mobile BI across various user levels. It examined that which feature will be the most important for the mobile consumers and discusses the issues that IT faces while handling data for mobile users		
8	DATA VISUALIZATION AND DISCOVERY FOR BETTER BUSINESS DECISIONS	David Stodder	2013

Summary - The text emphasizes the significance of data visualization in business intelligence, evolving from basic dashboards to advanced charts for uncovering hidden data relationships. The report focuses on organizational experiences with data visualization, offering best practices for improved decision-making. The survey involved 453 respondents, primarily business executives and IT professionals. Key points include the importance of data interaction in successful visualization and the central role of dashboards, with a growing interest in geospatial analysis and mobile device adoption. Organizations seek operational efficiency as a top benefit, aiming to reduce time lost in data access and analysis. The literature underscores data visualization's power for non-technical users, aiding effective data use and reducing time to insight. Overall, the text highlights data visualization's increasing importance in facilitating decision-making, collaboration, and operational execution.

9	Business analytics: Research and teaching perspectives.	Sharda, R., Asamoah, D. A., & Ponna, N.	2013

Summary - Big data and the business analytics are inter related to each other and the oppurtunities, prescriptive, descriptive and predictive analytics are expanding in a big way. The research and the teaching perspective getting widen within this field and it will help the analytics professionals to diversify the knowledge regarding the bigdata

10	Data-intensive applications, challenges, techniques and technologies: A survey on Big Data.	Chen, C. P., & Zhang, C. Y.	2014

Summary - Big Data attracts researchers, politicians, and corporations is obvious, its vast mass is a double-edged sword. On the one hand, the opportunity for efficiency gains and technological developments in a wide range of sectors is huge, offering a future in which Big Data mastery powers development. Capturing, storing, analysing, and visualising this data flood, on the other hand, creates substantial hurdles. Cutting-edge solutions such as granularity computing, cloud computing, and bio-inspired methods are being investigated to help discuss this level of complexity. At last, the future of Big Data relies on finding new solutions to its issues, allowing us to realise its full potential and pave the path for a data-driven future

11	Technology development in MSMEs.	Singh et al.,	2014
	Technology has an important impact on the global economy, businesses, and businesses, triggering fundamental developments. It changes industries and causes fundamental shifts in modern businesses, influencing the laws of business. Micro, Small, and Medium Enterprises (MSMEs) are critical to national economies, particularly in nations such as India, and they contribute significantly to revitalization and development. Technology is critical to MSME operations, ensuring their survival and expansion while also promoting economic and social development through job creation. Exploring aspects such as entrepreneurship, government regulations, organisational culture, and technology infrastructure may help MSMEs improve their technological development, demanding proactive efforts to strengthen their skills".		
12	Applications of business analytics in healthcare. Business horizons	Ward, M. J., Marsolo, K. A., & Froehle, C. M.	2014
	Summary - The United States' healthcare system is at a crossroads, with analytics emerging as an important factor in its development. As healthcare systems gain more electronic data, even from innovative sources such as DNA, the challenge of how to use this data to improve health at a sustainable cost arises. The analytics will be critical for deciding the future of healthcare, but its implementation will come with problems such as data standardisation high-quality data collecting, and labour shortages. There are other administrative difficulties, such as promoting uniform data use for improved care delivery and managing public data reporting and sharing. It also explores applications, obstacles and facilitators to analytics adoption, finally		
	showing its ability to accomplish modern healthcare goals of high-quality, responsive, inexpensive, and efficient treatment		
13	A unified foundation for business analytics	Holsapple, C	2014

Summary - This paper undertakes the synthesis of existing research to construct a comprehensive and holistic characterization of business analytics (BA), laying the groundwork for researchers, practitioners, and educators to study the field. The designed ontology encompasses three key components: identification of dimensions for examining BA possibilities, derivation of a six-class taxonomy covering BA perspectives, and the creation of an inclusive framework for the field. Beyond unifying the literature, the framework contributes by stimulating contemplation on the nature, roles, and future of BA initiatives. The paper deduces numerous unresolved issues, extending beyond traditional considerations of data management and technology use, encouraging further exploration by researchers, practitioners, and educators. This comprehensive approach provides a valuable foundation for advancing the understanding of business analytics and its multifaceted dimensions.

14	A cognitive analytics management framework (CAM-Part 3): Critical skills shortage, higher education trends, education value chain framework, government strategy.	Osman, I. H., & Anouze, A. L.	2014

Summary - The study examines the impact of the big data, business analytics, and technological innovations tsunami on the transmission and dispersion of knowledge around worldwide through the Internet of Things, and the design of future academic training and education programmes

15	Big data analytics in supply chain management: Trends and related research.	Rozados &Tjahjono	2014

Summary - Big Data Analytics emerges as a light of potential in the area of corporate transformation. While it has attracted the interest of scholars as well as professionals in sectors such as finance and marketing, its actual potential for revolutionising Supply Chain Management (SCM) remains untapped. This piece explores the principles of Big Data Analytics, its many manifestations, and the various stages of maturity within the SCM ecosystem. It tackles the real implementation challenges, providing essential best practices to help to reach the path

16	Making sense of complex data using interactive data visualization	Diane J. Janvrin	2014

	Summary - research highlights the increasing significance of Interactive Data Visualisation (IDV) in the context of decision-making, especially in accounting-related tasks. Educational research supports the efficacy of hands-on learning approaches, like the one outlined in the scenario, in developing practical skills. Pricing decisions that incorporate IDV tools are in line with more general conversations about using technology to enhance strategic accounting decision-making. Research also emphasises the benefits and difficulties that arise when accountants move into new professions that use developing technologies, stressing the necessity of both a mentality change and technical expertise. The accomplishment of learning objectives and good student feedback validates the efficacy of IDV-focused teaching approaches in bridging traditional roles and emerging technologies.		
17	The role of data visualization and analytics in performance management: Guiding entrepreneurial growth decisions	Julia Kokina	2015
	Summary - As demonstrated by the hands-on case method, the integration of Interactive Data Visualisation (IDV) in accounting education aligns with research that highlights the evolving role of accountants in decision support and the useful application of technology in data analysis. The example facilitates the transition between old tasks and developing tools by acknowledging the difficulties accountants encounter while adjusting to new responsibilities, particularly when handling complicated data using visualisation technology. The focus on using visualizations to support decision-making is consistent with studies that support the use of these tools in accounting education. The usefulness of the case in teaching IDV ideas is validated by positive student comments and learning goals that are		
	reached. This contributes vital insights to the growing landscape of novel pedagogical methods in accounting education.		
18	Business Analytics in the Context of Big Data: A Roadmap for Research	Gloria Phillips-Wren	2015

	Summary - Expert interviews and reviews of scholarly and professional literature emphasise how important it is to establish guidelines for determining key data sources and resolving big data storage issues. The talks highlight how crucial it is to organise big data with a balance between flexibility and preparation, including metrics for identifying data sources and recommending delayed data preparation to improve storage flexibility. The importance of these standards for analytics and complicated data analysis is emphasised; they acknowledge the problems that still exist and offer directions for further study and industry-academia collaboration. Agarwal and Dhar's (2014) and Andriole's (2012) pertinent literature add to the conversation on big data, data science, and analytics by shedding light on current issues and trends in technology.		
19	Traffic and Transportation Smart with Cloud Computing on Big Data.	Wang, X., & Li, Z.	2016
	Summary - Big data in the cloud computing is prior way to implement the smarter cities, with data mining and data visualisation which will facilitate the better traffic in the data. While the technology exists, organisations exploring the cloud face significant challenges in terms of security and privacy. A well-structured framework might provide a safety net, allowing for smarter judgements. Openly availablle data and transparency which made available to both the corporations and residents through smart devices. These smart devices have the potential to transform e-government and the future of cities		
20	Business analytics for managers: Taking business intelligence beyond reporting	Laursen	2016
	Summary – "Business Analytics for Managers: Taking Business Intelligence Beyond Reporting" offers a comprehensive exploration of the evolving realm of Business Analytics (BA) in the analytical age. The book goes beyond traditional reporting, introducing the concept of lead information for revolutionary process		

improvement and aligning it with organizational goals. It emphasizes BA as a holistic information discipline, encompassing IT, human skills, and processes. The strengths lie in the clear distinction between lead and lag information, a practical framework for information strategy, and a forward-looking perspective on the expanding role of BA. However, the focus on the "analytical age" concept may need further elaboration, and a more specific title and target audience could enhance its appeal. Despite these considerations, the book serves as a valuable resource for understanding BA's strategic role, providing insights into innovation and competitive advantage in the evolving landscape.

21	Big data visualization tools: a survey	Caldarola	2017
	Summary – In the era of Big Data, effective data visualization emerges as a critical skill, acting as the strategic bridge between vast datasets and human comprehension. This survey paper explores the landscape of Big Data visualization tools, emphasizing the pivotal role visualization plays in uncovering insights within the data deluge. It categorizes tools into embedded visualization tools, standalone visualization software, and visualization plugins, offering a comprehensive analysis of their features such as supported data formats, visualization types, interactivity, scalability, and ease of use. The paper extends beyond functional characteristics, considering non-functional aspects like cost, community support, and integrations. By providing a holistic view, the paper serves as a valuable guide for researchers, analysts, and business professionals seeking to navigate and harness the potential of Big Data visualization tools for informed decision-making.		
22	Understanding business analytics success and impact: A qualitative study	Thambusamy	2017
	Summary – This study addresses a critical gap in the Information Systems (IS) literature by focusing on the operationalization of business analytics (BA) and examining both theoretical and practical success factors. While existing literature has emphasized the role and necessity of BA, it has largely overlooked the specific factors contributing to its successful implementation. The research, conducted through a qualitative study, delves into the empirical exploration of BA success		

	factors and their impact on organizations. By providing deep insights into the operationalization of BA, the study aims to inform theoretical frameworks and practical implementations, offering valuable contributions to the understanding of how organizations can derive the most value from their BA initiatives in terms of timely insights, optimized processes, and growth opportunities.		
23	Big iot data analytics: architecture, opportunities, and open research challenges	Marjani, M., Nasaruddin, F., Gani, A., Karim, A., Hashem, I. A. T., Siddiqa, A., & Yaqoob, I.	2017
	Summary - ," iot data analytics exploring ways to make use of the enormous quantity of data generated by miniaturised iot devices. While existing solutions offer glimpses of important information, the field is still in its early stages and lacks a full viewpoint. To fill this need it provides a unique architecture for massive iot data analytics, and also an in-depth evaluation of analytic kinds, methodologies, and technologies. Real-world use cases show the field's potential, and the paper additionally suggests interesting areas for using data analytics in the iot paradigm. It also starts the open research addresses such as privacy, enormous data mining, visualisation, and integration, establishing the way for future progress		
24	Considerations for the Adoption of Cloud-based Big Data Analytics in Small Business Enterprises.	Ajimoko	2018
	The adoption variables that impact IT professionals in small business enterprises (SBEs) when they think about cloud-based big data analytics (CBBDA). Employing exploratory qualitative approaches such as semi-structured surveys and one-on-one interviews, emergent themes were found and coded. The study proposes two types of CBBDA adoption criteria: internal and external. Internal criteria, unique to each SBE, include technological and organisational elements, while external criteria, which vary across SBEs, include vendor-related and environmental variables. Internal variables supporting CBBDA adoption in SBEs include		

	technology/organization alignment, SBE data environment and demand, financial position, and support from owners and senior management. Notably, the study highlights the importance of owner/top management support in overcoming hurdles to CBBDA adoption, as well as its implications for future technology integration in SBEs.		
25	THE RELATIONSHIP BETWEEN DATA VISUALIZATION AND INSIGHT: AN EXAMINATION THROUGH THE LENS OF CRITICAL THINKING	Black, J. R.	2018
	Summary – This study addresses a critical gap in existing research by examining how users' critical thinking skills (CTS) influence their preferences and perceived usefulness of data visualizations in business intelligence systems (BIS). By proposing a theoretical framework that links BIS data visualizations to insight development through the dimensions of insight and CTS, the study aims to shed light on the complex interaction between these factors. Through a survey of 45 small business users utilizing partial least squares structural equation modeling (PLS-SEM), the findings challenge existing theories by not establishing a statistically significant direct relationship between CTS and user preferences or perceived usefulness of different data visualizations. The study suggests future research directions, encouraging exploration of specific CTS skills' impacts on distinct aspects of insight generation and the moderating role of individual differences in this context. Overall, this research contributes to understanding the intricate dynamics of data visualization use in decision-making, emphasizing the need for continued exploration of the CTS and insight generation relationship.		
26	Big data analytics—A review of data-mining models for small and medium enterprises in the transportation sector.	Mohd Selamat *et al.,*	2018
	The need for Small and Medium Enterprises (SMEs) to adopt data analytics has grown due to the inflow of data caused by technological improvements. Despite the extensive use of data mining in the transport industry, research on its application by		

	SMEs in this field is particularly limited. A thorough examination showed three common data mining methods used by important organisations in transportation: "Knowledge Discovery in Database" (KDD), "Sample, Explore, Modify, Model, and Assess" (SEMMA), and "CRoss Industry Standard Process for Data Mining" (CRISP-DM). Among these models, CRISP-DM has reached broad commercial adoption. However, an evaluation of these approaches exposes limits for SMEs. As a result, there is an essential need to design a fresh model customised to the needs of SMEs, particularly those in the transport sector.		
27	Deployment factors for mobile business intelligence in developing countries small and medium enterprises.	Adeyelure *et al.,*	2018
	The rapid buildup of data, that surpasses real-time digestion and consumption, poses issues for small and medium-sized organisations (SMEs), especially in countries that are developing where Mobile Business Intelligence (MBI) execution is neglected. Despite remarkable success in wealthy countries, few studies have looked into the factors affecting MBI execution in developing-country SMEs. In addition, the Advance Impact Analysis approach was utilised to assess the direct and indirect effects of variables on MBI deployment. The study divided affecting elements into four categories: active user privacy reactive altering trends crucial top management support and inert technician location These studies seek to help SMEs in developing countries by emphasising aspects that require attention during MBI adoption.		
28	The use of business intelligence (BI) in small and medium-sized enterprises (SMEs) in Bosnia and Herzegovina	Tatić *et al.,*	2018
	Small and medium-sized businesses (SMEs) play an important part in the economies of governments such as Bosnia and Herzegovina. However, evolving market dynamics, internationalisation, and advances in technology need effective decision- making at both the operational and strategic levels. According to research, nearly all of SMEs in Bosnia and Herzegovina do not have Business Intelligence (BI) systems, despite having other information systems such as Enterprise Resource Planning		

	(ERP) and Customer Relationship Management. These technologies create data that is kept in databases and might be used for business intelligence (BI). Although SMEs in Bosnia and Herzegovina understand the value of BI have the challenges to adoption exist such as , including insufficient financial resources, a lack of expertise in management, vague strategic goals, and undefined Key Performance Indicators (KPIs)		
29	A Survey of Scholarly Data Visualization	Liu	2018
	Summary - The escalating volume of scholarly information necessitates effective visualization techniques for comprehension, a challenge addressed in this survey. Scholars grapple with understanding complex networks formed by millions of papers, authors, citations, and connections. Various visualization tools and techniques offer solutions, enabling researchers to discern structural patterns, unveil hidden trends, and make informed decisions. Visualization tools range from customizable software packages to specialized platforms tailored for scholarly data analysis. Challenges arise from the sheer abundance and complexity of data, urging the development of innovative techniques and tools. The need for flexibility in accommodating diverse research interests and ongoing exploration of issues like scalability, interactivity, and accessibility underscore the evolving nature of scholarly data visualization. This survey provides a comprehensive overview while pointing towards future directions in handling the intricate landscape of scholarly information.		
30	Big data analytics services for enhancing business intelligence. Journal of Computer Information Systems	Sun, Z., Sun, L., & Strang, K	2018
	Summary - Big data analytics services incorporating in business might boost business intelligence (BI). It shows the Big Data Analytics Service-Oriented Architecture (BASOA) model and shows its use for enhancing BI and corporate systems through data analysis. It also uses three key features of intelligent BI that are compatible with consumer and decision-maker expectations: temporality, expectability, and relativity. In the end, this method attempts to accelerate advances		
	in business analytics, big data analytics, BI, and related topics such as big data science and computing		
31	Does Visualization Matter? The Role of Interactive Data Visualization to Make Sense of Information	Arif Perdana	2018

Summary - Existing literature highlights the positive impact of IDV on non-professional investors, addressing their specific needs. The study aims to fill a gap in understanding how IDV influences decision-making and perception, particularly among non-professional investors facing bounded rationality. By posing specific hypotheses, the research seeks to explore IDV's role in reducing decision-making time, improving heuristic information processing, decreasing perceived uncertainty, and enhancing task accuracy. The study employs an experimental design with financial statements' presentations and investment tasks, involving 324 non-professional investors. The research aims to contribute theoretical and practical insights into the role of IDV in decision-making, particularly for non-professional investors in the accounting domain.

32	Business intelligence for order fulfilment management in small and medium enterprises.	Ho *et al.*,	2019

The use of Business Intelligence (BI) technologies may considerably improve supplier order fulfilment management for Small and Medium-sized Enterprises (SMEs). SMEs may use data from their enterprise resource planning system to find opportunities to create collaborative partnerships with suppliers and launching just-in-time strategies. These BI tools are intended to help with the selection of suppliers for collaborative partnerships. By developing BI solutions that make use of limited information technology resources, the company solves both business and technical challenges associated with enormous unstructured datasets and long calculation times. The findings show that SMEs may gain tangible advantages from BI technologies at a reasonable cost, which fits into the growing tendency of using business analytics for systematic innovation.

33	Data visualization: an exploratory study into the software tools used.	Michael Diamond	2019

Summary - investigating the use of four software programs—Watson Analytics, Power BI, Tableau, and Microsoft Excel—to visualize supply chain shop bike sales data. The study's objectives are to evaluate the usefulness of these data visualisation tools and compare business school students' proficiency with them. These include challenges with Power BI's data labels and trend lines, as well as limitations with Watson Analytics' chart orientation problems and slower chart creation speed. To maximize the use of visualisation technologies in business education, several issues must be resolved. The findings show that while Microsoft Excel provided a simple creation procedure, labelling and data processing presented certain difficulties. There were issues with Power BI when it came to creating trend lines and data labels, especially when it came to quarter-based segmentation. Tableau made things simple. Looking into the visualisation of supply chain retail bike sales data using four software packages: Microsoft Excel, Tableau, Power BI, and Watson Analytics. The purpose of the study is to compare business school students' proficiency with these data visualisation tools and assess how beneficial they are. These include restrictions with Watson Analytics' chart orientation issues and slower chart production time, as well as issues with Power BI's data labels and trend lines. Several problems need to be overcome before visual aids in business education can be fully utilized. Results indicate that although Microsoft Excel offered a straightforward creation process, labelling and data processing posed certain challenges. Creating trend lines and data labels in Power BI was problematic, particularly when it comes to quarter-based segmentation. Tableau made things simple

34	Business Analytics: Defining the field and identifying research agenda.	Hindle, G. And Kunc, M	2019

Summary - This research employs real-world cases to explore the applications of business analytics, utilizing perspectives like technology affordances and dynamic capabilities. Through competence set analysis and predictive modeling, the study addresses challenges in competitive advantage, ethics, and big data. Notably, ethical implications in business analytics, particularly regarding value creation, and the challenge of overcoming data silos in supply chains are highlighted. The research proposes the implementation of ethical evaluation frameworks, such as a business ethics canvas, to address ethical concerns in analytics. Additionally, utilizing competence set analysis and predictive modeling techniques is recommended to break down data silos and enhance decision-making in supply chains and educational institutions.

35	Business Analytics: Defining the field and Identifying a research agenda	Hindle, G	2020
	Summary - This special issue on business analytics, featuring over 100 papers, underscores the field's burgeoning significance and popularity. The focus centers on how analytics can confer a competitive advantage to businesses, and the selected papers reveal compelling insights. Key findings indicate the maturation of business analytics, showcasing a robust foundation and established methodologies. Noteworthy is the identification of synergies between business analytics and operational research, presenting promising collaborations that open avenues for optimization and decision-making. The research emphasizes opportunities for the operational research community to contribute expertise to the evolving landscape of business analytics. The overarching message conveyed is that business analytics transcends mere buzzwords, emerging as a powerful tool vital for organizational success, with its connections to operational research promising even greater potential for the future.		
36	Business Intelligence Visualization Technology and Its Application in Enterprise Management	Sun jun	2020
	Summary - highlights the necessity for corporate development to derive value from large datasets. The study looks at real-world uses for business intelligence visualisation, fusing management choices with corporate data in areas including multi-level analysis, understanding market trends, and identifying target consumer segments. Citing studies conducted in a range of sectors, including retail, telecommunications, tobacco, and consumer goods, the literature review acknowledges the importance of data visualisation in decision-making. The process		
	of turning complicated corporate data into insightful knowledge for wise decision-making unites them all.		
37	Big data analytics adoption: Determinants and performances among small to medium-sized enterprises.	Maroufkh ani *et al.,*	2020

The adoption of Big Data Analytics (BDA) is critical for making precise decisions and achieving peak performance. The study, which analysed data from 171 Iranian small and medium-sized manufacturing enterprises, discovered that complexity, confusion, trialability, observability, top management support, organisational readiness, and outside help all had an important effect on BDA adoption. The findings highlight the significant effect of BDA adoption on performance enhancement across several areas, including marketing and finance. Understanding these variables enables managers to carry out effective efforts, while BDA service providers can utilise the findings to promote and support BDA adoption in SMEs.

38	Understanding the Impact of Business Analytics on Innovation	Duan, Y.	2020

Summary – This research explores the relationship between Business Analytics (BA) and innovation within the context of Big Data, aiming to address a gap in understanding the mechanisms of BA's contribution to innovation success. Drawing on absorptive capacity theory, the study develops a research model covering BA usage, environmental scanning, data-driven culture, innovation (new product newness and meaningfulness), and competitive advantage. Through a questionnaire survey of 218 UK businesses, the results reveal that BA directly improves environmental scanning and enhances a company's innovation. Additionally, BA directly contributes to a data-driven culture, which further impacts environmental scanning. The data-driven culture moderates the effect of environmental scanning on new product meaningfulness. This study underscores the positive impact of BA on innovation and emphasizes the pivotal roles of environmental scanning and data- driven culture, suggesting that organizations aiming to leverage BA must focus on both external and internal changes.

39	Small and medium enterprise business solutions using data visualization.	Kamaruddin, N., Safiyah, R. D., & Wahab, A.	2020

Summary - smes collect operational data using automated systems, but their reporting is slowed down by a lack of excellent visualisation. This delayed feedback loop makes discovering basic issues difficult and limits corrective action. Because of increasing amounts and variety of data, conventional analytics are becoming increasingly not enough. Enter iid-SME, a real-time data visualisation interactive dashboard. By aggregating raw data, iid-SME helps informed decision making, resulting in favourable business results.This proof-of-concept dashboard tracks case turnaround times, individual performance, and other essential metrics, enabling subject matter experts to make choices informed by data while reducing interactions. Finally, iid-SME solves the shortcomings of traditional reporting, allowing smes to obtain feedback more quickly, make better decisions, and acquire greater understanding into operational data

40	How data visualization tools can improve decision making processes based on customer satisfaction?	Bento, M. R. D. S.	2021

Summary – This literature review addresses the challenge faced by companies, particularly in the competitive hospitality industry, in translating insights from business intelligence (BI) tools into improved decision-making based on customer feedback. By exploring data-driven marketing, decision-making processes, data visualization, and business analytics literature, the review seeks to bridge this gap. It emphasizes the significance of data-driven marketing strategies, customer segmentation, and real-time insights for effective decision-making in the hospitality sector. Drawing on research by Kahneman and Simon, it underscores how data visualization tools can overcome cognitive limitations and biases in decision-making by presenting information clearly. Principles of effective visual design, as highlighted by Tufte and Few, are deemed crucial for impactful data visualization. The review concludes by aligning with Davenport's definition of business analytics, leveraging tools like Microsoft Power BI to transform customer data into actionable insights for enhanced decision-making in a practical case study context.

41	Role of Big Data Analytics in supply chain management: current trends and future perspectives.	Maheshwari, S., Gautam, P., & Jaggi, C. K.	2021

	Summary -In today's world, data rules supreme, with its volume developing across all industries. Managing this tsunami of data is the greatest corporate test, and Big Data Analytics (BDA) appears as the champion, offering efficient solutions to decision-makers. BDA shines ideal in the vital fields of Supply Chain Management (SCM), Logistics Management (LM), and Inventory Management (IM), improving operations by understanding consumer behaviour		
42	Towards a business analytics capability for the circular economy	Eivind Kristoffer sen	2021
	Summary - The research employs a qualitative approach, combining literature review and interviews to develop a conceptual model for Business Analytics in Circular Economy. Key findings highlight the importance of BA resources like data quality, technology integration, and financial support. The study identifies challenges in scaling circular strategies, including the lack of common standards and regulatory alignment. To address this, the proposed solutions involve creating standards, aligning regulations, refining pricing for environmental impacts, and promoting collaboration. The research contributes a novel model for Business Analytics Capability in the Circular Economy, supported by the Nordic Green Growth Research and Innovation Programme as part of the circit project.		
43	Data analytics for quality management in Industry 4.0 from a MSME perspective.	Sariyer et al.,	2021
	The Industry 4.0 technology may assist MSME executives with regulating production quality. It proposes a three-stage method for classifying items based on faults and identifying mistakes using machine learning. The model, which was tested at a Turkish kitchenware manufacturer, uses Multilayer Perceptron algorithms to achieve 96% accuracy in product quality classification and 98% in rework prediction. Major flaws necessitate additional rework, with assembly and material		
	identified as primary causes using association rule mining. This study emphasises the need of data-driven techniques for improving industrial quality control.		
44	Iot data visualization for business intelligence in corporate finance	Cuili Shao	2021

Summary - The study uses a strong methodology, assembling a team of professionals from academia and industry to tackle business intelligence (BI) issues. This is consistent with research that supports interdisciplinary cooperation in BI research. Determining the causal relationships between variables is a challenging task for the Internet of Things-based Efficient Data Visualisation Framework (iot- EDVF), which calls for a methodical approach to decision-making. The industry administrators and academic researchers working together is in line with previous study on industry-academia collaborations to improve technology frameworks. Plans for utilising a fuzzy-based deep learning model to enhance the iot-EDVF are

in line with research on how to leverage new technologies to enhance BI capabilities.

45	A study of big-data-driven data visualization and visual communication design patterns.	Zhu, W.	2021

Summary - The new media changes the way how we will communicate and consume data, technology and science intelligence services must adapt. The investigation explores into massive data representation and design models, offering an approach that is maximised using imagery schema theory. This theory encourages inclusive and creative designs and it will retain the logical consistency in multi- domain data representation. Beyond the basic data visualisation, the article provides a full approach for identifying sub-patterns, creating interactive features, and smoothly integrating them into specific applications. This deep integration offers data's actual potential, establishing the door for a smarter and more effective

scientific and technology intelligence service

46	Visual analytics for decision support: A supply chain perspective.	Khakpour, A., Colomo-Palacios,	2021
		R., & Martini,A.	

Summary - Supply chains's enormous data trove provides insights for better decisions, but effective analysis requires the correct tools. Visual Analytics (VA) emerges as a strong tool, but there is no comprehensive map of its Supply Chain uses. There is a research bridges the gap by laying out a strategy based on use cases, decision kinds, visualisations, analytics, and data sources. There is a possibilty to study to go through the newest trends, find uncharted territory, and link SC procedures with effective VA strategies. VA will help us to provide data insights to create a smarter, more efficient supply chain.

47	Measurement and Sorting of MSMEs Business Performance Rating Using Analytical Hierarchy Process.	Arini et al.,	2022

This study done inside a venture capital-backed the company that supports 876 Micro, Small, and Medium Enterprises (MSMEs), focuses on improving the confidence of performance evaluation systems and selecting top-performing MSMEs for recognition. The research develops appropriate performance measuring criteria based on focus group discussions and current data. The approach uses the Analytical Hierarchy Process (AHP) to give weights to criteria based on pairwise comparisons, assuring assessment consistency and reliability. The technique, which emphasises user-friendliness and stakeholder accessibility, allows for the quick calculation of business performance scores for each MSME and sorts ratings to identify the most accomplished partners, therefore boosting stakeholder consensus and successful collaboration. This methodical approach simplifies decision-making processes while simultaneously incentivizing good performance, resulting in a more resilient and cooperative corporate environment.

48	Empowering small and medium enterprises with data analytics for enhanced competitiveness.	Mosbah et al.,	2023

2023 SMEs are increasingly using corporate data analytics to make more informed decisions in today's world. However, our understanding of its potential and execution is limited. This study attempts to shed light on the idea and requirements

for effective data analytics installation in small and medium-sized enterprises. It focuses on four critical elements: data, people, technology, and process. Success is influenced by aspects such as data quality, established goals, high-quality tools, and analytical abilities. While data analytics can increase competitiveness, SMEs may encounter obstacles owing to limited resources, thus hindering their adoption of advanced analysis when compared to bigger firms.

49	Tech-Business Analytics in Primary Industry Sector.	Kumar *et al.,*	2023
	The implementation of Technology-based Analytics (TBA) in the primary manufacturing industry wants to enhance the efficiency and sustainability of agricultural and natural resource extraction activities. The mining sector is heavily dependent on natural resources and environmental conditions, thus decisions based on data are critical for optimising operations and reducing environmental impact. Similarly, in natural resource extraction, TBA can optimise operations through analysing data from multiple sources in order to increase resource utilisation, decrease waste, and reduce environmental effect. Despite the risks of climate change and resource depletion, firms in the primary sector of industry may use TBA to enhance their operations and address environmental concerns.		
50	Analyzing the Influence of Cloud Business Intelligence on Small and Medium Enterprises A Case Study of Morocco.	Khouibiri *et al.,*	2023
	Business intelligence (BI) has always played an important role in increasing organisational competitiveness by providing strategic insights that are critical for decision-making and corporate growth. Cloud computing has made it easier to share and collaborate on data. The study suggests for the use of Cloud BI as an innovative tool to boost economic growth among Morocco's small and medium-sized firms (SMEs). It underlines the symbiotic link between SME success and the general health of the Moroccan economy, demonstrating the need of regulatory agencies prioritising not just financial support but also technology improvements. The investigation analyses how combining technology might help SMEs gain a competitive advantage. It proposes a framework for transferring business intelligence to the cloud within the Cloud BI domain.		
51	Data Analytics Capability Maturity Models for Small and Medium Enterprises–A Systematic Literature Review.	Marohn	2024

Organisations are becoming more aware of the value of investing in data analytics. But due to budget restrictions, small and medium-sized firms (SMEs) might find it difficult to develop strong data analytics skills. A Data Analytics Capability Maturity Model (DACMM) emerges as a critical tool for SMEs to assess their data analytics capabilities, identify areas for expansion, and develop a path for increasing data analytics maturity. The investigation of current models discovered restrictions, such as inadequate data management dimensions, the lack of a prescriptive model, and the need for theory-based and evidence-informed model creation customised to SMEs' needs. As a result, the research recommends developing a new DACCM for SMEs employing action design research technique.

| 52 | THE ROLE OF DATA VISUALIZATION IN ENHANCING TEXTUAL ANALYSIS | Milev, P. | 2023 |

Summary – This paper explores the pivotal role of data visualization in enhancing textual analysis, focusing on techniques such as word clouds and sentiment charts. It delves into the transformative impact of machine learning and AI on text data visualization, emphasizing increased interactivity and informativeness. Ethical considerations, including privacy concerns and potential bias, are scrutinized. The benefits of data visualization include improved decision-making, richer understanding, and the democratization of data accessibility. Challenges, such as safeguarding data privacy and addressing biases, are acknowledged, along with the hurdle of acquiring technical expertise. Anticipated future trends involve the integration of AI for intelligent and interactive visualizations, the utilization of virtual reality for immersive exploration of data, and the development of user-friendly tools to broaden data visualization accessibility. In conclusion, the paper underscores the transformative potential of data visualization in unraveling the narratives concealed within textual data, while acknowledging ongoing challenges in the evolving landscape.

2.2 National perspective

S. No.	Title	Author	Year
1.	Business Analytics in India: Opportunities and challenges; discussion	Murthy, Ishwar	2006
	Summary – This report from IIM Bangalore represents the differentiation that Business Intelligence or Analytics brings across industries. There are opportunities of gaining competitive advantages as mentioned in other paper but also challenges such as infrastructure, manpower, technology, integration and more. The crucks lie in successful application and leveraging strengths.		
2	Data Visualization: Past, Present, And Future	Director of National Parks	2007
	Summary - This study presents the journey of data visualization. Data visualization can be useful only if one understands and realises how to use it carefully. It gives the user a platform to both make sense of the data given as well as communicate the understanding developed. Hence, the potential is vast and need not be undermined.		
3	The effectiveness of knowledge visualization for organizational communication in Europe and India	Sabrina, Martin, Asha & Riina	2011
	Summary – This study presents how knowledge maps and visualizations are crucial for communicating ideas and insights in businesses. This study focuses on testing effects of the various visualizations on the attitude of those consuming it based on the content, checking the effectiveness.		
4	Use of analytics in Indian enterprises: an exploratory study	Maria Xavier, Arun & Anil Srinivasan	2011
	Summary - This paper considers how adopting analytics in decision making enhances the customer experience. The main purpose is to remove the ambiguity of the word 'analytics' across business platforms and organizations to understand and implement it efficiently.		
5	Mapping Business Problems to Analytics Solutions: Surrogate Experiential Learning in an MBA Introductory Data Science and Business Analytics Course	Institute for Operations Research and the Management Sciences	2015

	The course design adheres to literature that emphasizes the practical application of analytics in business education and includes a hands-on case exercise utilizing the Data Analytics Lifecycle framework. Research already conducted emphasizes how important it is for analytics courses to incorporate steps such as operationalization, model planning, data preparation, and discovery. The difficulties noted, like striking a balance between managerial acumen and technical depth, are consistent with research on the varied backgrounds of students enrolled in analytics programs and the necessity of compressing skills within condensed timeframes. instruction. The course's overall goal is to advance students' understanding of analytics in business by using data-driven methods to address real-world issues. This approach is backed by a body of literature that advocates for hands-on, experiential learning in analytics education.		
6	A Survey of Data Visualization Tools for Analyzing Large Volume of Data In Big Data Platform	R S Raghav	2016
	The study focuses on assessing big data platforms' data visualisation tools for large-scale dataset analysis. It is consistent with previous research that highlights the value of efficient data visualisation for decision-making, enhancing return on investment, and reducing time. The study emphasizes the necessity of appropriate dashboards, user-friendly interfaces, and proper data extraction. It supports the need for improving visualisation methods and resolving inaccuracies, echoing research on difficulties in managing a variety of data sources. The research's demand for careful planning is consistent with the body of literature highlighting the importance of a		
	carefully considered approach in data visualisation initiatives. Essentially, the study adds to well-established guidelines for efficient data visualisation by stressing preparation, error correction, and appropriate instruments for extracting valuable information from massive datasets.		
7	Big Data Implementation in Small and Medium Enterprises in India and Poland.	Polkowski *et al.,*	2017

The exponential increase of information throughout the world, highlighting the concept of big data and its importance to businesses. It highlights that small businesses may also benefit from big data analytics to make more informed decisions and promote company growth. In countries like India and Poland, big data initiatives aren't limited to major corporations; startups and technology suppliers are assisting SMEs in harnessing data for scalability and insights. The availability of low-cost data centres through cloud suppliers has reduced entrance barriers for small firms. The study intends to provide a framework for big data application in SMEs, with an emphasis on India and Poland owing to international university collaborations between the two nations.

8	A Survey on Visualization Techniques Used for Big Data Analytics	Pradeep Reddy	2019

Summary – This survey explores the landscape of visualization techniques for Big Data analytics, acknowledging the challenges posed by the data explosion. It evaluates traditional, interactive, and emerging tools, highlighting their respective advantages and limitations. The proposed methodology introduces a novel approach, leveraging Big Data tools for efficient processing, transforming data into QR codes, and employing the Unity 3D engine for augmented reality (AR) visualizations. The benefits include a fusion of traditional reporting with immersive AR experiences and the use of open-source tools for affordability. However, limitations involve the prerequisite knowledge of Big Data and AR development and potential accessibility issues with AR technology. While offering a promising framework for tool selection, the paper emphasizes the need for further research to explore the proposed AR approach's applicability across diverse domains.

9	Data visualization and analytics – using a business intelligence tool to design a dashboard.	Simranjit Singh	2019

After conducting a thorough tool evaluation and consulting literature that highlights the importance of data visualisation tools for decision-making, the organisation decided on Power BI. Department heads were interviewed for four weeks about the effects of leadership and how to communicate effectively amid organisational changes. The literature on change management served as a source for organisational restructuring and website redevelopment. Issues with data collecting and project restarts because of leadership changes were among the challenges that were tackled with the help of pertinent literature.

With the use of data-driven decision-making literature, the Power BI dashboard was implemented, and this resulted in improved websites, targeted marketing campaigns, and optimised content. Conversion rates for ticket sales went up and the user experience was enhanced as a result. The comprehensive survey of literature encompassed scholarly journals, trade publications, and novels, offering a succinct basis for managing organisational difficulties.

10	Linking big data analytics and operational sustainability practices for sustainable business management	Raut, Mangla, Narwane, Gardas, Priyadarshinee& Narkhede	2019
	Summary – This study presents how industries are under pressures to integrate sustainable practices in their daily operations, and how big data analytics could be a predictor for the performance. Focusing on manufacturing sector, an artificial neural network model is used to integrate big data analytics and sustainability practices.		
11	A Survey on Visualization Techniques used for Big Data Analytics	Sumit Hirve & C.H. Pradeep Reddy	2019
	Summary - This study presents that how bid data is important as much as the process of drawing conclusion and findings from it is. The study shows how visual aids such as graphs and charts help derive better insights from the data. It also weighs the pros and cons of data visualization techniques and tries to predict which one to use where whilst dealing with different data.		
12	Business Analytics Adoption in Firms: A qualitative study elaborating TOE Framework in India	Amit Kumar & Bala Krishnamoorthy	2020

Summary - Author has discussed about the challenges adoption of business analytics in the emerging countries such as India that are growing at a rapid pace. However, the adoption of business analytics is scant as compared to the growth of these economies. The authors have thus shed light on the technological, organizational and environmental factors influencing business analytics adoption in India. The study validates factors such as perceived benefits, organizational data environment and competitive pressure, along with highlighting challenges such as data quality and the human resource competency.

13	Emerging trends and impact of business intelligence & analytics in organizations: Case studies from India	Aditi S Divatia, Jyoti Tikoria & Sunil Lakdawala	2020

Summary – This study presents the answers to the questions, like why are companies regularly investing in business analytics these days? And what is going to be the impact of such investment? Thus, the study dwells on discovering patterns and the usage & effectiveness of business analytics across organizations, while accounting for the maturity and capability levels of functional groups and organizations.

14	Data Visualization	Aarti Mehta Sharma	2020

Summary - This study has attempted to address the role of effective and efficient conclusion drawing while decision making. The prime focus has been kept on Dashboards and how particularly they are helpful for managers in addressing their needs easily by absorbing lots of information in one place.

15	Leading Business Intelligence (BI) Solutions and Market Trends	Anuj Tripathi & Teena Bagga	2020

Summary – This study presents emphases of Business intelligence on improving the understanding of insights from data. BI and its insights have become a part of every firm and its operation now. This paper dealt with the industry wide adaptability and solution generation to help businesses through BI.

16	Profundity of Business Analytics & it's Purview in India	Akshat Negi	2021

Summary – This study represents that how business analytics is a transpiring phenomenon that deals with the growing importance of data that in turn flourishes on the basis of its variety, velocity and volume. It describes how big data, when transformed into useful information can help an organization with benefits and growth.

17	An analytical survey on recent trends in high dimensional data visualization	Alexander Kiefer & Khaledur Rahman	2021
	Summary – This paper presents the ability of people to be easily able to understand and get manipulated by data visualisations. The research has been done to analyse the strengths, weaknesses, separation quality, runtime, memory usage et. For creation of more strong visualizations.		
18	Business Analytics Contribution in the growth of Indian Digital Business	Maran, Senthilnathan, Usha & Venkatesh	2022
	Summary – Here the paper talks about the role of business analytics on increasing the efficiency and productivity of businesses. Especially in all the sectors of the Indian economy. These sectors include IT, Travel, transport, Pharma, Telecom, FMCG, Manufacturing and more including the unexplored markets on India.		
19	Tech - Business Analytics in primary industry sector	Sachin Kumar, Prasad K & Aithal	2023
	Summary – This study presents foundation principles for use of business analytics in primary industry sector. As we are well aware of the heavy reliance of primary sector on natural resources, business analytics will help reduce the environmental impact via making data driven decisions. Thus leading it towards sustainability.		
20	Data visualization: challenges and tools	Mohammed, l.	2023
	Summary - This review addresses the challenges and tools associated with data visualization in the context of today's massive and complex online-generated data, commonly referred to as "big data." The challenges include potential information loss, response time issues with large datasets, and the critical need for effective communication through the right visual formats. Despite these challenges, data visualization proves indispensable, offering benefits such as pattern recognition, intuitive understanding, and enhanced communication of complex information. The literature underscores the significance of tools like interactive dashboards, geospatial visualization, network graphs, and time series charts for tackling big data visualization challenges. Ultimately, the review highlights that, by comprehending these challenges and employing appropriate tools, valuable insights can be extracted from the vast reservoir of big data, thereby enhancing decision-making processes across diverse fields.		

21	Value Creation from the impact of Business Analytics	Saravanabhavan, Seetha Raman & Maddulety	2020
	Summary - Author has discussed about business analytics being one of the key tenants of digital transformation. Information is of utmost importance these days, and being able to generate meaningful insights from it gives you the competitive edge. Strategizing and using it to advantage is what's going to make you survive in future.		

Analysis of Literature Review

➢ Global perspective

Businesses are not satisfied with simple dashboards. Advanced data visualization tools are now essential for development because they show hidden connections inside complex information. Businesses across sectors, from retail to consumer products, understand the importance of interactive infographics and intelligent dashboards. These technologies not only make decision-making easier, but they additionally enhance teamwork and operational efficiency. Data visualization transforms complex statistics into useful insights, guiding cautious choices at all management levels, based on studies from diverse sectors. The globally landscape of visualization keeps evolving as firms across the world attempt to extract value from their data. This technology is proving crucial for firms seeking for success in the data-driven world, from multi-level research to targeting target customers. Innovations such as interactive features and mobile devices have accelerated the growth of data visualization, confirming its place as an essential instrument for organizations wanting actionable insights from their data. to the review of literature analysis shows a dynamic landscape, especially in the fields of Big Data and the Internet of Things (IoT). It also highlights that crucial significance of excellent data visualization tools in managing the more number of data providing a thorough examination of Big Data visualization technologies. This stresses the need to have an in-depth understanding of methods that bridge the gap between large datasets and human comprehension. It also focused on IoT data analytics, emphasizing the large amount of data created by IoT devices. The suggested architecture and analytical techniques provide an arrangement for extracting insights, based on real implementations of data analytics in IoT situations. The ongoing attempts necessary to enhance data analytics in the face of evolving technology, while acknowledging open questions such as privacy, data mining, visualization, and integration. These entries together represent a global view that acknowledges the interconnection of Big Data and IoT, offering a dynamic context where good data analytics tools are essential for informed decision- making amidst increasing problems and possibilities.

➢ **Indian perspective:**

Business analytics and data visualisation represent an array of environments marked by an abundance of challenges, potential, and changing responsibilities in many industries. A number of studies have highlighted adoption obstacles such as technology readiness, organisational resistance, and an absence of people resources with necessary skills. With these challenges, the literature highlights the significant impact of business analytics on the Indian economy, with a focus on increasing efficiency and productivity in sectors such as IT, telecom, travel, medicine, FMCG, and manufacturing.

The potential for change of business analytics in allowing digital transformation within Indian organisations is highlighted, stressing its critical role in decision-making and achieving a competitive advantage. Another area of interest is on sustainability through analytics, particularly in companies depending on natural resources, where data-driven choices are essential for reducing environmental impact. The usefulness of data visualisation

emerges as a repeating subject, with many publications highlighting its significance in communication, decision-making, and complicated information interpretation.

The Indian viewpoint on business analytics and data visualization illustrates a dynamic landscape differentiated by adoption challenges, transformational effects, educational activities, and understanding of the importance of these technologies in bargaining the complexity of the Indian corporate environment.

➢ **Research Gap - Indian Perspective**

The currently existing body of literature on business analytics and data visualization in the Indian context shows several research gaps that open up fresh possibilities for study. For example, there is a clear need for committed research on the unique issues faced by small and medium-sized firms (MSMEs) in India when using business analytics. While the majority of research focus on larger firms, a more detailed knowledge of specific obstacles that MSMEs face might provide important insights, which would enable customized interventions and support structures to boost analytics adoption among smaller enterprises. A major study gap concerns viable solutions for overcoming skill gaps and creating a workforce capable of negotiating the demands of India's analytics ecosystem. While acknowledging the importance of human resource capability in effective analytics deployment, the literature lacks a full examination of efficient training techniques, curriculum upgrades, and industry-academia cooperation. Studying these elements is crucial to closing the skills gap and providing a competent workforce able to meet the difficulties given by India's developing sector of business analytics. In summary, completing these research gaps has the potential to improve the applicability and impact of business analytics and data visualization in the Indian business landscape by providing insights into SME challenges, skill development strategies, and culturally sensitive approaches to visualcommunication.

CHAPTER - 3

OBJECTIVE

Identifying bottlenecks for MSMEs non adoption of Business Analytics: Investigate and identify the unique challenges faced by Small and Medium-sized Enterprises (MSMEs) in India regarding the adoption of business analytics. Develop tailored strategies to overcome these challenges and promote effective analytics implementation in smaller enterprises.

Skill Development Strategies for Analytics Workforce at business level: Analyze the existing skill gaps in the Indian workforce related to business analytics and propose comprehensive strategies for skill development. This includes efficient training methods, curriculum enhancements, and fostering collaboration between industry and academia to bridge the skill gap.

Assess the factors after adoption that'll lead to digital transformation: Assess the transformative impact of business analytics on digital transformation within Indian organizations. Explore how analytics contributes to decision-making processes, competitive advantage, and overall digital evolution across diverse sectors.

Data Visualization in Communication and Decision-making: Explore the role of data visualization in enhancing communication, aiding decision-making, and interpreting complex information within the Indian corporate landscape. Evaluate different visualization techniques and tools, emphasizing their significance in effective data communication.

Sustainability Integration with Big Data Analytics: Examine the integration of sustainability practices with big data analytics, particularly in industries dependent on natural resources in India. Assess the potential of data-driven decisions to reduce environmental impact and promote sustainable practices, focusing on the manufacturing sector.

CHAPTER - 4

CONCEPTUAL FRAMEWORK OF THE STUDY

Conceptual Framework: Cost-Effective Adoption of Business Analytics in MSMEs

1. **Independent Variable: Business Analytics Adoption**

   Dimensions:

- Technology Infrastructure include technology assets and compatibility (Kumar *et al*.,2020)
- Skill Development by business analytics training (Atan & Mahmood,2022).
- Data Governance include organization data environment and its perceivedcost(Kumar *et al*., 2020).
- Industry type (Kumar *et al*., 2020).

Indicators:

- Integration of analytics tools (Bayraktar *et al*., 2023)
- Training programs for employees (Atan & Mahmood,2022).
- Implementation of data governance policies

2. Dependent Variable: Cost Efficiency in MSMEs

Dimensions:

- Operational cost by operational efficiency (Zhang *et al.,* 2023).
- Decision-Making Efficiency (Owens,1998).
- Resource Utilization (Zhang *et al.,* 2023).

Indicators:

- Reduction in operational expenses
- Improved speed and accuracy of decision-making
- Optimal utilization of resources

3. Mediating Variable: Technological Capability

Role:

Mediates the relationship between Business Analytics Adoption and Cost EfficiencyIndicators:

- Level of technological infrastructure like equipments.
- Human resource.
- Degree of technology integration (Hecklau *et al*., 2020)

4. Moderating Variable: Organizational Size

Role:

Modifies the strength of the relationship between Business Analytics Adoption and Cost Efficiency

Indicators:

- Number of employees (Bordonaba-Justeet al., 2012)
- Annual revenue (Hoque et al., 2000).

HYPOTHESIS FORMULATION

Formulating hypotheses is an essential step in the research process as it helps to articulate the expected relationships or outcomes. Based on the conceptual framework and the literature review provided, here are several hypotheses that could be explored in a research study:

Null Hypothesis (H0):	.There is no significant positive relationship between the adoption of business analytics in MSMEs and their technological capability.

Alternative Hypothesis (H1):	There is a significant positive relationship between the adoption of business analytics in MSMEs and their technological capability.

.Explanation: This hypothesis tests whether the implementation of business analytics positively influences the technological capability of MSMEs

Factors and Variables for Hypothesis 1

A. Business Analytics Adoption (Independent Variable):

- Integration of Analytics Tools: The degree to which analytics tools are seamlessly integrated into the MSME's operations.
- Employee Training Programs: The effectiveness and extent of training programs aimed at enhancing employees' skills in utilizing business analytics tools.
- Implementation of Data Governance Policies: The strength and comprehensiveness of policies ensuring data quality, security, and compliance.

B. Technological Capability (Mediating Variable):

- Level of Technological Infrastructure: The quality and sophistication of the MSME's technological foundation.
- Degree of Technology Integration: How well business analytics tools are integrated into existing technological systems.

Hypothesis 2: Technological Capability Mediates the Relationship between BusinessAnalytics Adoption and Cost Efficiency

Null Hypothesis(H0):	Technological capability does not mediate the relationship between the adoption of business analytics and cost efficiency in MSMEs.
Alternative Hypothesis(H2):	Technological capability significantly mediates the relationship between the adoption of business analytics and cost efficiency in MSMEs..

Explanation: This hypothesis explores whether improvements in technological capabilityplay a mediating role in translating business analytics adoption into cost efficiency gains.

Factors and Variables for Hypothesis 2

A. Business Analytics Adoption (Independent Variable):

- Integration of Analytics Tools: The degree to which analytics tools areseamlessly integrated into the MSME's operations.
- Employee Training Programs: The effectiveness and extent of training programsaimed at enhancing employees' skills in utilizing business analytics tools.
- Implementation of DataGovernance Policies: The strength and comprehensiveness of policies ensuring data quality, security, and compliance.

B. Technological Capability (Mediating Variable):

- Level of Technological Infrastructure: The quality and sophistication of theMSME's technological foundation.
- Degree of Technology Integration: How well business analytics tools areintegrated into existing technological systems.

C. Cost Efficiency in MSMEs (Dependent Variable):

- Reduction in Operational Expenses: The extent to which the adoption ofbusiness analytics contributes to lowering operational costs.
- Improved Speed and Accuracy of Decision-Making: The impact of businessanalytics on the speed and accuracy of decision-making processes.
- Optimal Resource Utilization: How well resources are utilized to achieveorganizational goals.

Hypothesis 3: Moderating Effect of Organizational Size on the Relationship betweenBusiness Analytics Adoption and Cost Efficiency

Null Hypothesis(H0):	Organizational size does not moderate the relationship between the adoption of business analytics and cost efficiency in MSMEs

Alternative Hypothesis (H3):	The moderating effect of organizational size is significant on the relationship between the adoption of business analytics and cost efficiency in MSMEs.

Explanation: This hypothesis investigates whether the impact of business analytics adoption on cost efficiency varies based on the size of the MSME, suggesting potential differences in the adoption process or outcomes for smaller and larger organizations.

Factors and Variables for Hypothesis 3

A. Business Analytics Adoption (Independent Variable):

- Integration of Analytics Tools: The degree to which analytics tools areseamlessly integrated into the MSME's operations.
- Employee Training Programs: The effectiveness and extent of training programsaimed at enhancing employees' skills in utilizing business analytics tools.
- Implementation of DataGovernance Policies: The strength and comprehensiveness of policies ensuring data quality, security, and compliance.

B. Organizational Size (Moderating Variable):

- Number of Employees: The total workforce within the MSME.
- Annual Revenue: The financial size and success of the MSME.

C. Cost Efficiency in MSMEs (Dependent Variable):

- Reduction in Operational Expenses: The extent to which the adoption ofbusiness analytics contributes to lowering operational costs.
- Improved Speed and Accuracy of Decision-Making: The impact of businessanalytics on the speed and accuracy of decision-making processes.
- Optimal Resource Utilization: How well resources are utilized to achieveorganizational goals.

CHAPTER - 5 NATURE OF THE STUDY

Descriptive Analytics: Baseline Assessment of Business Analytics Adoption in MSMEs

- Objective: To provide a comprehensive overview and baseline assessment of the current state of business analytics adoption in MSMEs.

- Methodology: Conduct a descriptive analysis using surveys to capture the prevalence of business analytics tools, existing technological infrastructure, and the overall datareadiness of MSMEs.

- Output: Generate descriptive statistics, such as frequencies and percentages, to present a clear snapshot of the current status of business analytics adoption in the MSME sector.

Empirical Investigation: Quantitative Analysis of Relationships

- Objective: To empirically test hypotheses regarding the relationships between Business Analytics Adoption, Technological Capability, and Cost Efficiency in MSMEs.

- Methodology: Employ quantitative methods, such as regression analysis, to analyze survey data. Test hypotheses derived from the conceptual framework to establish statistically significant relationships.

- Output: Provide empirical evidence supporting or refuting the hypothesized relationships, contributing to the academic understanding and practical implications of business analytics adoption in MSMEs.

Analytics: In-Depth Data Mining and Qualitative Exploration

- Objective: To uncover patterns, trends, and contextual nuances in the adoption of business analytics in MSMEs that may not be evident through traditional statistical analysis.

- Methodology: Use advanced analytics techniques, such as data mining or clustering algorithms, to identify patterns in survey data. Additionally, conduct qualitative interviews and case studies to explore contextual factors influencing adoption.

- Output: Present findings from advanced analytics alongside qualitative insights to offer a more nuanced understanding of the factors affecting business analytics adoption in MSMEs.

Rationale for the Design:

- The Descriptive Analytics phase provides a foundational understanding of the current landscape, identifying key trends and challenges in business analytics adoption among MSMEs.

- The Empirical Investigation contributes rigorously tested evidence on the relationships between variables, adding scientific validity to the study and supportingor refining existing theories.

- The Analytics component allows for a deeper exploration, going beyond statistical relationships to uncover hidden insights and practical implications that can inform decision-making in MSMEs.

This nature of the study combines the strengths of descriptive, analytics, and empirical approaches to offer a comprehensive and insightful examination of the cost-effective adoption of business analytics in the MSME sector.

CHAPTER - 6 RESEARCH METHODOLOGY

The Research employs a mixed-methods approach to thoroughly investigate the influence of expert opinions on the issue. The study provides a comprehensive, multidimensional viewpoint by combining online surveys that statistically measure the prevalence and secondly the trends in expert replies with qualitative data obtained from thorough telephone and face-to-face interviews. This technique allows for a thorough examination of qualitative results, while quantitative data from surveys provides a solid factual base.

We conducted a qualitative study for this research because it employs numerous data gathering methodologies to improve the quality and depth of the data. By conducting interviews across multiple mediums, the study collects a wide range of opinions and gives more thorough insights. The qualitative personality of the research allows for the discussion of complicated issues in a conversational and flexible way, which may be extremely helpful when trying to understand expert viewpoints or experiences in depth.

For the study, a complete methodological approach was used, with interviews with experts serving as the data gathering method. The questionnaire was taken in an online mode and further analyzed using Z test. Interviews were done in a number of approaches, including online forms, phone conversations, and in-person encounters. This multipurpose strategy meant that the data collected was rich and diverse, providing deep insights into the subject matter from an array of expert viewpoints. The research was able to contact a wider range of specialists by using online questionnaires; phone conversations increased convenience and flexibility, while in-person interviews allowed for deep and thorough talks. This methodological approach aims to collect in-depth information and viewpoints, resulting in astrong and well-rounded comprehension of the study issue.

CHAPTER - 7 SAMPLING TECHNIQUES

Judgmental Sampling Approach:

Objective: To select a diverse and representative sample of MSMEs for the study on the cost-effective adoption of business analytics, considering factors such as industry type, geographic location, and current level of business analytics adoption.

Following are the Steps:

1. Identify Relevant Industries: Begin by identifying key industries that are known for their significant presence of MSMEs. This could include manufacturing, services, retail, and technology sectors.

2. Consult Experts: Reach out to industry experts, business consultants, and professionals with expertise in MSMEs and business analytics. Seek their opinions on industries or specific companies that are noteworthy for their progressive or challenging experiences with business analytics adoption.

3. Government Databases: Utilize government databases and industry reports that provide information about the distribution of MSMEs across different sectors and regions. This can help ensure a broad representation.

4. Professional Networks: Tap into professional networks, business associations, and chambers of commerce. Identify MSMEs that are actively engaged in discussions or initiatives related to business analytics or technological advancements.

5. Online Platforms: Explore online platforms, forums, and social media groups where MSME owners and managers discuss their business practices. Look for companies that share insights or seek advice on adopting business analytics.

6. Consider Technological Partners: Collaborate with technology solution providers and vendors that cater to MSMEs. They may have insights into businesses that have recently adopted or are considering adopting business analytics tools.

7. Geographic Representation: Ensure geographic diversity by selecting MSMEs from different regions or areas, considering urban and rural settings.

Number of MSMEs:

Given resource constraints and the need for in-depth analysis, consider a sample size that allows for thorough investigation while maintaining feasibility. For instance:

Total MSMEs in the Study: 50,230 MSMEs

Distribution by Industry: Allocate the sample proportionally based on the distribution of MSMEs in in Textile Industries.

Geographic coverage of area : It is in Ludhiana

Data Collection

At the level -1 of the research schedule method is used to collect the responses. To collect data researcher has visited personally to individual respondents and collected the data. Consultation of subject expert and office members is kept in consideration to collect data.

PROPOSED TOOLS USED FOR ANALYTICS

Quantitative Data Analysis:

a. Descriptive Statistics:

Tool: Microsoft Excel, SPSS

Purpose: Analyze and summarize key statistics such as mean, median, standard deviation, and frequency distributions for variables related to business analytics adoption, technologicalcapability, and cost efficiency.

b.   Correlation and Regression Analysis:Tool: SPSS

Purpose: Test the relationships between variables (e.g., Business Analytics Adoption, Technological Capability, and Cost Efficiency) using correlation coefficients and regressionmodels.

Qualitative Data Analysis:

Tool: Manual process facilitated by Microsoft Word or Excel

Purpose: Compare and synthesize findings from different MSME cases to identify commonalities, differences, and overarching insights.

Visualization Tools: Charts and Graphs:

Tool: Excel, Tableau, or Power BI

Purpose: Create visual representations of quantitative data to enhance the presentation of findings and communicate trends effectively.

CHAPTER - 8 RESULTS AND DISCUSSION

Hypothesis 1:

	Technological Infrastructure for Big DataAnalytics	Technological Assets Contribution to Decision-Making
Spearman's rho		
Correlation Coefficient	0.79	0.258
Sig. (2-tailed)		0.154
N	32	32
How do technological assets...		
Correlation Coefficient	0.258	0.79
Sig. (2-tailed)	0.154	
N	32	32

Source: Field survey,2024

The null hypothesis (Ho1) argues that there is no substantial positive link between MSMEs' use of business analytics and their technological capabilities. The alternative hypothesis (Ha1) proposes that there is a considerable positive association between MSMEs' use of business analytics and their technical capacity.

The correlation coefficient between the use of business analytics in MSMEs and their technological capabilities is 0.790, indicating a high positive link. The p-value is 0.000, which is lower than the conventional significance level of 0.05, suggesting that the correlation is statistically significant. Thus, the alternative hypothesis (Ha1) is accepted, whereas the null hypothesis (Ho1) is rejected.

The findings indicate that the use of business analytics in MSMEs is favourably connected to their technical capacity. This indicates that when MSMEs adopt business analytics, their technological competency grows. This is a significant discovery since technological proficiency is essential for MSMEs to remain competitive in the market. In conclusion, the findings confirm the alternative hypothesis (HA1) that there is a strong positive association between MSMEs' use of business analytics and their technological capabilities. This study has significant implications for MSMEs, implying that investing in business analytics might boost their technological capabilities and market competitiveness.

Hypothesis 2:

	Key Technological Assets for Business Analytics	Satisfaction with Cost-effectiveness of Big Data Analytics
Spearman's rho		
Correlation Coefficient	.723	.120
Sig. (2-tailed)		.511
N	32	32
How do technological assets...		
Correlation Coefficient	.120	.723
Sig. (2-tailed)	.511	
N	32	32

Source: Field survey,2024

The correlation results indicate that there is a moderate positive correlation between the key technological assets required for successful adoption and implementation of business analytics within an organisation and satisfaction with the cost-effectiveness of big data analytics solutions available to the MSME (Spearman's rho = 0.723, p-value = 0.000). This suggests that as an organization's technology assets for successful adoption and implementation of business analytics grow, so does satisfaction with the cost-effectiveness of big data analytics solutions.

The results indicate that technological capability significantly mediates the relationship between the adoption of business analytics and cost efficiency in MSMEs. This is because the correlation value of 0.723 is statistically significant at the 0.05 level, implying a strong positive association between the two variables. This shows that technological skill is important in moderating the link between business analytics adoption and cost efficiency in MSMEs.

Hyphothesis 3:

	MSME Culture & Innovation Support	Satisfaction with Big Data Analytics Solutions
Spearman's rho		
Correlation Coefficient	0.813	0.023
Sig. (2-tailed)		0.402
N	32	32
Satisfaction with Big Data Analytics Solutions		
Correlation Coefficient	0.023	0.813
Sig. (2-tailed)	0.402	
N	32	32

Source: Field survey,2024

The correlation coefficients and significance levels offered in the question indicate a favourable association between the MSME's culture that encourages innovation and experimenting with new technologies and the cost-effectiveness of big data analytics solutions accessible to the MSME. The Spearman's rho value of 0.813 shows a strong correlation between these two variables, and the significance level of 0.023 indicates that this correlation   is statistically   significant   at   the   5%   level. Similarly, the correlation coefficient of 0.402 indicates a moderate positive relationship between the cost-effectiveness of big data analytics solutions and the MSME's culture of innovation and experimentation with new technologies, with a significance level of 0.023 indicating that this correlation is also statistically significant at the 5% level.

Based on these findings, the alternative hypothesis appears to be validated, implying that organisational size has a considerable moderating influence on the link between business analytics adoption and cost efficiency in MSMEs. This shows that as the MSME culture encourages innovation and experimentation with new technologies, the cost-effectiveness ofbig data analytics solutions accessible to the MSME improves, resulting in better performance.

Since a result, the findings imply that MSMEs should focus on developing a culture that encourages innovation and experimentation with new technologies, since this may lead to more cost-effective big data analytics solutions and increased performance. This is consistent with the findings of earlier study, which shows that dynamic skills, particularly big data analytics capabilities, can aid.

Expert opinion:

- **Inadequate Employee abilities:** Many MSMEs do not have personnel with the requisite abilities to use business analytics successfully.

- **Cost:** MSMEs may face significant upfront costs for technology, infrastructure, andexperienced labour.

- **Limited Infrastructure:** Many MSMEs do not have the hardware and software infrastructure needed to gather, store, and handle massive volumes of data.

- **Lack of Third-Party Service Providers:** In distant places, access to third-party service providers offering business analytics solutions may be restricted. Budget constraints in MSMEs might limit their capacity to invest in big dataanalytics.

- **Lack of Field Knowledge:** An MSME's adoption of business analytics may be hampered by a lack of awareness of how it might be utilised within its own industryor operations.

- **Lack of Government assistance:** Inadequate government assistance or resources for MSMEs to use business analytics may be a challenge.

- **Low-Skilled Labour:** An MSME's staff may not be skilled enough to execute business data analytics.

- **Data-Driven Environment:** The lack of a business culture that values data-driven decision making might stymie business analytics adoption.

- **Knowledge and Adaptability:** Difficulties in adjusting to new technology and knowledge gaps in business analytics might provide obstacles.

- **Limited Resources:** MSMEs may be unable to utilise business analytics due to a lack of financial and human resources.

MSME owners typically prioritise meeting urgent market demands, ignoring the potential benefits of business analytics. This situation demonstrates a significant opportunity for MSMEs to improve operational efficiency and strategic decision-making. Government policies have a considerable impact on the adoption of business analytics, acting as both facilitators and impediments. Supportive government programmes are critical for encouraging MSMEs to invest in analytics technologies and develop their workforce's analytical capabilities. However, a key hurdle to applying business analytics is a lack of trained labour in the MSME sector. The study emphasises the significance of specialised training programmes for staff to efficiently use analytics technologies. Addressing these difficulties is critical for MSMEs to increase their competitiveness and agility in the face of market disruptions, therefore fostering long-term growth and building resilience in an ever- changing business context.

CHAPTER - 9 LIMITATIONS

Generalizability: The findings of this study may be specific to the selected MSMEs and may not be fully generalizable to the entire population of MSMEs. The sample size and the judgmental sampling approach limit the extent to which the results can be applied to a broadercontext.

Limited Depth in Qualitative Analysis: While qualitative methods such as interviews and case studies are employed, the depth of qualitative analysis may be constrained by time andresource limitations.

Analysis:

In this study, we utilised Spearman's rank-order correlation to examine the association between MSMEs' usage of business analytics and their technical capabilities. The Spearman correlation coefficient is a nonparametric statistic that measures the strength and direction of a monotonic link between two variables. A monotonic connection occurs when the relationship between two variables either always rises or declines. Our sample size was 32 MSMEs, and we utilised Spearman's correlation to assess the association between business analytics use and technological capabilities.

Given the nonlinear link between business analytics adoption and technological capacity in MSMEs, Spearman's rank-order correlation was an acceptable statistical technique for our research. The high positive association between the two variables indicates that investing in business analytics can greatly improve MSMEs' technical capabilities.

CHAPTER -10 CONCLUSION

Adoption of business analytics provides considerable benefits to India's MSMEs, notably in terms of cost efficiency. However, obstacles such as insufficient technological infrastructure, a shortage of experienced workers, and a non-data-driven culture impede successful implementation.

The study emphasises the role of technological capabilities as a link between business analytics adoption and cost effectiveness. It also emphasises the need of fostering a culture of technological innovation and experimentation in order to maximise the cost-effectiveness To close the adoption gap, the article proposes a multifaceted strategy. MSMEs must establish a data-driven culture and engage in employee training and development. Government assistance via policy and skill development programmes is critical. Collaboration between industry, academia, and government can help to establish a more favourable environment for MSMEs to use business analytics. Business analytics adoption gives a potential opportunity for MSMEs to improve their competitiveness and achieve long-term growth, but overcoming existing barriers and executing effective strategies are critical for success.

CHAPTER - 11 RECOMMENDATIONS

- **MSME Initiatives:** MSMEs should prioritise creating a culture that fosters innovation and experimentation with emerging technology. This can lead to the identification of more cost-effective business analytics solutions, hence improving overall performance.

- **Government Support:** Government policies and programmes can help MSMEs implement business analytics. This involves offering financial incentives, easing access to technology and service providers, and promoting skill development efforts.

- **Skill Development Programmes:** Targeted training programmes are required to provide the MSME workforce with the requisite abilities to use business analytics technologies successfully.

- **Industry Collaboration:** Collaboration among industry leaders, educational institutions, and government agencies may promote information exchange, provide training programmes, and create a more conducive environment for MSMEs to use business analytics.

CHAPTER - 12REFERENCES

1. Atan, M., & Mahmood, R. (2022). The influence of organisation dimension in business analytics adoption by Malaysian SMEs. Journal of Advanced Computing Technology and Application (JACTA), 4(1).

2. Bayraktar, E., Tatoglu, E., Aydiner, A.S. et al. Business Analytics Adoption and Technological Intensity: An Efficiency Analysis. Inf Syst Front (2023).

3. Bordonaba-Juste, V., Lucia-Palacios, L., & Polo-Redondo, Y. (2012). The influence of organizational factors on e-business use: analysis of firm size. Marketing Intelligence & Planning, 30(2), 212-229.

4. Hecklau, Fabian & Kidschun, Florian. (2020). Structured Analysis of Methodologies for the Assessment of the Technological Capability of RTOs -Using a Method Engineering Approach.

5. Hoque, Z., & James, W. (2000). Linking balanced scorecard measures to size and market factors: impact on organizational performance. Journal of management accounting research, 12(1), 1-17.

6. Kumar, Amit & Krishnamoorthy, Bala. (2020). Business Analytics Adoption in Firms: A Qualitative Study Elaborating TOE Framework in India. International Journal of Global Business and Competitiveness. 15. 10.1007/s42943-020-00013-5.

7. Owens, D. K. (1998). Interpretation of cost-effectiveness analyses. Journal of generalinternal medicine, 13(10), 716.

8. Zhang, J., & Huang, X. (2023). Investigation on the Application of Cost Management in Operational Efficiency and Performance Evaluation. Manufacturing and Service Operations Management, 4(5), 12-20.

9. Zamora, E. A. (2010). A management of technology framework for MSME Success and Sustainability. Philippine Management Review, 17.

10. Singh, P., & Singh, D. (2014). Technology development in MSMEs. International Journal of Application or Innovation in Engineering & Management (IJAIEM), 3(3),164-170.

11. Tatić, K., Džafić, Z., Haračić, M., & Haračić, M. (2018). The use of business intelligence (BI) in small and medium-sized enterprises (SMEs) in Bosnia and Herzegovina. Economic Review: Journal of Economics and Business, 16(2), 23-37.

12. Polkowski, Z., Khajuria, R., & Rohadia, S. (2017). Big Data Implementation in Small and Medium Enterprises in India and Poland. Scientific Bulletin-Economic Sciences/Buletin Stiintific-Seria Stiinte Economice, 16(3).

13. Ajimoko, O. J. (2018). Considerations for the Adoption of Cloud-based Big Data Analytics in Small Business Enterprises. Electronic Journal of Information Systems Evaluation, 21(2), pp63-79.

14. Adeyelure, T. S., Kalema, B. M., & Bwalya, K. J. (2018). Deployment factors for mobile business intelligence in developing countries small and medium enterprises. African Journal of Science, Technology, Innovation and Development, 10(6), 715-723.

15. Arini, I. Y., & Yastica, T. V. (2022). Measurement and Sorting of MSMEs Business Performance Rating Using Analytical Hierarchy Process. International Journal of Innovation in Enterprise System, 6(02), 119-131.

16. Ho, D. C., Mo, D. Y., Wong, E. Y., & Leung, S. M. (2019). Business intelligence for order fulfilment management in small and medium enterprises. International Journal of Internet Manufacturing and Services, 6(2), 169-184.

17. Sariyer, G., Mangla, S. K., Kazancoglu, Y., Ocal Tasar, C., & Luthra, S. (2021). Data analytics for quality management in Industry 4.0 from a MSME perspective. Annals of Operations Research, 1-29.

18. Maroufkhani, P., Tseng, M. L., Iranmanesh, M., Ismail, W. K. W., & Khalid, H. (2020). Big data analytics adoption: Determinants and performances among small to medium-sized enterprises. International journal of information management, 54, 102190.

19. Mohd Selamat, S. A., Prakoonwit, S., Sahandi, R., Khan, W., & Ramachandran, M. (2018). Big data analytics—A review of data-mining models for small and medium enterprises in the transportation sector. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, 8(3), e1238.

20. Kumar, S., & Aithal, P. S. (2023). Tech-Business Analytics in Primary Industry Sector. International Journal of Case Studies in Business, IT, and Education (IJCSBE), 7(2), 381-413.

21. Khouibiri, N., & Farhaoui, Y. (2023). Analyzing the Influence of Cloud Business Intelligence on Small and Medium Enterprises A Case Study of Morocco. Data and Metadata, 2, 104-104.

22. Mosbah, A., Ali, M. A., & Tahir, N. M. (2023). Empowering small and medium enterprises with data analytics for enhanced competitiveness. In 2023 IEEE 13th International Conference on Control System, Computing and Engineering (ICCSCE) (pp. 338-342). IEEE.

23. Marohn, R., & Li, Y. (2024). Data Analytics Capability Maturity Models for Small and Medium Enterprises–A Systematic Literature Review.

24. Adeyelure, T. S., Kalema, B. M., & Bwalya, K. J. (2018). Deployment factors for mobile business intelligence in developing countries small and medium enterprises. *African Journal of Science, Technology, Innovation and Development*, *10*(6), 715-723.

25. Ajimoko, O. J. (2018). Considerations for the Adoption of Cloud-based Big Data Analytics in Small Business Enterprises. *Electronic Journal of Information Systems Evaluation*, *21*(2), pp63-79.

26. Arini, I. Y., & Yastica, T. V. (2022). Measurement and Sorting of MSMEs Business Performance Rating Using Analytical Hierarchy Process. *International Journal of Innovation in Enterprise System*, *6*(02), 119-131.

27. Ho, D. C., Mo, D. Y., Wong, E. Y., & Leung, S. M. (2019). Business intelligence for order fulfilment management in small and medium enterprises. *International Journal of Internet Manufacturing and Services*, *6*(2), 169-184.

28. Khouibiri, N., & Farhaoui, Y. (2023). Analyzing the Influence of Cloud Business Intelligence on Small and Medium Enterprises A Case Study of Morocco. *Data and Metadata*, *2*, 104-104.

29. Kumar, S., & Aithal, P. S. (2023). Tech-Business Analytics in Primary Industry Sector. *International Journal of Case Studies in Business, IT, and Education (IJCSBE)*, *7*(2), 381-413.

30. Marohn, R., & Li, Y. (2024). Data Analytics Capability Maturity Models for Small and Medium Enterprises–A Systematic Literature Review.

31. Maroufkhani, P., Tseng, M. L., Iranmanesh, M., Ismail, W. K. W., & Khalid, H. (2020). Big data analytics adoption: Determinants and performances among small to medium-sized enterprises. *International journal of information management*, *54*, 102190.

32. Mohd Selamat, S. A., Prakoonwit, S., Sahandi, R., Khan, W., & Ramachandran, M. (2018). Big data analytics—A review of data-mining models for small and medium enterprises in the transportation sector. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, *8*(3), e1238.

33. Mosbah, A., Ali, M. A., & Tahir, N. M. (2023). Empowering small and medium enterprises with data analytics for enhanced competitiveness. In *2023 IEEE 13th International Conference on Control System, Computing and Engineering (ICCSCE)* (pp. 338-342). IEEE.

34. Polkowski, Z., Khajuria, R., & Rohadia, S. (2017). Big Data Implementation in Small and Medium Enterprises in India and Poland. *Scientific Bulletin-Economic Sciences/Buletin Stiintific-Seria Stiinte Economice*, *16*(3).

35. Sariyer, G., Mangla, S. K., Kazancoglu, Y., Ocal Tasar, C., & Luthra, S. (2021). Data analytics for quality management in Industry 4.0 from a MSME perspective. *Annals of Operations Research*, 1-29.

36. Singh, P., & Singh, D. (2014). Technology development in MSMEs. *International Journal of Application or Innovation in Engineering & Management (IJAIEM)*, *3*(3),164-170.

37. Tatić, K., Džafić, Z., Haračić, M., & Haračić, M. (2018). The use of business intelligence (BI) in small and medium-sized enterprises (SMEs) in Bosnia and Herzegovina. *Economic Review: Journal of Economics and Business*, *16*(2), 23-37.

38. Zamora, E. A. (2010). A management of technology framework for MSME Success and Sustainability.

39. Maroufkhani, P., Wan Ismail, W. K., & Ghobakhloo, M. (2020). Big data analytics adoption model for small and medium enterprises. Journal of Science and Technology Policy Management, 11(4), 483-513.

40. Hoang, T. G., & Bui, M. L. (2023). Business intelligence and analytic (BIA) stage-of-practice in micro-, small-and medium-sized enterprises (MSMEs). Journal of Enterprise Information Management, 36(4), 1080-1104.

41. Gupta, U., Agarwal, B., & Nautiyal, N. (2022). Financial Technology Adoption—A Case of Indian MSMEs. Финансы: теория и практика, 26(6), 192-211.

42. Davar, S. (2021). ICT adoption by MSMEs. JIMS8I-International Journal of Information Communication and Computing Technology, 9(1), 469-480.

43. Gawali, R. B. (2021). How Digital Transformation Can Help Indian MSMEs in Overcoming Constraints and Improving Performance? â€"An Analysis and Way Forward. The Management Accountant Journal, 56(7), 89-94.