EMPLOYABILITY OF DATA ANALYTICS TOOLS AND TECHNIQUES IN BOOSTING THE COMPETITIVENESS OF SMALL AND MEDIUM ENTERPRISES (SMEs)

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ABSTRACT

In today's competitive environment, Small and Medium-sized Enterprises (SMEs) are increasingly adopting business data analytics to glean insights and make informed decisions. However, the essence of big data extends beyond volume to include the analysis process and resulting insights crucial for effective decision-making by managers. Yet, there's a gap in understanding SMEs' utilization of data analytics and its potential for informed decision-making. This paper aims to clarify the concept of business data analytics for SMEs and delineate the necessary prerequisites for its successful implementation, enabling SMEs to leverage analytics for competitiveness. It suggests that a robust data analytics system for SMEs should encompass four key elements: data, people, technology, and processes. The impact of data analytics on competitiveness is influenced by factors such as data quality, well-defined objectives, the quality of analytical tools, and the availability of analytical skills. Data yields insights that foster knowledge, leading to wisdom. However, due to resource constraints, SMEs may be less inclined to engage in advanced predictive and prescriptive analytics compared to larger firms.

INTRODUCTION

In recent decades, the rapid expansion of technological resources has become crucial for enhancing the competitiveness of Small and Medium-sized Enterprises (SMEs). Despite SMEs being slower to adopt new technologies compared to larger firms, the utilization of data-related technologies enables them to collect and analyze data to support their daily business activities. One such technology is business data analytics, which is increasingly being embraced by companies. In the era of Industry 4.0, data has emerged as a vital organizational resource, even for SMEs, who now accumulate large volumes of data that can sometimes pose challenges. Particularly in the manufacturing sectors, Industry 4.0 has initiated a dynamic evolutionary process for SMEs. Thom et al. provided a learning factory training approach for SMEs to autonomously tap into Industry 4.0, with key roles assigned to managers.

Business analytics offers numerous organizational-level benefits, including agility, innovation, and competitive performance. By leveraging data analytics and intelligence, SMEs can enhance

their business decisions, identify problems or issues, assess market trends, and uncover new opportunities.

In today's competitive market, effective information processing alone is not sufficient. Managers need to recognize the strategic business value of data analytics, which forms the basis for a firm's competitive advantage. Without utilizing data analytics, SME managers often rely solely on their experience to make decisions, which carries a high risk of failure. Various factors may hinder SMEs from adopting data analytics and gaining valuable insights, with resource constraints, particularly financial and human resources, being a prominent characteristic of SMEs. Llave reported that research on Business Analytics has predominantly focused on large enterprises, while the existing literature has limited insights into how data analytics impacts the competitive performance of SMEs. Dong and Yang argued that a comprehensive understanding of whether and how data analytics creates value for businesses is yet to be fully comprehended and requires large-scale empirical validation. Mikalef et al. emphasized the need to examine the development of capabilities over time with new technologies and identify the obstacles encountered during this process. These gaps have prompted Bharati and Chaudhury to call for more research on SME information systems and their competitive environment outside the US.

Addressing these limitations, this paper aims to explore the role of business data analytics in SME competitiveness. It seeks to explain the concept of business data analytics in the context of SMEs and provide insights into how SMEs can effectively leverage data analytics to enhance their competitiveness. This paper contributes in two ways: first, by shedding light on SMEs' utilization of data analytics and contributing to the knowledge base of corporate data analytics and competitiveness; second, by assisting SME managers in understanding the benefits and requirements of data analytics for informed decision-making

UNDERSTANDING BUSINESS DATA ANALYTICS

Business analytics, as defined by Prat, encompasses a collection of systems, techniques, and technologies utilized to analyze data, enabling enterprises to gain a deeper understanding of their business and market dynamics. This field amalgamates principles from business management and computing to generate actionable insights. Figure 1 delineates four distinct types of business data analytics: descriptive, diagnostic, predictive, and prescriptive. These categories are delineated by two key factors: the level of analytical sophistication and the proactive/reactive nature of decision-making.

In essence, descriptive and diagnostic analytics concentrate on analyzing historical data, while predictive and prescriptive analytics utilize existing data and trends to forecast future trends and guide decision-making processes, respectively. However, SMEs are less likely compared to larger

firms to employ predictive and prescriptive analytics in their operations. The business analytics process encompasses five key stages:

• Data Sourcing

• Data Engineering & Analysis

• Situation Awareness

• Decision Making

• Decision Support

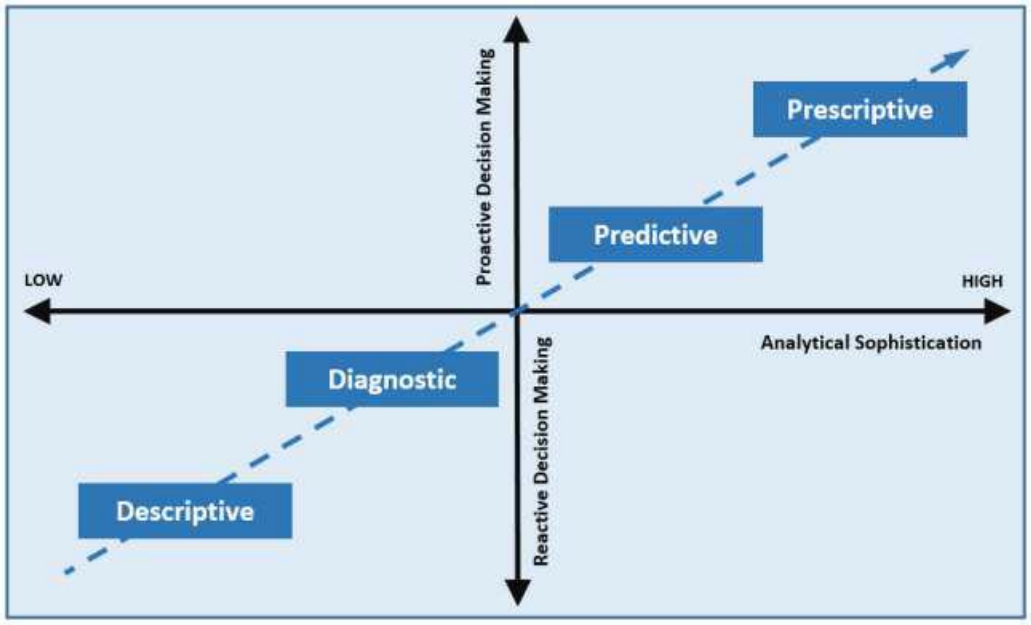

Figure 1: Types of business analytics [10].

Business data analytics involves analyzing data to generate actionable insights that aid managers in making informed business decisions. Within the realm of business intelligence, there are several other subsets or domains, including competitive intelligence, environmental intelligence, customer intelligence, and market intelligence.

HARNESSING DATA ANALYTICS FOR SME COMPETITIVENESS

Recognised by scholars and industry experts, a company's competitiveness stems from its distinctive advantages and capabilities, which are deeply rooted in its resources. Extensive

literature supports this perspective. Barney's seminal work, as cited in [12], delved into a firm's strategic resources, emphasising that a company gains competitive edges when it implements a value-generating strategy that stands out among competitors, making it arduous for others to replicate the benefits. Barney further introduced the VRIO framework, asserting that resources can yield sustainable competitive advantages only if they possess four key attributes: Value, Rarity, Imitability, and Organization.

The discussed data analytics system acts as a central nexus, enabling interaction among resources like personnel, data, and technology. Moreover, the insights derived from the system represent invaluable resources. Given SMEs' typical resource constraints, the following sections will elucidate how SMEs can procure a data analytics system that aligns with their resources and effectively leverage it to bolster competitiveness.

A. Data Analytics System for SMEs

For managers to make informed decisions based on data, a business data analytics system must integrate four essential elements: data, personnel, technology, and processes. The interaction among these elements is illustrated in Figure 2. These four elements represent inputs to the system, while the output consists of the information or insights derived from the analytics process.

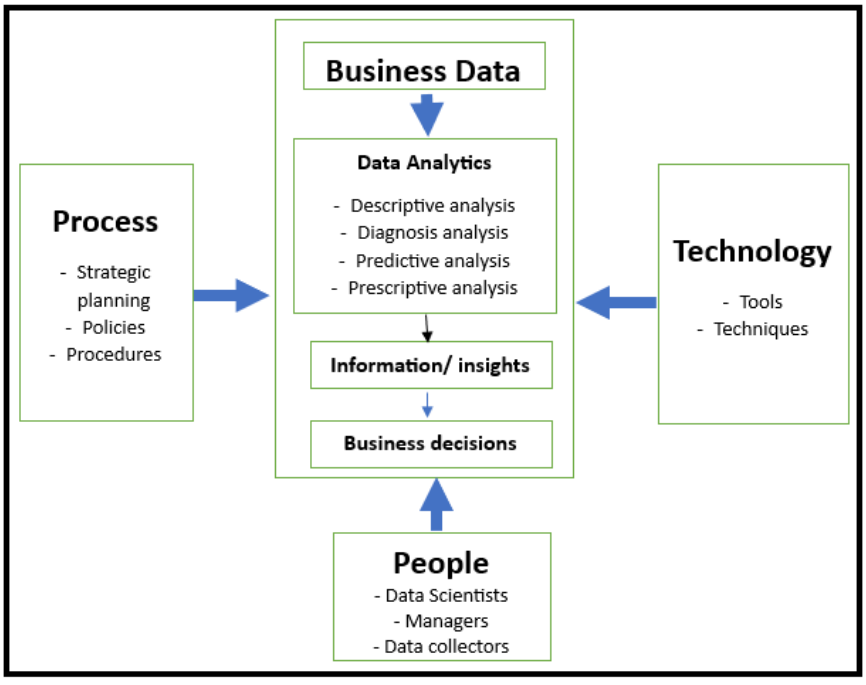

Figure 2: SMEs business data analytics system

The "process" element encompasses strategic planning, including vision, objectives, strategies, and the policies and procedures required to govern data management activities such as data collection, storage, analysis, and utilisation for decision-making purposes. Data analytics encompasses many tools and software programs, with commonly accessible options including Microsoft Excel, SPSS, MATLAB, R, and Python. Goundar et al. [25] provide a more extensive list of tools companies utilise in their data analysis processes. However, it's crucial to note that while some tools are fundamental to the analytics system, others may need to be more affordable for SMEs. These tools support various techniques broadly categorised into statistical and mathematical methods, visualisation techniques, and machine learning and artificial intelligence techniques.

Therefore, SME managers are strongly advised to pay attention to the significance of these tools and techniques. They should prioritise establishing proper strategic planning, developing effective policies, and implementing suitable organisational changes. Many SMEs may need more resources and expertise to acquire these elements despite governmental support. Wee et al. [13] proposed a six-step or three-stage process, namely novice, cross-functional, and organisation-wide, for SMEs to build their data analytics system. Since SMEs are unlikely to establish the entire system overnight, they should gradually adopt elements and components of the system, starting somewhere and scaling it up over time. Another approach could involve identifying and utilising free solutions and weighing the trade-off between cost and efficiency when adopting additional tools.

Regarding skills, SMEs can leverage Massive Open Online Courses (MOOCs) to enhance the business knowledge of their current IT staff. Additionally, SMEs should seek networking opportunities and cooperation with governmental agencies, universities, and specialised research institutes. Active engagement with these measures will compensate for the lack of resources, enabling SMEs to efficiently utilise big data analytics for better business decision-making.

B. Proposed Framework to Enhance SME Competitiveness through Data Analytics

It is widely acknowledged that data serves as the foundation for generating insights, which, in turn, contribute to knowledge and wisdom. Therefore, the focus should not solely be on the data but its analytics. In other words, it's not the type, size, or variety of data that holds significance but how individuals within the organisation utilise it and derive valuable insights. Hence, the quality of analytics becomes crucial and is primarily influenced by four factors: data quality, clarity of objectives, types/quality of analytic tools and techniques, and analytical skills.

To ensure that data analytics positively contributes to firm competitiveness through informed decisions, several measures are recommended. Firstly, firms must recognise that the benefits of

data analytics can only be realised when attention is directed towards factors that amplify business value while simultaneously addressing any obstacles that hinder the business value of analytics. This necessitates a supportive work culture and an effective decision-making system. The objectives and expectations of top management must align with the capacity of the analytics system. Secondly, financial resources necessary for the utilisation of data analytics should be ensured by the firm's management to at least enable the acquisition of essential tools that cannot be obtained for free. Thirdly, fostering innovation through a trial-and-error approach among data scientists is encouraged. This approach may involve a degree of error tolerance, leading to additional costs and project delays, particularly in the early stages. As highlighted by Mikalef et al. [1], to derive value from big data, firms need to develop the organisational capacity to identify areas within their business that can benefit from data-driven insights, strategically plan and execute data analytics projects, and assemble the necessary resources to transform data into actionable insights. SMEs can enhance their dynamic capabilities through learning mechanisms such as social media analytics and competitive intelligence processes, which involve planning, collecting, analysing, and disseminating information.

CONCLUSION

In conclusion, this paper aims to enhance understanding of how SMEs can leverage business data analytics to improve their competitiveness. SMEs are typically characterized by limited resources compared to larger firms. The paper provides an explanation of the concept of business data analytics and its application in SMEs' business settings. It emphasizes the importance of leveraging analytics on various types of data to enhance competitiveness, considering that competitors may include large firms or multinational companies. Customer data, in particular, is highlighted as crucial since customers play a central role in business objectives and actions. However, the focus should not solely be on the size of the data but on how it is analyzed and the insights derived from it to enable informed decision-making.

While the potential of business data analytics for SMEs is significant, its impact on competitiveness depends on factors such as data quality, clarity of objectives, types/quality of analytic tools, and analytical skills. Limited resources often restrict SMEs from performing advanced analytics, such as predictive and prescriptive types. To effectively leverage data analytics for competitiveness, several actions are crucial for SMEs. First, top management support is needed to align objectives and expectations with the system's capacity, provide financial resources for acquiring necessary tools and applications, and encourage innovation. Second, areas and stakeholders within the firm that can benefit from data-driven insights must be identified. Third, data analytics projects should be strategically planned and executed with sufficient resources to transform data into actionable insights. Fourth, learning mechanisms such as social

media analytics and competitive intelligence should be employed to enable continuous improvement.

One limitation of this paper is the absence of empirical data. Conducting qualitative studies through interviews with SME managers and data scientists could provide valuable insights into the underlying mechanisms and relationships between data analytics and SME competitiveness. Future work includes adopting this approach to gain firsthand insights into the process of turning data into valuable information for informed decision-making, as well as the challenges and issues encountered along the way. Qualitative studies have proven useful in generating valuable research findings, particularly in new research domains or topics with limited existing knowledge.

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