Big Data and Performance: The Mediating Effect of Customer Agility

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Abstract: This study investigates the impact of big data analytics capabilities on firm performance, with a focus on the mediating role of customer agility. The research is based on the dynamic capabilities theory and utilizes data from 123 senior managers. The study finds that customer sensing and customer responding mediate the relationship between big data analytics capabilities and firm performance. The results indicate a significant indirect effect of big data analytics capabilities on firm performance through customer sensing and customer responding. The study contributes to the understanding of the mechanisms underlying the impact of big data analytics and customer agility on firm performance.

Keywords: Big data analytics capabilities, Dynamic capabilities, Customer agility, Sense and respond, Firm performance

1. Introduction

In the field of knowledge management, big data analytics has emerged as a critical tool for firms seeking to improve their performance and gain a competitive advantage in the data-driven business world. Leveraging advanced analytics techniques and tools, firms can gain insights into consumer behavior, market trends, and other critical business variables, thereby enhancing their decision-making and operational efficiency (Akter et al. 2016; Chen, Chiang, and Storey 2012; Hajli et al. 2020; Mikalef et al. 2018; Popovič et al. 2018; Raguseo and Vitari 2018).

Despite existing empirical studies supporting a positive association between big data investments and firm performance (e.g. Müller et al. 2018; Wamba et al. 2017), there is a lack of empirical research investigating the mechanisms that underlie this relationship (Suoniemi *et al.*, 2020; De Luca *et al.*, 2021). One such mechanism that may mediate the relationship between big data analytics and firm performance is customer agility, which is defined as the ability of firms to respond to customer changes rapidly and effectively in the business environment (Hajli et al., 2020; Kalaignanam et al., 2021; Roberts and Grover, 2012; Tseng, Aghaali, and Hajli, 2022; Zhou et al., 2018). However, there is a dearth of research on the role of customer agility in the relationship between big data analytics and firm performance.

Therefore, this study aims to contribute to the literature on big data analytics and firm performance by investigating the effect of big data analytics on firm performance and the mediating role of customer sensing and customer responding, the two dimensions of customer agility. Specifically, we propose research Hypothesis 1 (H1):

> *H1: Customer sensing and customer responding serially mediate the relationship between big data analytics capabilities and firm performance.*

To test this hypothesis, we collect data from a sample of firms that have invested in big data analytics and use structural equation modeling techniques to analyze the data and test our hypotheses.

Our findings are expected to provide insights into the mechanisms that underlie the impact of big data analytics and customer agility on firm performance, thus contributing to the knowledge management literature. Moreover, our study has practical implications for firms seeking to leverage big data analytics to enhance their performance and become more agile in responding to changing market conditions.

2. Literature Review

2.1 Dynamic Capabilities

Dynamic capabilities are based on the resource-based theory of the firm, which posits that a firm's resources and capabilities are the primary determinants of its competitive advantage (Teece, 2007). Dynamic capabilities are thus the firm's ability to develop, integrate, and reconfigure its resources and capabilities in response to changes in the business environment, which allows it to gain and maintain a competitive advantage over its rivals. Teece (2007) argues that dynamic capabilities are essential for firms to succeed in the rapidly changing business environment, and they can be developed through a combination of internal and external factors, such as managerial expertise, organizational culture, and industry structure. The theory suggests that firms with stronger dynamic capabilities are more likely to adapt to changes in the business environment, and thus, achieve better firm performance compared to firms with weaker dynamic capabilities.

2.2 Big Data Analytics Capabilities

Big data analytics capabilities refer to a firm's ability to acquire, store, process, and analyse large amounts of data in various forms, and deliver information to users that allows organisations to extract value from big data in a timely fashion (Kung et al., 2015). This includes big data analytics management, technology, and talent capabilities. Management capabilities involve cultural support for big data initiatives. Technology capabilities encompass databases, data warehousing, middleware, and analytics tools. Talent capabilities involve data scientists who can find patterns in data and transform it into useful insight. These capabilities enable firms to manage, store, and exploit multi-structured data for data-driven decision making (Akter *et al.*, 2016). Big data analytics capabilities can be considered dynamic capabilities because they involve a set of processes and resources that enable firms to continuously sense and reconfigure to adapt to their business environment.

2.3 Agility

Organizational agility and customer agility are two important concepts that have gained significant attention in recent years in marketing and management research (Amit & Zott, 2015; Helfat & Peteraf, 2015).

Organizational agility refers to the ability of an organization to quickly and effectively respond to changes in the market, competition, or other external factors. It involves the ability to rapidly adapt to changes in technology, competition, customer needs, and regulatory requirements. Organizational agility is closely related to concepts such as flexibility, adaptability, and responsiveness (Teece, 2014).

On the other hand, customer agility is bidimensional and refers to the ability of a business to sense and respond to the changing needs and preferences of its customers (Roberts and Grover, 2012; Hajli *et al.*, 2020; Haider and Kayani, 2021). Customer sensing involves developing a deep understanding of customer needs, preferences, and behaviors, and using this knowledge to anticipate changes in customer demand. Customer responding involves the ability to quickly and effectively respond to changes in customer needs and preferences, and deliver personalized products, services, and experiences.

2.4 Firm Performance

Firm performance is a widely researched topic in the field of management and organizational studies. The concept of firm performance is multidimensional, and it encompasses a range of factors, such as customer satisfaction, market effectiveness and profitability (Suoniemi *et al.*, 2020). Research suggests that there are numerous factors that can impact firm performance, including organizational culture, leadership, strategy, human resources, and technology. The literature also indicates that there is a positive relationship between firm performance and various external factors, such as the business environment, market conditions, and government policies (Wilden and Gudergan, 2015; Moorman and Day, 2016; Mikalef *et al.*, 2018). Overall, the literature on firm performance highlights the importance of effective management practices, strategic decision-making, and adaptation to changing conditions for achieving sustained success and competitive advantage.

3. Method

To conduct our study, we utilized a field study methodology and administered online questionnaires to senior managers from various industries worldwide. Previous studies on big data analytics have also employed a multi-industry approach (Suoniemi *et al.*, 2020). Following Huber and Power's (1985) recommendations for obtaining high-quality data from key informants, we selected executives with expertise in big data, marketing, technology, or customer relationship management to serve as key informants. This approach is commonly used in studies of market-oriented behavior (Olson, Slater and Hult, 2005). To minimize the risk of common method variance, we separated questionnaire questions and items and established methodological separation of measurements (Podsakoff et al., 2003). The questionnaire for this study was developed based on mainstream literature and adapted to fit the context of big data analytics. All measurement items were taken from existing literature and were customized to ensure clarity for managers. Content validity was established through the review of an experienced data analyst and a marketing academic, and reliability was assessed using Cronbach's alpha, with all measures exceeding the recommended threshold of 0.70.

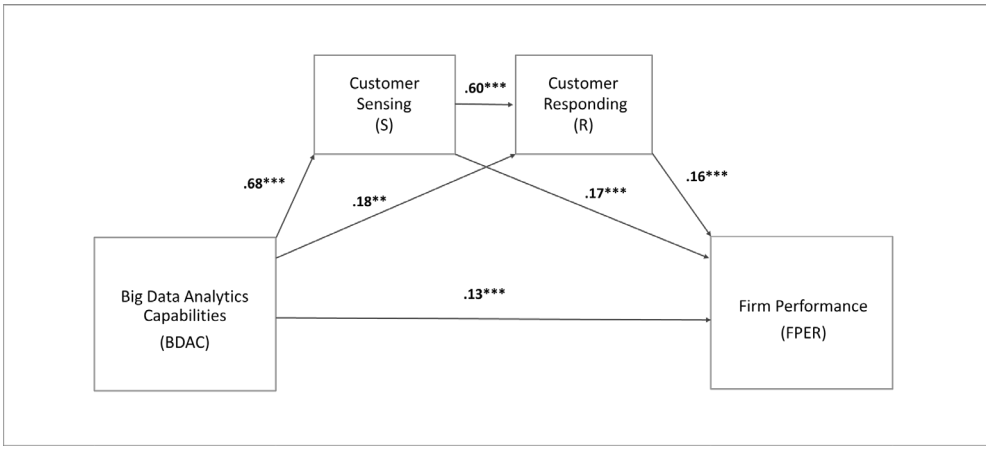
4. Data

Data collection occurred between April 2022 and December 2022, where 300 professionals who used analytics daily and were members of the ‘marketing’, ‘data’, and ‘sales professionals’ groups were invited to participate in the study. Out of the 150 targeted professionals who agreed to participate, 124 questionnaires were

considered valid for further analysis, resulting in a response rate of 41.3%. 74% of respondents were based in Europe, while 24% were in MENA region, and 2% were in America. The majority of respondents were in middle management positions, with 48% of them in firms with 250 employees or more. To test the model, a serial mediation regression analysis using the PROCESS Macro by Hayes (2017) was conducted.

5. Result

Given the sophistication and ease of processing of the Macro PROCESS developed by Hayes (2017) and the frequency of its use by researchers publishing in leading management journals, we used this tool to test our model. We conducted a serial mediation regression analysis with big data analytics as independent variable, customer sensing and customer responding as the mediators and firm performance as the dependent variable (PROCESS Model 6; Hayes 2017; see Figure 1). We applied the PROCESS Macro by Hayes (2017) to estimate all the constructs simultaneously.



*Note: **p* < 0.01; **** p* < 0.001.

Figure 1: Structural Model

The study assessed the serial mediation with customer sensing and customer responding serially mediating the relationship between big data analytics capabilities and firm performance. The results revealed a significant indirect effect of big data analytics capabilities on firm performance through customer sensing and customer responding (b = 0.068, t = 2,563), supporting H1. furthermore, the direct effect of big data analytics on firm performance in presence of the mediators was also found significant (b = 0.137, p < 0.001). Hence, there is partial serial mediation of sensing and responding on the relationship between big data analytics capabilities and firm performance. The results of the mediation analysis show that big data analytics have a significant positive effect on firm performance, and this effect is partially mediated by the two mediators, customer sensing and customer responding. Specifically, the indirect effects of big data analytics on firm performance through sensing, responding, and sensing and responding were all significant. These findings suggest that companies should focus not only on enhancing their big data analytics capabilities but also on improving customer sensing and responding to improve their performance. Mediation summary is presented in Table 1.

Table 1: Mediation Analysis Summary

Total Effect (BDAC -> FPER)	Direct Effect (BDAC -> FPER)	Relationship	Indirect Effect	Confidence Interval		T-statistics	Conclusion
				Lower Bound	Upper Bound		
0.356 (0.000)	0.137 (.001)	H1: BDAC -> S -> R -> FPER	0.068	0.019	0.125	2.563	Partial Mediation

Note : t-statistics is calculated by dividing Indirect effect by SE 0.0687/0.0268.

6. Discussion

Comparing our results with previous studies, we find that our findings corroborate the notion that agility plays a vital role in enhancing firm performance (Roberts and Grover, 2012; Piccoli and Ives, 2014; Hajli et al., 2020; Haider and Kayani, 2021; Kalaignanam et al., 2021). Specifically, our study demonstrates that customer sensing and customer responding sequentially mediate the relationship between big data analytics capabilities and firm performance.

6.1 Implications

The findings of this study have significant implications for management and offer valuable insights for practitioners seeking to enhance firm performance and adapt to dynamic market conditions. Firstly, organizations should focus on developing strong customer sensing capabilities. By investing in strategies and tools that enable effective gathering and analysis of customer data, firms can identify evolving customer needs, preferences, and market trends. This information can inform decision-making and facilitate the development of tailored offerings, leading to improved customer satisfaction and performance outcomes. Secondly, fostering customer responding capabilities is crucial. Organizations should create an environment that encourages responsiveness to customer feedback and enables agile decision-making. Promptly addressing customer needs and preferences can enhance customer satisfaction and loyalty, contributing to improved firm performance. Thirdly, the study underscores the importance of embracing big data and adopting a holistic approach that integrates big data analytics, customer sensing, customer responding, and firm performance. Organizations should align data-driven insights with customer-centric practices to achieve competitive advantage and superior performance outcomes. Finally, organizational factors should be considered. Achieving customer agility and fully capitalizing on big data analytics capabilities require careful planning and integration. Organizational culture, leadership support, technology infrastructure, and talent development should be prioritized to create an environment conducive to leveraging the identified mechanisms effectively.

6.2 Limitations and Future Research

Despite the research design being customized to address the research objectives and prioritize crucial elements, there are still certain limitations in this study that offer prospects for future research. First, our research relies on self-reported data collected through online questionnaires. This method introduces the possibility of common method variance and social desirability bias. Although we took measures to mitigate these concerns, such as ensuring methodological separation of measurements, there is still a potential for bias. Future studies could consider employing alternative data collection methods or using objective performance measures to enhance the robustness of the findings. Second, our study focuses on the mediating role of customer agility in the relationship between big data analytics and firm performance. However, there may be additional factors and mechanisms that could influence this relationship. Exploring other potential mediators and moderators could provide a more comprehensive understanding of the underlying dynamics.

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