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Exploring a nexus between big data analytical capabilities and the supply chain performance of firm in big Four ASEAN countries: The Mediating Role of Environmental Dynamism

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Abstract

This study aims to examine the relationship between big data analytical capabilities and supply chain performance in the four largest ASEAN nations, as well as the role of environmental dynamics in determining this relationship. Using a quantitative research design, the investigation collects data from a number of local companies. The findings suggest that big data analytical skills have a favorable impact on supply chain effectiveness. The environment's changing nature appears to impair this link. According to the study, environmental dynamism also acts as a mediator between big data analytical capabilities and supply chain effectiveness. It is crucial to comprehend and respond to the external environment while employing big data analytics to improve supply chain performance. The findings have ramifications for regional managers and legislators, highlighting the significance of investing in big data analytics and executing an external environment-adaptive approach in order to improve supply chain performance. This study contributes to our understanding of the relationship between big data analytical capabilities and supply chain performance in the four most populous ASEAN nations by highlighting the importance of environmental dynamics as a crucial component of this relationship. In addition, this research contributes to our comprehension of the relationship between big data analytical capabilities and supply chain effectiveness in the four largest ASEAN nations. In conclusion, the findings indicate that firms can boost supply chain efficiency by adopting a strategic approach to exploiting big data analytics while also taking into account the external environment.

Keywords: Big data, analytical capabilities, supply chain performance, Environmental Dynamism

BACKGROUND

Big data can be referred to as 3Vs, i.e. high variety, high velocity, and high volume. Big data is large-scale data with moving and streaming content in text, videos, and numerical form. It is an information asset for an organization, which offers an innovative and cost-effective form of information processing to draw useful insights for effective decision-making related to organizational matters (Ali & Ahmed,2022). It has a greater ability to deal with huge amounts of data and adopting powerful analytical approaches to these datasets, which has increased the popularity of big data analytics. Firms become able to acquire big data and implement powerful analytical approaches to

make complex decisions that were previously done on intuition or human judgment. Through the use of BDA, organizations become able to gather a variety of complex data and apply useful analytical approaches. Decisions can be made based on facts and figures rather than intuition or human judgment (Al-Khatib,2022). Irrespective of the popularity and usefulness of big data, it has been revealed by recent reports of industry that CIOs (chief information officers) and executive officers are reluctant for making investments in BDA. Firms experience the use of BDA by other firms indirectly or even directly but still do not make major investments in it (Al-Khatib,2023). It is questioned by some business executives and CIOs that BDA is just a repackaging of conventional business intelligence and processes of data mining. However, BDA possesses new capabilities that can offer competitive advantages to firms. It is important to determine and understand the difference between big data analytics from traditional approaches of business intelligence for helping practitioners solving the concerns of CIOs and business executives.

As per the International Data Corporation Report 2011, the volume of data that is available across the globe in 2005 has been increasing at a rate of 50 percent every year. By 2015, it was expected to increase by 8000 exabytes. Most of the data is in the unstructured form, such as news feed, video clips, web content, posts on social media, and other forms of data, which cannot be combined into recurring fields (Bag et al.,). Therefore, big data is a term for acquiring datasets with complexity and velocity. These datasets cannot be captured using traditional data processing approaches. BDA is a far different approach from conventional business intelligence tools (Benzidia et al.,2023). It offers different ideas to different people based on their needs and requirements. Businesses can draw data or information related to their concerns and requirements through the use of big data analytics. Thus, it can offer different opportunities to different organizations. Significant advancements in BDA technologies are encouraged by the opportunities linked with data analysis. The critical business data can be analyzed for supporting businesses in making timely decisions with the market dynamics (Del Giudice et al.,). The business-centric practices and methodologies are embraced by BDA, which can be applied to different applications with high-impact, including market intelligence, e-commerce, e-government, security, and healthcare (Dubey et al.,2019). The BDA evolution is at the initial stages of development. It has been suggested by literature that the concept of BDA varies for different organizations based on the organizational capabilities of managing data set in different business aspects.

The use of BDA has been conceptualized as a crucial capability of an organization, which can help in creating cutting-edge capabilities and knowledge for complying with the dynamic nature of the business environment (Ferraris et al.,2019). The theory of dynamic capabilities is a helpful insight for understanding the potential influences of BDA. The mission and vision of a firm are supported by SCP (supply chain performance) through improving tactics, efficient strategy, and effective operational decision making. It is essential to analyze SCP for solving the challenges and issues before they create an influence on overall organizational operations. Organizations are supported by SCPM to reduce the gap in demand and supply and provide guidance for achieving competitive advantage and excellence in the supply chain (Fosso Wamba & Akter,2019).

SCPM supports an organization in developing strong BDA capabilities and improving supply chain performance (Jha et al.,2020). Proactive decision-making can be supported, and future performance can be predicted through a good BDDSC performance evaluation system (Kache & Seuring,2017). The managerial behavior can

be stimulated along with improvement in organizational performance through SCP measurement. The level to which individual and organizational performance is influenced by SCPM is based on a performance management system adopted and implemented by an organization (Mikalef et al.,2020).

LITERATURE REVIEW

Use of Big Data Analytics and Supply Chain Performance

SC was conventionally referred to as the domain of research in operations management. Recently, SCM has attained considerable attention from the scholars of information systems, as it can be conceptualized as a digitally supported inter-firm process (Nisar et al.,2022). It has been demonstrated by literature that a focal firm becomes able to integrate the information, material, and flow of finances across its partners in the supply chain by IT-based SCM systems for improving organizational outcomes (Rashid & Rasheed,2022). It is contended that a useful insight for determining the utilization of BDA is offered by the SCM domain.

Organizations can receive enormous information through BDA, which helps in real-time tracking of different parameters of performance (Rialti et al.,2019). Service and manufacturing organizations need to alter their processes continuously through the use of suitable measures for improving performance (Sanders, 2016). It is suggested by literature that traditional supply chain evaluation based on previous information, still, and isolated are not efficient in providing relevant information to make decisions (Sheng et al.,). It was proposed by Singh & El-Kassar (2019) that three main components are included in a BDDSCC performance measurement framework, which includes BDA capability, performance planning, and performance monitoring. Some other new measures for determining performance capabilities were found to have an association with BDA performance measurement as well.

The current research is based on BDA tools rather than SCM systems, which can be adopted in the processing of information and data generated by different SCM systems. The previous IS literature has categorized SCM systems as relational or transactional systems. The transactional systems include online bidding; purchase ordering systems and relational systems include CRM and private B2B exchange, etc (Wamba et al.,2020). These relational and transactional information systems are not produced but processed by the performance impacts of BDA. This has not been empirically investigated. Within a supply chain, significant amounts of tactical, strategic, and operational information across various stages are shared in routine. Thus, there is a need for businesses to understand the relational and transactional information acquired from SCM systems to achieve success (Yasmin et al.2020). It is suggested that the capability of converting data into useful insights and trends with BDA can help in influencing the performance of the supply chain (Zhu et al.,2022). Based on the previous IT management studies, the value influence of using BDA on business processes has been assessed. BDA is defined as the level of BDA to develop business insights across the supply chain activities, including input sourcing, purchasing, manufacturing, distribution, and end-customer services. It has been asserted based on the dynamic capabilities' perspective that the use of BDA is instrumental in achieving competitive advantage by an organization (Sharma et al.,2020). This research study has particularly examined the impact of big data analytics on the supply chain performance by incorporating two important dimensions, i.e. growth of business and asset productivity.

Role of Environmental Dynamism as a Moderator

An important situational parameter is an environmental dynamism in the dynamic capabilities theory. This suggests that the difference is the competitive advantage provided by the capability of an organization is based on the dynamism of the environment (Ahmed et al.,2022). The idea of the unpredictability of outcomes of dynamic capabilities in highly volatile markets is adopted by some previous research studies. It was asserted by Mohammad (2019) that predictable and linear paths are generally adopted by firms in moderately dynamic markets. These markets are classified by the stability of industry structures and defined boundaries of the market. The use of existing knowledge determines the effective dynamic capabilities in an environment with moderate dynamics. Alternatively, high-velocity markets are less predictable and nonlinear. The volatile industry structure characterizes such markets, i.e. unclear and dynamic players and boundaries of the market (Yu et al.,2022). Irrespective of the assessment related to the volatile nature of dynamism of an environment on organizational performance, it has been posited in this research that a greater opportunity is provided by such an environment on critical competencies of the firm. Such an environment can lead to an increase or failure of organizational competencies. Thus, firms can improve their core competencies by capitalizing on BDA. It has been shown by previous research studies that a dynamic environment can destroy or enhance the critical competencies of a firm (Zhang & Zhu,). It has been contended that the use of BDA impacting the supply chain performance will be improved in the case of markets with high-velocity. This argument is based on the idea that dissemination of knowledge can result in improved variation in outcomes of the performance in a dynamic environment. Great pressure is levied by environmental dynamism on firms to leverage organizational knowledge in taking actions and decision making (Aryal et al.,2020). In a dynamic market environment, situations must be rapidly and effectively evaluated for execution for important decision-making. Greater stress can be imposed by a high-velocity marketplace on cognitive demands and hindering their abilities for implementing imperative ideas and understand situations.

The confidence of important decision-makers of an organization can be reduced by a turbulent environment while making decisions related to operations and strategy formulation (Asamoahet al.,). Thus, BDA becomes an important need for businesses on decision making in a turbulent environment. Moreover, dynamic capabilities are not much dependent on current knowledge and more dependent on the creation of new knowledge specific to circumstances. It gives an additional potential influence created by big data analytics. It is suggested by the above discussion that BDA use is most salient when the environment has high dynamics, as it can increase the ability of an organization to explore new insight or knowledge (Fatorachian & Kazemi,). It is related to the SCM practices where large volume of data is collected from various sources at different times, i.e. operating process data, data of shipments, demand data, inventory records, and transactional data, etc.

For making decisions in a market with dynamism, such data should be integrated, processed, analyzed, and interpreted in an effective manner. The generation of insights is supported through BDA in a faster and effective way within supply chain activities, including product run optimization, planning, and forecasting, and logistics improvement (Singh & El-Kassar, 2019). These offer cost savings and opportunities to grow to the firm. It is indicated by previous research studies that a sense of confidence is provided by new

insights and knowledge in a market with high velocity, which supports managers in dealing with emotional hurdles while dealing with risks and uncertainties. Therefore, managerial confidence is improved by BDA in such circumstances (Sanders,2016). Moreover, managers are allowed by new knowledge specific to the estuation for understanding the dynamic circumstances and adapting to it. To investigate the theoretical association between the use of BDA and supply chain performance under different levels of dynamism of the environment, the following research hypothesis has been developed:

Hypothesis1: BDAC is associated with CSRP.
Hypothesis2: BDAC is associated with END.
Hypothesis3: END is mediating between BDAC and CSRP.

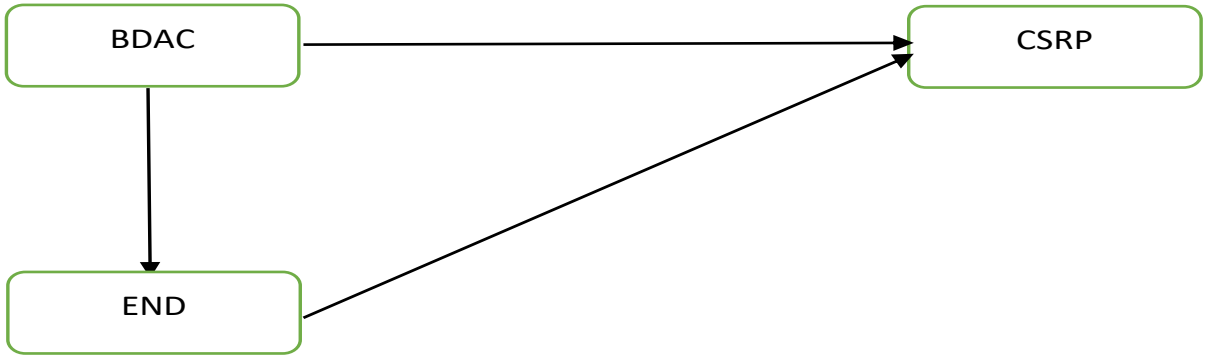

Figure 1.
Conceptual Framework

METHODOLOGY

This study explored the nexus between big data analytical capabilities and the supply chain performance of firms in the Big Four ASEAN countries, with the mediating role of environmental dynamism. A quantitative, cross-sectional research design was used for this study. The target population was the Big Four ASEAN countries, namely Indonesia, Malaysia, the Philippines, and Thailand. Purposive sampling techniques were used to select the sample, and a structured questionnaire was distributed to supply chain managers in firms operating in these countries. A survey instrument was used to measure the variables of the study. The instrument was developed based on previous literature and underwent a pilot test to ensure its reliability and validity. The questionnaire consisted of four sections: (1) Big data analytical capabilities, (2) Environmental dynamism, (3) Supply chain performance, and (4) Demographic information. The data were analyzed using SEM-PLS. The PLS algorithm was used to analyze the relationships between the latent variables and observed variables in the model. The mediating effect of environmental dynamism on the relationship between big data analytical capabilities and supply chain performance was examined.

RESULTS

The program Sem-pls was utilized to conduct the study's analysis; this is a two-step procedure including both the measurement model and the structural model.

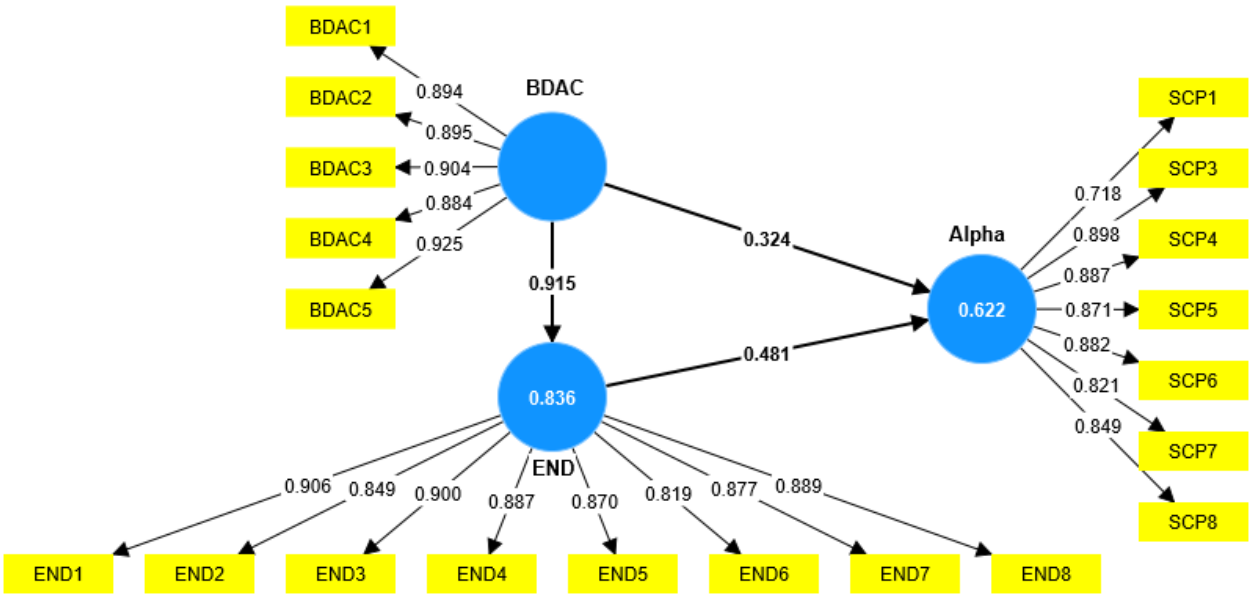

Figure 2.
Measurement Model

When employing the method of partial least squares to conduct structural equation modeling, "outer loadings" refer to the regression coefficients that indicate the relationships between the observable variables and the latent variables (PLS-SEM).

Table 1.
Outer Loading

	Alpha	BDAC	END
BDAC1		0.221	
BDAC2		0.220	
BDAC3		0.219	
BDAC4		0.215	
BDAC5		0.235	
END1			0.148
END2			0.133
END3			0.145
END4			0.142
END5			0.139
END6			0.137
END7			0.146
END8			0.151
SCP1	0.218		
SCP3	0.165		
SCP4	0.164		
SCP5	0.162		
SCP6	0.168		
SCP7	0.152		

SCP8	0.160		

Reliability analysis assesses the consistency and stability of a Partial Least Squares (PLS) Structural Equation Model (SEM) to draw meaningful conclusions about the data (Hair et al.,2022). The measurement model, which encodes latent-observable relationships, has a substantial impact on the quality and outcomes of PLS-SEM models. Composite Reliability (CR) and Average Variance Extracted are used to measure PLS-SEM dependability (AVE). When CR, the mean square of factor loadings for a latent variable, is near to 1, reliability is high. (Shrestha,). AVE computes the contribution of latent factors to observable variance.

Table 2.

Reliability Analysis

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Alpha	0.934	0.938	0.947	0.720
BDAC	0.942	0.943	0.955	0.811
END	0.956	0.957	0.963	0.766

Table 3 shows the study's discriminant validity.

Table 3.

Discriminant validity

	Alpha	BDAC	END
Alpha	0.848		
BDAC	0.764	0.901	
END	0.777	0.915	0.875

Discrimination validity ensures unrelated variables are unrelated. Fornell and Larker analysis was used (Ronkko & Cho,). As bold loadings are bigger than others, Table 3 shows that all constructs have good discriminant validity. Data are valid and trustworthy based on convergent, reliability, and discriminant validity tables.

Structural Model:

The structural model validated the computed hypothesis. Each variable is latent.

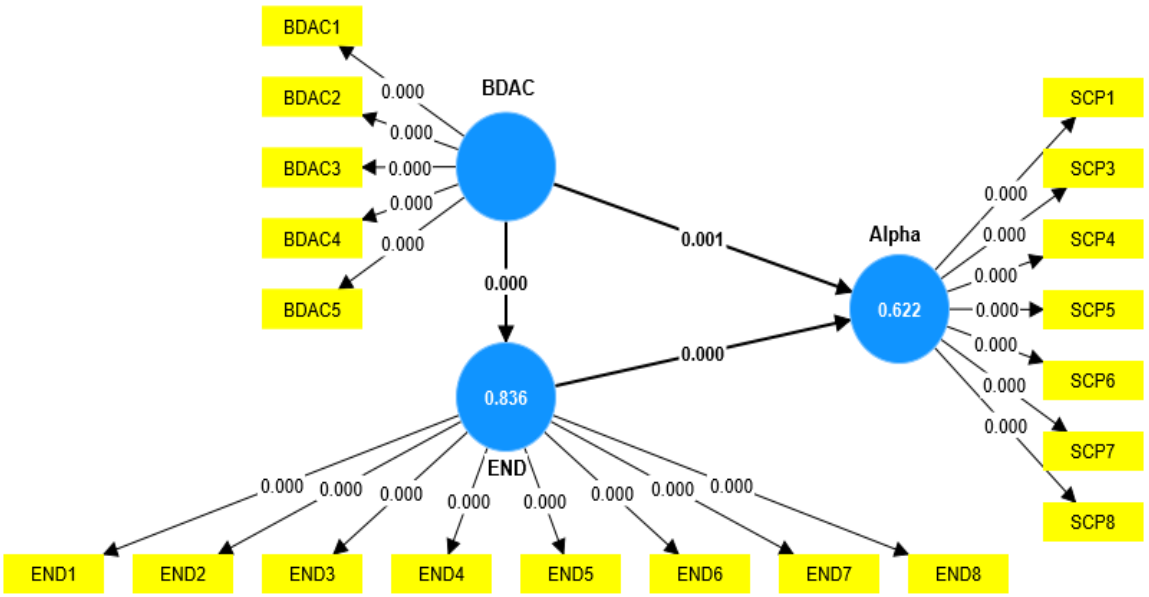

Figure 3.
Structural Model

Structural equation modeling (SEM) with Partial Least Squares (PLS) uses latent variable correlations to express data causality. Structural modeling covers both methods (Henseler & Schuberth,2022). PLS-SEM uses measurement model structural equations to estimate external loadings. This model tests hypotheses and predicts latent variable correlations using observable data. Table 4 proves all theories.

Table 4.
Direct Results

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
BDAC -> Alpha	0.764	0.766	0.046	16.771	0.000
BDAC -> END	0.915	0.914	0.016	57.114	0.000
END -> Alpha	0.481	0.487	0.095	5.082	0.000

Table 5 shows the mediation investigation's statistically significant mediation path.

Table 5.
Mediation Analysis

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
BDAC -> END -> Alpha	0.440	0.446	0.089	4.926	0.000

DISCUSSION

The effect of big data analytics on supply chain performance was examined in a study that assessed the relationship between analytical capabilities and supply chain

performance for enterprises in the Big Four ASEAN countries, with environmental dynamism serving as a moderator. The objective of the study was to determine whether environmental change had a moderating effect.

The results of the study indicate a correlation between big data analytics competence and supply chain operations effectiveness. This result is consistent with previous research demonstrating the utility of big data analytics for optimizing supply chain operations. In addition, the study illustrates the moderating effect of environmental dynamism, indicating that the influence of big data analytics on supply chain performance is magnified in environments with high degrees of environmental dynamism.

This report examines the impact of big data analytics on supply chain performance in each of the four main ASEAN economies as one of its most valuable contributions. The study revealed that the influence of big data analytics on supply chain performance varies considerably by country. This emphasizes the significance of firms incorporating regional peculiarities into their supply chain strategies.

Companies with a presence in the Big Four ASEAN nations will also experience the study's effects in the real world. Companies who seek to improve their supply chain performance must invest heavily in the development of big data analytical expertise. They should also modify their strategies to account for the influence of climate change on conflict mediation. In order to better adapt to changing market conditions and improve supply chain efficiency in highly dynamic environments, businesses should prioritize enhancing their ability to evaluate huge quantities of data.

In conclusion, the work contributes significantly to the existing literature on big data analytics and supply chain efficiency. It emphasizes the necessity for businesses to invest in the expansion of their big data analytics capabilities and make improvements to their supply chain optimization strategies in order to enjoy the benefits of big data analytics.

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