Eduvest – Journal of Universal Studies
Volume 4 Number 9, September, 2024
p- ISSN 2775-3735- e-ISSN 2775-3727

THE ROLE OF BUSINESS ANALYTICS ADOPTION IN FOSTERING VALUE CREATION TO ACHIEVE COMPETITIVE ADVANTAGE IN INDUSTRY 4.0

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ABSTRACT

In the era of Industry 4.0, where disruption and uncertainty reign, the strategic adoption of business analytics emerges as a vital force in driving competitive advantage through value creation. This study investigates the pivotal role of business analytics adoption in fostering value creation to achieve a sustainable edge in Industry 4.0. By analyzing data from 237 E-commerce firms operating in fiercely competitive markets, the research explores the strategic imperatives for maximizing the utilization of data and information assets. It highlights the importance of integrating business analytics into organizational processes and fostering collaboration and dynamic capability to optimize decision-making and spur innovation. The findings underscore the necessity for firms to develop competencies in leveraging data-driven insights for competitive advantage. Moreover, this study contributes to bridging gaps in both Resource-Based Theory and dynamic capability literature, offering insights into practical actions for navigating the complexities of Industry 4.0. Ultimately, the research provides a comprehensive framework for understanding and implementing business analytics adoption as a strategic imperative for organizational success in the digital era, with implications for enhancing competitive advantage and driving sustained growth.

KEYWORDS *Business analytics adoption, collaboration, dynamic capability, value creation, competitive advantage, Industry 4.0*

INTRODUCTION

The emergence of the fourth industrial revolution has instigated profound shifts in human lifestyles. With the rise of artificial intelligence (AI), groundbreaking innovations have reshaped the future trajectory of humanity. In

How to cite: Dian alanudin (2024). The Role Of Business Analytics Adoption In Fostering Value Creation To Achieve Competitive Advantage In Industry 4.0. *Journal Eduvest. 4* (9): 8351-8366
E-ISSN: 2775-3727
Published by: https://greenpublisher.id/

response, the World Economic Forum has initiated the Centre for the New Economy and Society program, aimed at fostering research in data science, establishing new norms and models, and catalyzing collaborative efforts for systemic change across public and private sectors. These endeavors seek to deepen our comprehension of the evolving landscape.

Based on the insights from these initiatives, global enterprises are urged to reconsider their perspectives to gain a competitive edge in the future world. As societies transition away from traditional assets like gold and oil towards more abstract resources such as data, the effective exploration and management of these assets become increasingly vital. While organizations recognize the importance of data-driven value creation, many lack adequate preparedness for the challenges posed by Industry 4.0. The ability to transfer knowledge from individual to individual or from individual to organization remains deficient, primarily because organizations lack the internal expertise to optimize the utilization of data and information. Consequently, valuable intangible assets often remain underutilized, hindering sustainable innovation and growth.

For instance, in Indonesia, despite its cultural richness and diverse culinary heritage, traditional food recipes are underutilized for business value maximization. Success in the fourth industrial revolution hinges on the effective transfer and management of data and information. However, many companies, both large and small, have yet to fully grasp the significance of these resources. By optimizing their utilization through collaboration and enhanced skills, organizations can thrive in Industry 4.0 and compete globally. The transition to Industry 4.0 necessitates dynamic capabilities and extensive collaboration to drive value creation. Businesses must leverage tools like business analytics to predict industry trends and derive actionable insights. In Indonesia, initiatives like "Making Indonesia 4.0" aim to enhance connectivity, technology, and information integration to bolster the economy.

Efforts to maximize the benefits of Industry 4.0 require collaboration among stakeholders, including governments, industries, technology firms, and educational institutions. Only through concerted efforts can the potential of Industry 4.0 be fully realized, driving sustainable growth and prosperity. The importance of knowledge transfer in Industry 4.0 cannot be overstated. However, many companies struggle to equip themselves with the necessary capabilities to thrive in this new era. As data becomes increasingly valuable, firms must adopt new paradigms and collaborative models to remain competitive. In conclusion, Industry 4.0 presents both challenges and opportunities for businesses. Success in this era demands a strategic approach to data utilization, collaboration, and dynamic capability development. By embracing these principles, organizations can unlock new avenues for value creation and sustainable growth in the digital economy.

Literature Review

Theoretical Map

Based on the Theory of The Growth, the firm is a bundle of resources, and firms within the same industry are heterogeneous. Firm heterogeneities come from how the resources are endowed, develop, and combined, i.e., 1) type of resource

collected, and 2) various capabilities used to exploit them. Firms grow by exploiting excess resources in order to fulfill productive opportunities (Penrose, 1959). Strategic management literature provides the differential performance of firms in the same line of business (Amit and Schoemaker, 1993; Peteraf, 1993; Teece et al., 1997). Hall (1993) divide the resource to assets and capabilities. The resource-based theory of the firm states that firms need valuable resources and capabilities in order to attain competitiveness (Barney, 1991). Figure 2.1 summarized the theoretical map used in this research from the perspectives, frameworks, and variable approach.

Firms succeed in competition because of their valuable resources. Technological resources, organizational, people, and relational resources are the sources of growth that can be used to grasp productive opportunities and create business value. This opportunity will create differential performance and competitive advantage. The concept of competitive advantage as firm performance in this study is relevant to resource-based theory, (Barney, 1991), which explains about VRIN concept and as the pillar of what (Peteraf, 1993) argues. It is four cornerstones of the competitive advantage of the firm; imperfect mobility (resources are not easily imitated or transferred), heterogeneity (the firm has different resources), ex-post limits to competition (customer satisfaction), ex-ante limits to competition (first-mover advantage). Business analytics are an example of imperfect mobility because they are tacit, socially complex, and rare.

Resource-Based Theory: Business Analytics Adoption

In the context of industry 4.0, (Frank et al., 2019) stated the foundation for the growing research on the interface in Industry 4.0 is mainly focused on adding value to the customer (demand-pull) and frequently related to adding value to the process (technology-push). In industry 4.0, innovation needs data and analytics to have better products and services, lower the production cost, and have higher quality. With this challenge and goal to win the competition in industry 4.0, the decision to derive the action should be based on data, information, and business analytics adoption. “Business analytics adoption is concerned with the extensive use of data, statistical, and qualitative analysis, explanatory and predictive models and fact-based management to derive decision and actions” (Davenport and Harris, 2007, p.7). Business analytics adoption can create operational and strategic business value. According to (Aydiner et al., 2019), there are four dimensions of business analytics adoption: Data acquisition and processing, Prescriptive analytics, Predictive analytics, and Descriptive analytics.

Big data analytics study comes from Information System (IS) and Information Technology (IT) sciences (Aydiner et al., 2019; Sharda, Ramesh, 2016). Big data analytics are the term from IT and IS sciences and focused more on the technical, data mining, and algorithm. Business analytics is the combination of two scientific fields: management and IT/IS sciences. In IT/IS sciences, the business process: business process management (BPM), business process re-engineering (BPR), and business process innovation (BPI) with big data (Wamba & Mishra, 2017; Wamba, 2017), mostly focused on technical aspects. (Mikalef et al., 2018; Vidgen et al., 2017). Business analytics tries to explain the business

process on how a firm's organizational changes cope with big data and how they should leverage strategically (Mikalef et al., 2018). Business analytics is categorized to three main stages characterized by different levels of difficulty, value, and intelligence: Descriptive analytics, Predictive analytics, and Prescriptive analytics (Krumeich et al., 2016; Akerkar, 2013; Šikšnys & Pedersen, 2016). Lepenioti et al. (2020) argue Prescriptive analytics is finding the best course of action for the future.

Prescriptive analytics is often considered as the next step towards increasing data analytics maturity and leading to optimized decision making ahead of time for business performance improvement (Lepenioti et al., 2020). Predictive analytics is "a term mainly used in statistical and analytics techniques. This term is drawn from statistics, machine learning, database techniques and optimization techniques" (Kumar and Garg, 2018; Lepenioti et al., 2020). Predictive analytics has roots in classical statistics, and it uses to predicts the future by analyzing current and historical data. The future events and behavior of variables can be predicted using the models of predictive analytics (Kumar and Garg, 2018). According to Lepenioti et al. (2020), Descriptive analytics is concerned between the past ("What has happened?") and the present ("What is happening now?"). Predictive analytics, answering the questions "What will happen?" and "Why will it happen?" in the future. Prescriptive analytics, answering the questions "What should I do?" and "Why should I do it?" (Lepenioti et al., 2020).

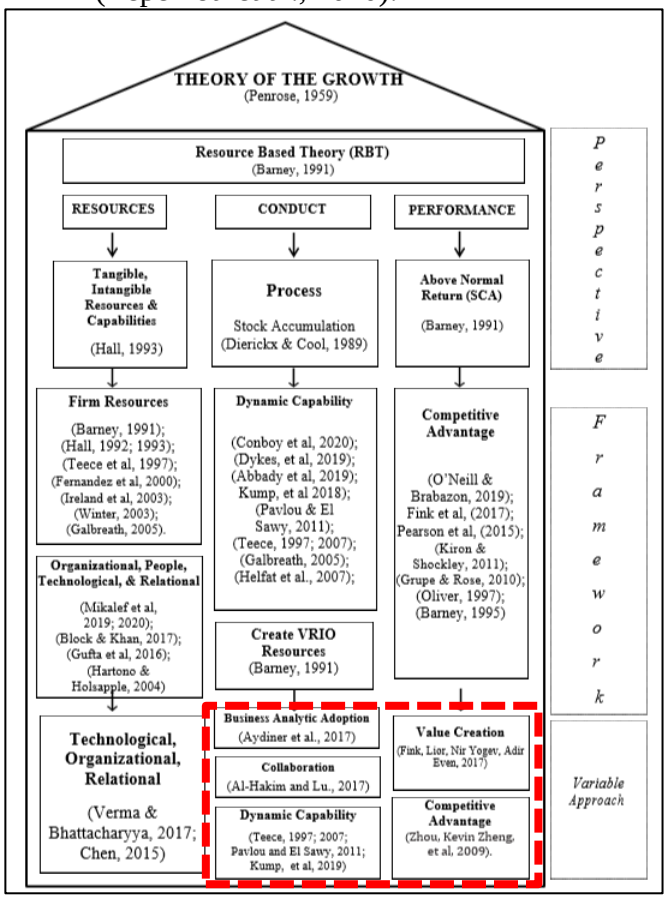

Figure 2.1. Theoretical Map

Dynamic Capability

Organizational learning is the source of dynamic capability (Zollo and Winter, 2002). Dynamic capabilities characteristics are structured persistent and planned activities enabling the evolution of operational routines and focuses on building distinctive competence, such as routine to develop new product or governance to make a strategic decision. Compare to dynamic capability, organizational learning can be more creative, unpredictable, and discontinued (Zollo and Winter, 2002). In the situation where certain learning mechanisms in an organization become systematic, organizational learning becomes a "second-order" dynamic capability (Collis, 1994). Furthermore, Pavlou and El Sawy (2011) argue that organizational learning can also be considered as a dynamic capability itself.

This study using Pavlou and El Sawy (2011) argument to derive the construct in the research model. Dynamic capability is a firm's ability to integrate, build and reconfigure internal and external competence to address rapidly changing environments (Teece et al., 1997).The dynamic capabilities perspective helps to shed light on how to employ big data analytics to detect, anticipate and respond to an uncertain environment. (Teece, 2007) characterized dynamic capabilities as the capacity to sense opportunities and threats, seize opportunities and maintain competitiveness through transforming assets. To understand changes in the environment, Teece suggested that dynamic capabilities require 'some kind of analytical framework' (Teece, 2012; Teece, 2007). For measuring Dynamic Capability, researchers using the measurement from Kump et al. (2019) perspective. This perspective aligns and supports the context and purpose of this study, e.g., the business value and value creation from business analytics adoption.

The business value of this context is not only for new products and services but also for strategic decisions and actions. (Kump et al., 2019) argue the need to compare the empirical findings and impairs data-based theory development from the original of a 14-item scale based on Teece's (2007); well established dynamic capability framework, assessing sensing, seizing, and transforming capacities. The existing research of dynamic capability measurement as conceptualized by Teece will summarize in Table 2.1.

Collaboration

Industry 4.0 focuses heavily on interconnectivity, automation, and real-time data, in this era collaboration is important. Collaboration refers to the internal and external sharing activities (Wang and Archer, 2004). Collaboration is the engagement of two or more organizations for the purpose of making commitments and joint efforts to achieve shared goals (De Man and Luvison, 2019; Wang and Archer, 2004; Zheng, 2006). A collaboration organization is a network consisting of a variety of entities (e.g., organizations and people) that are largely autonomous, geographically distributed, and heterogeneous in terms of their operating environment, culture, social capital, and goals, but that collaborate to better achieve common or compatible goals, and whose interactions are supported by computer networks (Camarinha-Matos, 2007). The discipline of collaborations focuses on the

structure, behavior, and evolving dynamics of networks of autonomous entities that collaborate to better achieve common or compatible goals" (Camarinha-Matos, 2007). The collaboration consists of four dimensions: (1) Structural, (2) Functional, (3) Componential, (4) Behavioral (Camarinha-Matos, 2007; Camarinha-Matos & Afsarmanesh, 2006). "Collaboration between two or more companies through partnership potentially to exchange some values such as exchange sharing resources and mostly continues beyond a single transaction" (Al-Hakim and Lu, 2017). "Collaboration between two or more companies through partnership potentially to exchange some values such as exchange knowledge and innovation, mostly continues beyond a single transaction" (Al-Hakim and Lu, 2017). Changes in the market and technology make any organization has to continuously maintain an existing relationship, renew, seek and collaborate with new partners (Bierly and Gallagher, 2007; Silva and Oliveira, 2017).

Table 2.1. Summary on Existing Research on Dynamic Capability Measurement

	Author(s) (year)	Underlying model	Operationalization of DC	Predictive validity
	Findings from the literature review between January 1997 to December 2015 (basis for scale development)			
1	Pavlou and El Sawy (2011)	Teece, Pisano, and Shuen (1997)	Sensing (four items)	Modification in operational capabilities, new product development performance
			Learning (five items)	
			Integrating (five items)	
			Coordinating (five items)	
			Reconfiguration (two items; second-order construct)	
2	Protogerou *et al.* (2012)	Teece *et al.* (1997)	Coordination (three items)	Firm performance
			Learning (three items)	
			Competitive responses (four items)	
3	Hawass (2010)	Part of Teece's (2007) model	Reconfiguration (four items)	n/a (Reconfiguration is criterion variable)
4	Naldi *et al.* (2014)	Part of Teece's (2007) model	Sensing (four items)	Innovative performance
			Seizing (four items)	
5	Wilden and Gudergan (2015)	Part of Teece's (2007) model	Sensing (four items)	Firm performance
			Reconfiguring (seven items)	
6	Nedzinskas *et al.* (2013)	Teece (2007)	Sensing (two items)	Relative nonfinancial performance
			Seizing (seven items)	Relative financial performance
			Reconfiguring (two items)	
7	Wilden *et al.* (2013)	Teece (2007)	Sensing (four items)	Financial solvency
			Seizing (four items)	
			Reconfiguring (four items)	
	Findings from the literature review between January 2016 to January 2018 (during scale development)			
8	Mandal (2017)	Teece *et al.* (1997)	Visibility for sensing (five items)	Hospital–supplier collaboration
			Visibility for learning (five items)	Hospital supply chain performance
			Visibility for coordinating (five items)	
			Visibility for integrating (five items)	
9	Pandit *et al.* (2017)	Teece *et al.*'s (1997) model; items partly based on Pavlou and El Sawy (2011)	Learning (two items)	Disruptive innovation
			Integrating (three items)	
			Coordinating (one item)	
10	Rashidirad *et al.* (2017)	Teece *et al.* (1997)	Sensing (six items)	Novelty
			Learning (seven items)	Lock-in
			Integrating (seven items)	Complementarities
			Coordinating (seven items)	Efficiency
11	Babelytė-Labanauskė and Nedzinskas (2017)	Teece (2007)	Sense (four aspects to be rated)	R&D performance
			Seize (five aspects to be rated)	Innovation performance
			Reconfigure (four aspects to be rated)	
12	Lopez-Cabrales *et al.* (2017)	Teece's (2007) model; items partly based on Pavlou and El Sawy (2011)	Sensing (threee items)	n/a (DC are criterion variables)
			Seizing (four items)	
			Reconfiguration (five items)	
13	Shafia *et al.* (2016)	Teece (2007)	Sensing (3 items)	Competitiveness of research and technology organizations
			Seizing (5 items)	
			Reconfiguration (6 items)	

Source: Kump, et al

Value Creation: Strategy and Operational Business Value

Business analytics adoption, collaboration, and dynamic capability have broader implications for value creation and in the end, will impact competitive advantage. Value creation of collaboration with new suppliers, customers in the community, and even competitors can leverage the firm's capability from external resources. Due to the organization's limitation of some resources that cannot be obtained internally, collaboration with partners will create strategic and operational business value to fulfill the additional resources (Fink et al., 2017; Dyar and Singh, 1998). In the context of industry 4.0, business analytics adoption, collaboration, and dynamic capability will enhance value creation to provide a better offering to the customer through reducing the operational cost, number of vendors, or create new product and services with better quality and customer experiences. Value creation through business analytics adoption can create new offerings to address customer needs and satisfy their aim in new and better ways. The offering of products and services from collaboration depends on research and development or leveraging new technologies (Katkalo et al., 2010; Teece, 2010). Value creation through collaboration can create new customers, new markets, customer groups, or market segmentation where companies offer products and services now or in the future (Afuah, 2014).

Competitive Advantage

Business analytics adoption and collaboration will optimize the function of dynamic capability within the firm. "dynamic capability is the role of managers' actions to effectively structure, bundle, and leverage firm resources." (Helfat and Peteraf, 2009; Sirmon et al., 2007). Three major dimensions of dynamic capability are sensing (which means identifying and assessing opportunities outside your company), seizing (mobilizing your resources to capture value from those opportunities), and transforming (continuous renewal). The dynamic capability will derive value creation. The value creation is frequently including the activities of thousands of people, sophisticated technology, important capital investments, and millions of lines of code that make up the operational systems and processes that enable a company to achieve its goals. (Stevens & Johnson, 2016).

Competitive Advantage (CA) is defined as the capacity of a company to enhance the value of its products, decrease the cost of its products, or expand business presence or benefit. (Porter, 1990; Grupe and Rose, 2010; Mcgahan and Porter, 2019). Cost Leadership, Differentiation of Product, Quality of Product (Teece et al., 1997) state that the determinant of competitive advantage is a dynamic capability. The firm can create a competitive advantage through new opportunities and streams of innovation (Ireland and Webb, 2007). In searching for a competitive advantage organization will face competitive dynamics. Collaboration and Business analytics adoption (Vidgen et al., 2017) are the main drivers to create competitive advantage through dynamic capability and value creation as mediators (Conboy et al., 2020). Business analytics adoption and collaboration as the imperfect mobility for competitive advantage mediated by dynamic capability and value creation. The unique and new value creations allowing firms to gain a competitive advantage (Rashidirad et al, 2017). The existing research on the business value of business

analytics from the year 2000—2020 (10 years) will summarize in Table 2.2.

Research Model & Hypothesis

Hypothesis Development

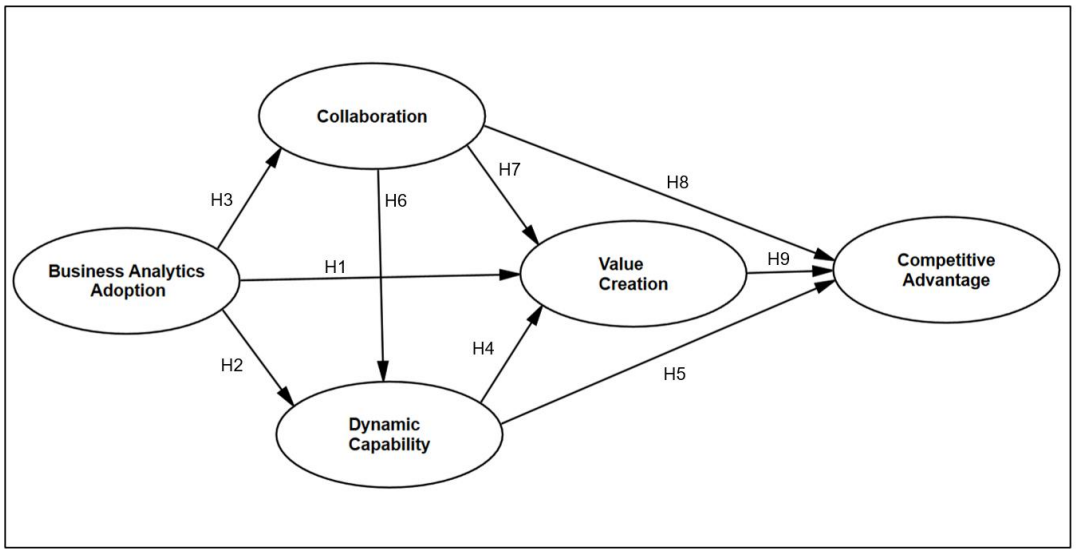

Figure 3.1. Research Model & Hypothesis

Based on the business analytics adoption in the context of change research as well as the variables discussed in section 2, in this section, the research hypothesis is developed based on the previous study in literature. The research model is presented in figure 3.1. In this model, the business analytics adoption will enhance the firm competitive advantage through value creation directly or mediated by collaboration and dynamic capability. Business analytics adoption and collaboration as the determinant of dynamic capability or value creation and competitive advantage are a consequence output. Therefore, in this context, the researcher formalizes the circumstances into hypothesis as follow:

H1: Business analytic adoption positively and significantly affects value creation
H2: Business analytic adoption positively and significantly affects the dynamic capability
H3: Business analytic adoption positively and significantly affects collaboration
H4: Dynamic capability positively and significantly affects the value creation
H5: Dynamic capability positively and significantly affects competitive advantage
H6: Collaboration positively and significantly affects the dynamic capability
H7: Collaboration positively and significantly affects the value creation
H8: Collaboration positively and significantly affects competitive advantage
H9: Value creation positively and significantly affects competitive advantage

RESEARCH METHOD

The purpose of this research is to examine Business analytics adoption and Collaboration as the determinants of the Dynamic capability process and Value creation that creates a competitive advantage. Thus, in this section, the researcher describes the research methodologies to conduct the study. Furthermore, in section 4.2, the researcher will explain the sample criteria that valid to measure a firm that has Analytic Capability and Collaboration as their resources, conducted Dynamic capability and Value creation, and in the end, and performs Competitive Advantage, as an output. In this study, the researcher uses an administrated questionnaire-based quantitative study with primary data to test the hypothesis developed in section 3.1. The theoretical gaps are identified in the literature review phase. Some data and information are also collected from the secondary data, such as media as well as the firm website. The questionnaires in this study are developed by using the measurement items from the previous study. The researcher will also combine questionnaires to make relevant with the research context about business analytics adoption and collaboration as the main driver. As the initial step of the study, the researcher will conduct an interview with the chairman of the E-Commerce Association and a leader from PT Aplikasi Karya Anak Bangsa to examine whether the developed constructs as well as the indicators are happened in the respondent firm and also examine the questionnaires, are well understood.

The growth of data in the recent year is impressive. Based on the predictions of the International Data Corporation (IDC) report, global data volumes are expected to grow exponentially from 4.4 zettabytes to 44 zettabytes between 2013 and 2020. By 2025, International Data Corporation (IDC) predicts there will be 163 zettabytes of data. How to manage and have the value from this extensive data initiative that affects the entire organization. In this study, the sample will use a local Indonesian firm that implements business analytics practices with its partners, customers, communities, and all stakeholders. All of them are E-commerce company include website application, mobile application, and social media commerce that mostly rely on collaboration for their value creation as suggested by Hartono & Holsapple (2004) and Krishnan and Rogers (2015). Collaboration a cooperative, inter-firm relationship that is negotiated in an ongoing communicative process and that relies on neither market nor hierarchical mechanisms of control (Lawrence et al., 2002; Majchrzak et al., 2015). Furthermore, in a business analytics strategy perspective, the firm may capture the value created by the collaboration or communities within the platform ecosystem (Hartono & Holsapple, 2004). The Industry 4.0 context in this study is presented in chapter 1.1. In order to examine the model, the researcher chooses the E-commerce company who has running more than 1 year. Mostly, this companies are from the Indonesian country as a unit analysis for this study. This study eliminates E-commerce start-up company with less than one-year operating duration. The sample will use 200 companies of E-commerce company with highly competitive market conditions.

Researchers use quantitative research designs related to the design of a research project involving 200 sample sizes and concentrate on the quality and quantity of responses to obtain answers to research questions. The researcher will use the expert evaluation method for wording test with leading E-commerce

managers and top management team as industry practitioners and a two-person matching profile to the respondent. These activities examine whether each questionnaire is well understood and relevant to the research context. Then, the researchers will spread the questionnaires to ten or more pre-test respondents from industry practitioners. These studies using probability sampling. Sampling Criteria describe as follow: (1) The company has been established for more than one year, (2) Eliminating start-up companies that have been operated for less than one year, (3) E-commerce company include website application, mobile application, and social media commerce (4) A highly competitive and turbulence environment. The total sample for this study is around 26,2 million units (BPS, 2019) and the target sample is 200 companies. In the respondent selection, the researcher will choose the respondent's background as close as possible to the main study.

The researcher will develop the questionnaire based on the previous study on the literature, and administrated questionnaire-based quantitative study, that has been adjusted with the research context. The researcher will also combine questionnaires to make relevant with the research context about business analytics adoption, collaboration, and dynamic capability as the business process. (Wakita et al., 2012) argue the Six Likert Scale will avoid the neutral answer. The researcher will use the Six Likert Scale in questionnaire development for this study. The pre-test will be conducted to align the questionnaire to the real situation and problem in practice. The objective of the pre-test is to examine the reliability as well as the construct of the scales used for the latent variable indicators. The expert evaluation method will be implemented for the wording test with two industry practitioners and two business analytics scholars as the representative from the respondents to examine whether each questionnaire is well understood and relevant to the research context. Then, the researchers will spread the questionnaires to the 10 or more pre-test respondents from industry practitioners. The researcher will choose the respondent's background as close as possible to the main study in the respondent selection process. They are executives who conduct business analytics on their daily basis through their work and the company was founded more than 5 years. Then, the researcher will conduct an exploratory factor analysis by using principal component analysis (PCA) with Varimax rotation to examine whether each indicator corresponding and groups to certain categories and correctly load to certain constructs. This explanatory factor analysis will be conducted after the pre-test data completed. According to (Hair et al., 2011), the loading factors of certain indicators should be above 0.6 to their respective constructs and lower to others. Furthermore, the researcher will use Bartlett's test to examine the sample adequacy by using Kaiser-Meyer-Olkin's (KMO) measure and usefulness of factor analysis. After that, the reliability of the constructs will be estimated by using Cronbach's alpha statistics with the result should be higher than 0.7 (Hair et al., 2011).

The source and data collection in these studies, in order to examine business analytics adoption, collaboration, and dynamic capability to create and enhance competitive advantage through value creation in industry 4.0, the data collection process in this research is: (1) Final questionnaire would be sent by email to respondents along with a formal letter from the chairman of the E-Commerce Association along with a formal letter from the head of the Graduate School of

Management (PPIM FEB-UI) and an introduction letter from the researcher. (2) Online survey website link, e.g., google form. (3) Simplify survey operations. (4) More comfortable to respondents (5) Response by email and phone numbers.

RESULT AND DISCUSSION

This study analyzes 237 e-commerce companies using quantitative methods, employing SPSS and Amos for data analysis. The findings of this study provide valuable insights into the relationship between business analytics adoption, dynamic capability, collaboration, value creation, and competitive advantage within the context of Industry 4.0. The research model proposed in Figure 3.1 outlines the interplay between these variables, offering a comprehensive understanding of their effects on organizational performance. Firstly, the results support H1, indicating that business analytics adoption positively and significantly affects value creation. This aligns with prior research suggesting that leveraging business analytics enhances organizations' ability to generate value by utilizing data-driven insights to improve decision-making processes, operational efficiency, and customer service. The multidimensional nature of business analytics adoption, encompassing data acquisition, processing, prescriptive, predictive, and descriptive analytics, underscores its role in facilitating value creation across various organizational dimensions. Moreover, H2 is supported by the findings, indicating a positive and significant relationship between business analytics adoption and dynamic capability. This highlights the crucial role of business analytics in enabling organizations to sense, seize, and transform opportunities in dynamic environments. By harnessing data-driven insights, organizations can enhance their ability to adapt to changing market conditions, innovate processes, and allocate resources effectively, thereby strengthening their dynamic capabilities.

Furthermore, the study confirms H3, demonstrating that business analytics adoption positively and significantly affects collaboration. Through the integration of data silos, fostering a data-driven culture, and enhancing analytics-related skills, organizations can facilitate both internal and external collaboration. This collaboration, in turn, enables the exchange of resources, knowledge, and information among stakeholders, fostering innovation, and improving overall performance. The results also support H4, H5, H6, H7, H8, and H9, indicating positive and significant relationships between dynamic capability, collaboration, value creation, and competitive advantage. These findings underscore the interconnectedness of these constructs, suggesting that organizations with strong dynamic capabilities and collaborative networks are better positioned to create value and achieve competitive advantage in Industry 4.0 environments. By continuously sensing and seizing opportunities, collaborating with external partners, and innovating value creation processes, organizations can differentiate themselves from competitors and enhance their long-term sustainability.

In conclusion, this study contributes to the growing body of literature on business analytics adoption, dynamic capability, collaboration, value creation, and competitive advantage in the context of Industry 4.0. The findings highlight the importance of leveraging data-driven insights, fostering collaborative networks, and enhancing dynamic capabilities to thrive in today's rapidly evolving business

landscape. By embracing business analytics adoption, organizations can improve decision-making processes, enhance operational efficiency, and drive innovation, ultimately leading to enhanced value creation and sustained competitive advantage. Moving forward, it is imperative for organizations to continue investing in technological capabilities, fostering a culture of collaboration, and adapting to changing market dynamics to remain competitive in Industry 4.0 ecosystems.

CONCLUSION

This research highlights the importance of business analytics adoption in creating added value and competitive advantage in the Industry 4.0 era. Based on an analysis of 237 e-commerce companies, the results show that the adoption of business analytics significantly affects value creation, dynamic capabilities and collaboration. Internal and external collaboration supported by data integration and improved analytical capabilities strengthen the organization's ability to adapt to a dynamic environment. In addition, value creation resulting from the adoption of business analytics improves operational efficiency and the quality of business decisions. Therefore, companies that adopt this approach are better able to compete and achieve sustainable competitive advantage. This research also makes a theoretical contribution to the literature of Resource-Based Theory and dynamic capabilities, and provides practical guidance for companies in facing the challenges and opportunities in the digital era.

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