CHALLENGES IN BUSINESS ANALYTICS IMPLEMENTATION: A COMPREHENSIVE REVIEW USING TOE FRAMEWORK

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ABSTRACT

Business analytics are changing how firms treat data. Using analytics, firms possess the capability to capture greater insights and predict the future, hence better decision-making process. However, the implementation of analytics in business has to be carried within the complexity of organization, technology, and environment. Given the complexity, this study aims to identify the challenge faced by firms across industries. The TOE framework is utilized to construct a more comprehensive framework of the challenges. Past studies related to implementation of business analytics are gathered and processed using literature review method. This study helps Asian firms to be more anticipative by providing a holistic and clearer view of challenges in adopting business analytics.

Keywords: business analytics; data analytics; technological challenges; organizational challenges; environmental challenges

INTRODUCTION

Business analytics (BA) are revolutionizing the way firms generate and utilize data (Ramanathan et al., 2017). Implementation of BA enables firms to conduct an integrative approach in organizing, processing, and analyzing data. BA also enables firms to capture insights from changing trends, and predict changes based on market requirements (Isik et al., 2013), and quickly responding to arised problems (Akhmetova & Nevskaya, 2020).

Adaptation of analytics in business has an impact on firm performance and firm's strategic business value (Krishnamoorthi & Mathew, 2018). Furthermore, from a strategic point of view, adaptation of BA enhances the firm's capabilities (Ashrafi et al., 2019; Cao et al., 2021) and performance (Whitelock, 2018; Mikalef et al., 2020). BA also keeps on being a top priority for many firms and the values offered by BA are considered attractive for many entities (Isık et al., 2013).

However, as it is with other information technology implementations, BA implementation also is involved with a number of aspects that may emerge challenges. Kash et al. (2014) explains that a firm's capacity to acquire, assimilate and internalize new knowledge (e.g. new technologies) are affected by its leadership, culture, and technologies. Saghafian et al. (2021) explains that technology adoption involves organizational culture and structure, leadership, and resources. This shows that adoption of BA occurs in a complex environment of stakeholders and variables.

Most of the previous studies related to BA implementation are not providing a comprehensive view. Past studies were mostly conducted and analyzed within the context of their domain. Moreover, a number of studies related to BA implementation did not cover wider category and not well summarized. Some of the studies also did not solely focus on discussing the challenge.

Thus, this study aims to provide a focused, holistic, and detailed review of BA adoption issues. This study filters, reviews the findings of each past studies, and synthesizes the results using TOE framework. Technology-organization-environment (TOE) framework is used in reviewing past studies to ensure that identified challenges are comprehensive.

Theoretically, this study provides a model to identify challenges faced by firms to successfully invest in BA. The proposed framework may support further researchers in studying analytics-related technology adoption in business. Practically, this study aims to provide Asian firms a vantage point in anticipating challenges of BA implementation.

LITERATURE REVIEW

Business analytics is composed of two main terminologies and independent concepts of "business" and "analytics". While the concept of business is commonly known, analytics are defined as the process of generating valuable insights from raw, extensive data using quantitative analysis, scientific methodologies, and statistical techniques where the generated insights are utilized to help the decision-making process (Boyd, 2012; Wilder & Ozgur, 2015).

BA can be generalized as the application of analytics to solve business problems (Power et al., 2018). Analytics is also considered as an umbrella term that includes types of applications of analytics such as business analytics and data analytics (Power et al., 2018). BA is utilized to improve business decision making at all levels within the firm.

From the orientation point of view, BA has three types- descriptive, predictive, and prescriptive analytics (Appelbaum et al., 2017; Sun et al., 2017). In BA, analytics techniques used are depending on business problems and orientations of the analysis to answer the stated business problem. Besides problems and orientations, the feasibility of BA techniques is also

dependent on the availability of data. Each orientation of BA answers different business questions. Descriptive analytics answers the question "what has happened?". It summarizes what has occurred within the internal and external environment of the firm. Descriptive analytics acts as the underlying framework of a continuous monitoring system and commonly include business dashboards, visualization types and KPIs (Appelbaum et al., 2017).

In the other hand, predictive analytics answers the question "what will happen?". Predictive analytics is about using analytics to sense what is ahead (Bradlow et al., 2017). Predictive analytics induces models from past data using statistical techniques. Alharthi (2018) reports that applications of predictive analytics are wide and across industries. Lastly, prescriptive analytics answers the question of "how to make it happen?". This analytics orientation incorporates techniques to assess and capture the best alternatives for a given defined constraints, such as complex objectives, and set of requirements (Frazzetto et al., 2019).

Types of BA may also be seen from dimensions of domain. Domain refers to the area where BA are being implemented, such as functional areas in business - marketing, finance, human resources, operations and production, and their sub areas. More specifically, Holsapple et al. (2014) describes that BA domains include:
- Web Analytics
- Google Analytics
- Software Analytics
- Crisis Analytics
- Knowledge Analytics
- Marketing Analytics
- Customer Analytics
- Service Analytics
- Human Resource Analytics
- Talent Analytics
- Process Analytics
- Supply Chain Analytics
- Risk Analytics
- Financial Analytics

Domain dimensions show that the BA implementation covers wide functional areas within an organization. BA becomes a part of decision management for both decision-makers in each area and decision-makers in top management. This means that the implementation of BA heavily involves participation of internal stakeholders, such as executives and managers between functional areas in organization and external stakeholders, such as clients, vendors, consumers, and the public. Dimensions above also implies that BA implementation deals with data-related issues. During the implementation of analytics, firms deal with a great amount of data, captured in different formats, and gathered from different sources (Colangelo et al., 2018).

RESEARCH METHOD

This study adopted the literature review method. Before conducting the review, researcher collects article by using defined criteria. First, that most of the articles must come from high-reputable journals or Scopus-indexed. Although only few journals were in other reputable indexes. Second, articles are limited to the past ten years. Third, article should describe and discuss analytics implementation in businesses and organizations.
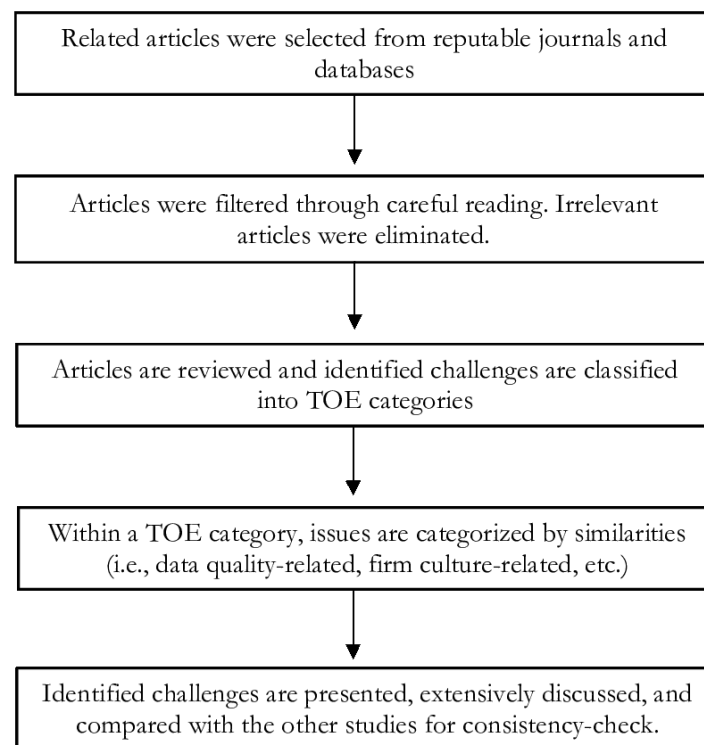
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│   Related articles were selected from reputable  │
│   journals and databases                          │
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│   Articles were filtered through careful reading. │
│   Irrelevant articles were eliminated.            │
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│   Articles are reviewed and identified challenges │
│   are classified into TOE categories              │
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│   Within a TOE category, issues are categorized   │
│   by similarities (i.e., data quality-related,    │
│   firm culture-related, etc.)                     │
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│   Identified challenges are presented, extensively│
│   discussed, and compared with the other studies  │
│   for consistency-check.                          │
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Figure 1. Research Design

Reviewed articles are collected from scientific databases: Emerald, ScienceDirect, SpringerLink and search engines such as Google Scholar. After filtering, the final number of articles is 22 (n=22).

This study uses Technology-Organization-Environment (TOE) framework to structure and classifies the findings from each literature. The TOE framework is regarded as a comprehensive and holistic framework in analyzing innovation adoption (Gangwar et al., 2015). The framework classifies factors that impact a firm's adoption phenomenon into three - technology, organization, and environment (Baker, 2012). This framework has been used in examining forms of technological adoption in various firms and industries (e.g. Al-Hujran et al., 2018; Abed, 2020; Kumar & Krishnamoorthy, 2020; Ullah et al., 2021; Stjepić et al., 2021).

In constructing the review, this study identifies the challenges from each literature, classify them on the TOE categories. Results are presented while heavily discussed and compared with other studies in order to be checked for consistency.

RESULTS AND DISCUSSION

Challenges in Organizational Context
Firm's Culture

Organizational culture is the collection of values, expectations, and practices that guide and inform the actions of all team members. Studies (e.g. Kash et al., 2014; Saghafian et al., 2021) suggest that organizational culture has an important role in determining IT-related adoption. Adoption of Business Analytics (BA) is considered as a technology adoption. Thus, the success of BA implementation in the organization also depends on existing perceptions of the organization towards data. Previous studies suggest that companies have different values and perceptions towards data in supporting decision making (data-driven decision making). Organizations have different levels of incorporating data to make sound decisions. The hard

thing is that developing a ready culture needs a significant amount of time and not an overnight process (Ramanathan et al., 2017).

The degree of data-driven culture can be defined as the degree of organization in making statements and business decisions based on data, rather than hunch. Vassakis et al. (2018) and Hamilton & Sodeman (2019) suggests that data-driven culture as one of important challenges in integrating analytics-related technology. Hamilton & Sodeman (2019) concluded that when managers are faced with the dilemma of data analysis and their instincts, they still prefer to believe in their instinct. This shows that managers are still reluctant to regard data and insights generated from data analytics as a valuable reference in making decisions.

Executives' comprehension on how BA brings value and support for BA projects

Omar et al. (2019) suggests that executives' support is crucial to ensure a firm's culture supports analytics and makes funding possible. Ahmed & Ji (2013) asserts that executives buy-in of data analytics is a challenge in convincing them to gain support. In securing funding, the challenge is that the executives must be convinced to understand the value of investment in analytics and through what mechanism BA brings added value to the firm. Hamilton & Sodeman (2019) adds that it is hard to gain support from executives to invest in analytics technology in the HR department. Executives are not seeing HR analytics as a priority (Akhmetova & Nevskaya, 2020), since they may regard departments like HR as not contributing directly to firm profitability so it may be harder to convince them to comprehend how investment in analytics will bring value to profitability through enhancing HR management. In ensuring that the firm's culture regards analytics as a crucial tool, the challenge is that executives are able to understand and communicate and set examples on how analytics are needed in decision-making.

Executives' comprehension is crucial in determining how they communicate the objectives of BA implementation. Liu et al. (2018) presented a case where a leader's effective communication is a challenge, when an analytics project is granted and in process. Leader's communication support is seen as his understanding, defining, and communicating the value of analytics. Vassakis et al. (2018) adds that in adopting data analysis, a leader's vision, and ability to ask the right questions and to motivate is required. Liu et al. (2018) also described that the impact of ineffective communication is that employees in the firm's functional areas did not have a common ground to build the platform. It is also important to understand BA is centralized, so data from respective functional areas are needed and cooperation between functional areas are needed.

An effective communication should be preceded by an adequate level of understanding of what BA is, how it brings value to the firm, what input is needed to make it properly functioning, and how to take advantage of the insight.

Talent capability and availability

Omar et al. (2019) mentions that successful implementation of BA requires first, the ability of decision-makers to understand the basis assumption of the analytical model and be able to effectively apply insights to business problems. Second, the need to enhance executives and managers' ability to take advantage of insights generated by the analytics and integrate them into the workflow. This means that data-savvy managers and employees are in need. This highlights the talent-related challenge, which is the availability of in-house employees with data knowledge (Ahmed & Ji, 2013; Lautenbach et al., 2017, Attaran & Attaran, 2018; Attaran et al., 2018) and finding data-savvy talents.

The first challenge is the limited data knowledge of current employees. By adopting BA, employees are expected to think data-analytically and be data-savvy to a certain degree.

However, it is common that employees who graduate from non-data science school will face obstacles in thinking about how to derive insights from data, especially if the amount of data is significant and broad in category. Employees will have a hard time thinking like a data scientist or analyst as they were most likely not trained to do so.

Earley (2015) explains this within the context of implementing data analytics in auditing service. Auditors are traditionally not equipped with data analytical skills. Also, auditors are generally not trained to use data analytics to consider whether a particular transaction makes sense thus enabling them to spot an anomaly and follow-up on the anomaly. Earley (2015) also adds that pattern recognition skills and evaluating anomalies in transactions are not the focus of traditional accounting education and training programs among the industry. This concludes that current employees may lack requisite capabilities to properly incorporate BA techniques in their task. Akhmetova & Nevskaya (2020) also addresses the same problem in the HR industry.

Challenges in talent mindset also appear in big data-based BA implementation in the HR department (Hamilton & Sodeman, 2019). HR managers are mostly focusing on costs of processing applications or recruiting new staff rather than having a clear focus on strategic issues, like thinking in a longer horizon by incorporating analytics in aspects of the HR management process. HR managers with the latter focus are not easy to find. Hamilton & Sodeman (2019) also adds that to conduct effective data analysis, HR managers need to comprehend the relationships between variables in the algorithms in BA.

In healthcare industry, Liu et al. (2018) provide an example that lack of expertise within the analytics team is a great challenge in BA implementation. It is emphasized that technical experience of the analytics team is an essential element in BA projects. Firms that overlook this element will risk the success of BA implementation. Liu et al. (2018) explains that an analytic project may failed since the organization did not possess the experience to grasp the complexity of the system it currently developed. Also in that case, the lack of proficiency in BA development also appears in defining the user of BA. The project defined the organization as the user, while the real users are healthcare providers and the patients.

Supply of qualified talent is also a great challenge in the implementation of BA (Ahmed & Ji, 2013; Omar et al., 2019; Hamilton & Sodeman, 2019). Vassakis et al. (2018) adds that talents related to the BA department (e.g. data scientist, data analyst) are especially difficult to find in the job market. In order to leverage data through BA, firms must recruit such talents with adequate technical skills. Moreover, Omar et al. (2019) explains that there are three main profiles that are competent in BA that firms need to find in the talent market - data scientists, someone with vast background in statistics, mathematics, and programming; business analysts, talents that have business background complemented with sufficient comprehension in statistics and analytics; and business users with knowledge of statistics and descriptive data analysis.

Financial Resources

Organizations faced the challenge in investing in analytics, as these investments are relatively expensive. Ahmed & Ji (2013) and Attaran & Attaran (2018) state that financial challenges in adopting analytics are related to the budget for analytics and the cost of ownership for analytical investments. Alharthi (2018) states that in maintaining and handling analytics technology, people who have a competent and dedicated process, significant investment of money is required. For instance, increasing amount of generated data leads to more space demanded to store the data, which also increases the financial needs (Bradlow et al., 2017; Raut et al., 2021). Lack of available financial resources becomes a serious problem in implementing analytics in the firm.

Furthermore, executive support affects the security of financial resources (Omar et al., 2019). Executives' attitude toward reception of investment in BA is based on their perception of what value and how BA will bring value to the firm. Thus, besides the availability of financial support, the challenge is that the company leaders must be able to be convinced to secure the funding to realize BA implementation.

Stakeholder collaboration

Collaboration between managers and departments are crucial in implementing BA. Liu et al. (2018) described that BA implementation may fail if there is no same ground between functional areas within the firm, since BA is centralized and thus needs cross-functional data. The challenge is to make sure all line managers understand the value of BA implementation in their area and realize what is needed to make sure BA works properly within the firm.

Hamilton & Sodeman (2019) asserts that implementation of data analytics must be regarded as "everyone's best interest". A supportive partnership between line managers within the firm is essential for BA to be successfully implemented. Moreover, managers in each department need to be interested in learning and training programs need to be conducted in order to successfully implement BA.

Hamilton & Sodeman (2019) also adds that employees hold a pivotal role as key stakeholders as they are directly connected to the data being collected. Employees' willingness to support and participate in the BA adoption success is also very crucial. Otherwise, the data problem will occur since data gathered may be incomplete and/or inaccurate. For example, in the HR department, the direct involvement of employees with data collecting may motivate them to regard data collection as a threat to their privacy, this may cause employees to sabotage the data gathering process (Hamilton & Sodeman, 2019).

Challenges in Technological Context

Resources readiness is also regarded as an important challenge in BA implementation, since adequacy of necessary technology and resources is still a prerequisite in success of BA. Data availability and quality are dubbed as the main issues in BA integration (Ahmed & Ji, 2013; Earley, 2015; Liu & Shi, 2015; Attaran & Attaran, 2018; Hamilton & Sodeman, 2019). Ward et al. (2014) adds that designing a quality data collection also becomes an issue.

Data Availability

Challenges in data availability concerns the convenience of data access (Lennerholt et al., 2018). This is apparent in the case where data needs to be obtained from external parties (i.e. clients) and internal parties (i.e. other departments). For instance, many relevant data within the firm are spread over functional areas in the organization, and the data is large in overall size. Problems may occur if those functional areas are not cooperating - i.e. not allowing their data to be fully shared to other parts of the firm (Liu & Shi, 2015; Hamilton & Sodeman, 2019). Also, motivation of stakeholders to sabotage data collection processes as described in stakeholder collaboration may put a significant barrier into the availability of data. Thus, it is challenging for the firm to obtain sufficient volume of the data (Attaran & Attaran, 2018).

Similarly, challenges of data availability are related to the capability and policy of external parties. For instance, in the case of BA implementation in the auditing industry (Earley, 2015), many clients are limited in their capability to collect and manage data. This further makes data collection and data cleaning challenging for the firm. Moreover, in the similar case, even if the clients have the ability to capture and manage data, there are issues in the level of access they will provide to the firm. This also varies from company to company since they have different policies towards data sharing.

Data Quality

Challenges are faced by firms when obtaining quality data. A quality data can be seen through its accuracy, completeness, currency, and consistency. Data collected must be of sufficient quality in order to be fit for use. Lack of cooperation and ability in data collecting from both internal and external parties affects the quality of gathered data. Moreover, low data quality is difficult to manage and process (Ahmed & Ji, 2013; Bhosale & Ukhalkar, 2020), since great efforts are needed to clean the data before it is ready to be used (Liu & Shi, 2015).

Challenges to obtain quality data are also related to locating the data. Since data is located in different places (i.e. different population, different firm departments), the analytics team needs to remember and navigate to find all possible locations where data exist and feasible to be gathered (Ward et al., 2014; Hamilton & Sodeman, 2019). Inability to navigate data collections will result in incomplete datasets and inaccurate analysis.

Issues in data quality are also related to the standard of data collected by the firm. Even though data is available and collectible for the firm, the data may be inaccurate, noisy, and incompatible. Hamilton & Sodeman (2019) explains that data captured in a particular department within a firm is not easily linked with other departments. The variation of data standard and format among departments may result in accuracy and relevance issues. Ward et al. (2014) adds in the case of BA implementation in the healthcare industry, although the organization has employed electronic recording of patients' data, the same piece of information may be captured in many different ways. Thus, firm-wide data standardization could resolve issues of inequality of captured data from each department.

Data Collection Process

Ward et al. (2014) asserts that there is an inseparable link between data quality and data collection process. So, it is a challenge for the firm to employ high quality data collection to ensure that data gathered are of sufficient quality. However, incompatibility among IT platforms used by the firm may cause problems (Ramanathan et al., 2017). This incompatibility interferes with the data collection process.

Ward et al. (2014) adds that the challenge also includes how the firm designs an effective and efficient data collection process that is embedded in the daily workflow of employees. Alharthi (2018) asserts the need of integrating data recording system (e.g. Electronic Health Record in healthcare organization) in work environment. Through this way, important data with quality are collected without hampering employees' tasks.

Data Management Process

Data management is related to the firm's ability to obtain, combine, transform, and store data using available tools and techniques (Raut et al., 2021). Data management challenges in BA appear in whether firms possess the adequate tools and techniques to constantly ensure that the data are fit for use. Alharthi (2018) revealed that it is a common issue that organization's data are scattered in multiple areas and enterprise systems, are stored in different formats, and stockpiled tremendously rapidly. This leads to a task for the analytics team to cautiously control the processes of generating data that are accurate, timely, accessible, reliable, consistent, relevant, and detailed.
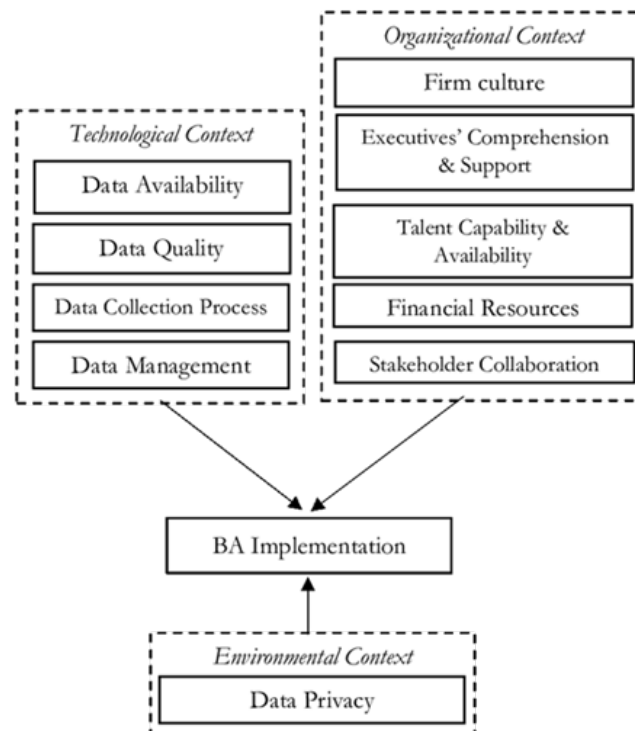
Figure 2. Conceptual Model of Challenges in BA Implementation

Challenges in Environmental Context
Data Privacy Issues

Mass collection of data is regarded to be suspicious activity, as it is related with concerns of privacy and cybersecurity (Vassakis et al., 2018; Omar et al., 2019). This is a challenge for firms regarding the data collection process, as this activity may result in liability.

There are trust issues from consumers regarding data collection. Vassakis et al. (2018) explains that most of the consumers believe that their personal data, that is collected by companies, are used unethically. Hamilton & Sodeman (2019) explains that in their case of HR management, employees may view data collection as a threat to their privacy. Akhmetova & Nevskaya (2020) adds that employees' data is also at risk of unethical use. Furthermore, smuggling recoverable data also became a serious ethics issue (Amalina et al., 2020). This case is seen as a serious privacy invasion and a sensitive issue to many stakeholders.

Therefore, in order to prevent this issue becoming a liability to firms implementing BA, safeguarding systems and policies are necessary to ensure that data collection is conducted with transparency and consent. Stakeholders should be convinced that their personal data are used ethically.

Moreover, with the emergence of General Data Protection Regulation, ethical aspects related to data are becoming a more crucial aspect in adoption of BA. Vidgen et al. (2020) asserts that firms performing in complex stakeholder environments, e.g. Social media, healthcare industry, and social care industry are the entities with highest likelihood to suffer if ethical aspects of analytics are overlooked. Thus, the exploration of ethical issues should be incorporated in firm's analytics adoption and embedded into standard practice of firm's analytics activity.

However, on the other hand, Dai et al. (2020) explains that it is challenging to maintain privacy protection during the data analytics process. Although conventional data analytics schemes maintain privacy while conducting the process, those schemes could not be implemented with huge volume data and heterogeneous structures.

CONCLUSION

In order to increase the chance of success BA implementation, firms need to consider what challenges that may be faced. The nature of BA as one of IT adoption in an organization makes it important for firms to consider the complex environment resulting in organizational challenges, technological challenges, and environment challenges.

First, within the context of organization, firms are facing the complex challenges of leadership, knowledge, stakeholders, culture, and financial support. Executives' support is crucial since they are in charge of decisions and leadership within the firm. Sufficient knowledge is a prerequisite in order to effectively integrate BA. Collaboration of stakeholders are critical, since BA is cross-functional, requiring participation and a common ground to be widely adopted in the firm. A culture of openness and analytical thinking is needed in order to absorb BA into decision making. Financial sufficiency is needed in order to obtain adequate resources to run BA. Firms also need to comprehend that all of these entities are interrelated in determining the success of BA implementation.

Second, in the context of technology, firms are facing the challenges of resources readiness such as data and underlying technologies. The issue of data availability is dependent on the collaboration of internal and external parties with the firm. The issue of data quality is related to the readiness and fitness of the data to be further used. Firms also faced the issue of having a working data collection process that may conveniently and effectively collect data. A solid data management is needed as it is related to data quality.

Lastly, related to the environment, firms may need to consider data privacy issues. Firms need to develop analytics processes that also take account of personal privacy and security. This challenge is incredibly sensitive since any failure of adherence to this ethical-related issue may result in a great risk for the firm.

Further research should focus more on the challenges of data analytics implementation across industries since issues in analytics implementation may vary thanks to different domains of use and focus. Studies may also focus on challenges in analytics adoption in different domains and techniques to address more detailed issues.

Framework constructed by this study also may be incorporated with other theories and concepts to develop structural models so hypothesis testing may be possible. Future research also needs to conduct statistical test to rank the factors based on their importance of impact towards the success of BA implementation.

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