Big Data Analytics Technology Capability and Data-Driven Decision Making in Malaysian Higher Education Institutions: A Conceptual Framework

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Abstract. In the era of big data, many organizations are aiming to become more data-driven and increase their decision-making efficiency. Nevertheless, there is an insufficient investigation that explores the antecedents of data-driven decision making (DDDM) in the context of Malaysian Higher Education Institutions (HEIs). Therefore, the study examines existing literature and utilises the Big Data Analytics Technology Capability (BDATC) dimensions such as connectivity, compatibility and modularity to conceptualize a DDDM framework. The study utilises Resource-Based Theory (RBT) to highlight the key dimensions for BDATC and how these dimensions are being integrate in order to establish effective DDDM for excellent performance. The antecedents of DDDM is a relatively new approach that is documented in literature, where literature seems to be diversified in terms of offering theoretical and conceptual frameworks, together with a model that Higher Education Institutions (HEIs) can utilize. The study chooses HEIs that undergo Malaysian Research Assessment Instrument (MyRA) as the focus of investigation. The data was collected from the key informants of Malaysian HEIs. In conclusion, the contribution of the study is to highlight the influence of BDATC for DDDM to attain better performance of HEIs in Malaysia.

1. Introduction

Big data analytics (BDA) and The Fourth Industrial Revolution (4IR) have tremendously driven the global industry to establish an innovative strategy to stay competitive. These scenarios significantly impacted global industry players as they are required to apply new ways of doing things with technology embedded within their business processes [1]. Big data is being denoted to large datasets with sizes beyond the ability of conventional software instruments to capture, curate, manage and process the data within a specified elapsed time [2]. Meanwhile, the Big Data Analytics Capability (BDAC) is being described as an organization’s ability to mobilize, deploy and utilize BDA resources efficiently; and to perform effective decision-making for strategy alignment and boosting organizational performance [3]. Despite the importance of big data analytics (BDA) and data-driven decision making (DDDM) [4], more effort needs to be conducted to understand the link between BDATC and DDDM as an emerging subject of an investigation which might bring newness to this phenomenon. Consequently, not very much is known about how BDATC can improve DDDM. As many organizations are still striving to figure out how to use data analytics, the absence of such understanding limits the ability of an organization to effectively leverage BDA for value creation. While waiting for how BDA influences organizational decision-making is better understood, realizing business value from BDA will remain a question [4].
As reported by researchers, the current practices of data analytics in Malaysia’s higher education are mostly in the traditional way where the majority of data are scattered all over desktops, offices and set in different arrangements, making them difficult to capture, consolidate and merge [5]. Thus, to practically utilize these data, managing and representing the information while securing accurate data across all databases, is a major reason for implementing big data analytics in higher education. On the other hand, data management is also an issue in actualizing big data analytics in Malaysian HEIs, as information is collected from various sources [6]. This is due to the fact that data are managed by various divisions within the institution with different configurations, and since most divisions would not corporate, gathering all of the data would be a major problem. Therefore, the conceptualization of DDDM in a higher education setting would be the important factor for implementing BDATC towards effective DDDM, and it is presumably critical to attaining superior performance.

Therefore, the subsequent section presents the literature review and related studies. Then, followed by the conceptual framework and the formulation of the hypotheses. The final section was the conclusion.

2. Literature review

Presently, more organizations want to operate smarter, more responsive, and more well-organized businesses by using accurate data to support efficient and effective decision-making [7]. This scenario is generally known as data-driven decision making (DDDM), which emphasizes making decisions based on the analysis of data rather than purely on intuition, political influence and power. DDDM is specifically beneficial and imperative when a business owns large datasets that are interconnected and include time-series data reflecting past, current and future performances [7]. Top management should comprehend that data-driven decision making (DDDM) takes priority in their day-to-day business operation [8].

2.1 The Resource-Based Theory (RBT) as the underpinning theory

The RBT has been extensively known as one of the most popular and effective theories to describe how organizations reach and maintain competitive advantage because of the resources they possess or hold under their supervision [9]. Based on the fundamental concept of RBT, an organization is seen as a collection of invaluable tangible and intangible resources, which can be brought together to create a competitive advantage [10]. The foundation of RBT describes resources as rare, inimitable and non-substitutable organizational exclusive assets that empower an organization to employ a value-creating strategy to produce income [11]. This notion was subsequently separated to differentiate between possession of strategic resource and capability-building, two different mechanisms that are significant to RBT. Possession of strategic resource includes activities of finding and buying or managing resources that are seen as being of strategic value, while capability-building is related to the instrumentation and supervision of these resources into strategically beneficial assets [12]. In addition, resources are tradable and nonspecific organization assets, and capabilities are non-tradable organization-specific capacities that integrate, deploy and use other resources within the organization [13]. Furthermore, there is researcher described the difference between possession of strategic resource and capability-building in their foundational work and illustrated possession of strategic resource is a major feature since it not only benefits the organization by way of obtaining strategic resources but is also imperative for the economic outcome of the organization by evading possibly exhausted or non-valuable resources [12].

2.2 Measuring Malaysian Higher Education Institutions performance based on Malaysian Research Assessment Instrument (MyRA)

Nowadays, the higher education sector in Malaysia is under increasing pressure to transform and be relevant to regional, national, and international demands. Unfortunately, despite huge investments by the Malaysian Government in the higher education sector, the organizational performance of HEIs, in general, is very much lacking. Based on the U21 report, Malaysia ranked 11th highest out of 50 countries, just behind Singapore for government spending on higher education, investment and R&D [14]. However, this substantial investment did not translate into successful outcomes, as Malaysia ranked 39th in terms of research output, institution rankings, enrolment, and employability. In
In contrast, China, at the 43rd ranking, allocated the least government expenditure on higher education, yet managed to achieve better returns on their investment, as shown by their ranking as the 21st in that particular category. This clearly shows the lack of efficiency in strategic planning on the part of the Malaysian Government’s investment in higher education. As a result, Malaysian HEIs are constantly searching for actionable insights for DDDM to generate strategies they can use to meet these new demands such as scoring better results in Malaysian Research Assessment or popularly known as MyRA [15]. MyRA is an important performance indicator for Malaysian HEIs, particularly in research output [16].

MyRA is underpinned by a number of important key areas of measurement. The measurement consists of eight sections (A-H) which are: A) General information, B) Quantity and quality of researchers, C) Quantity and quality of research, D) Quantity of postgraduates, E) Innovations and intellectual property, F) Professional services and gifts, G) networking and linkages, and H) Services. All universities are required to attempt a MyRA self-assessment using the web-based system that takes input data of each criterion and computes the marks obtained, which shows an indicator of a RU qualification. MyRA assessment was developed to inculcate the culture of excellence in research and development in higher education which requires strategic planning to improve performance by ensuring that the best decision is made [15]. In strategic planning, it is important to have comprehensive understanding on the factors and its connection affecting each key area of measurement in order to design relevant policies to improve its performance. However, the web-based system only allows university management to keep track of values and the calculation. Generally, it is a static model that does not attribute to strategic planning or give information on the relationship between variables. Based on that argument, implementing BDAC is capable of capturing the dynamic, complex and non-linear behaviour of a system, and supporting DDDM for strategic planning [17]. Therefore, the focus of this study is to examine whether Malaysian HEIs possess resources to implement BDAC and how BDAC influences DDDM to attain excellent performance, as well as to investigate the relationships between various elements and their interrelationships that generate performance improvement over time.

Therefore, DDDM has the potential to enable institutions to thoroughly examine their present challenges, identify ways to address them as well as predict possible future outcomes. However, because the role of BDATC and DDDM is a new phenomenon in higher education, its conceptual relevance, as well as the opportunities and limitations it might bring, is still unknown [18]. The study describes the conceptual underpinning of DDDM research and presents possible opportunities as well as limitations associated with unlocking the value of BDAC in higher education.
3. Conceptual framework and formulation of hypothesis

In order to further progress, more effort needs to be initiated in order to explore the components of DDDM capabilities and its outcomes. Thus, the study reviews the past literature review on BDAC in order to examine its influence on DDDM. The study then summarizes three approaches on how BDAC can influence DDDM, which is the Big Data Analytics Technology Capabilities (BDATC). Then, via applying the Resource-Based Theory (RBT), the identification of BDA resources to develop BDATC for effective DDDM for the purpose of improving the performance of Malaysian HEIs would be achieved. Based on Figure 1, the research proposed BDATC as the antecedents of DDDM and the performance of HEIs as the outcome of DDDM. Furthermore, several researchers highlight that technology dimensions are important in a big data environment, which helps each other improve DDDM in order to enhance firm performance [19–22]. These dimensions of BDATC and their relationships with DDDM are supported by scholar who highlighted that technology management capability is essential to explore and manage a variety of data [23].

The study hypothesized that BDATC has a positive impact on DDDM in Malaysian HEIs. The analysis that examined the influence of BDATC on DDDM suggested that connectivity, compatibility, and modularity were important dimensions for DDDM in order to achieve better HEIs performance. As literature in BDATC has devoted, organizations should be willing to allocate investments in BDATC to the gain success of their organizations [23,24]. Organisations that concentrate on BDATC for DDDM will influence and shape organizations in their business activities and will push their competencies toward superior performance. In Malaysian HEIs, the ability of infrastructure and technical software to quickly improve, deploy and support necessary system components [25] is crucial for DDDM in order to develop an effective strategic plan to improve performance of HEIs. Thus, in a dynamic, competitive and unpredictable market nowadays, the tendency of HEIs being exposed to technological change and demands due to the changing landscape of higher education and the impact of globalization is intense.

The outcome from the study will outline the influence of connectivity, compatibility and modularity capability towards DDDM for an effective strategic plan. For example, uncertainties or changes could be triggered by globalization and thus technologies will provide HEIs with a time frame to prepare an efficient response in confronting the changes. Therefore, in the context of HEIs, the antecedents of DDDM have been deliberated on and discussed in the literature review according to the three (3)
dimensions of BDATC such as 1) BDA infrastructure (Connectivity), 2) BDA process integration (Compatibility) and 3) BDA standardization and flexibility (Modularity). Therefore, based on the abovementioned figure 1, the study hypotheses are being proposed as follows;

H1: BDATC has a significant positive effect on DDDM.
H2: DDDM has a significant positive effect on Malaysian HEIs performance.

4. Conclusion

In a nutshell, founded on the research framework established in the study, there are three significant BDATC resources, which are connectivity, compatibility and modularity that can directly influence DDDM and have a significant relationship with DDDM and the performance of HEIs in the context of Malaysian HEIs. These three significant BDATC resources that are essential to HEIs were proven through experimental investigation. The study discovered that in order for HEIs to attain greater performance, these three BDA resources must be put in place. By pursuing RBT, the study has leverage on the proposing theory by constructing a framework for scrutinising the antecedents and outcome of DDDM towards achieving greater performance from HEIs. These three BDATC resources are vital for Malaysian HEIs to distinguish them from their rivals. An invaluable discovery with experimental evidence has verified and recommended that BDATC dimensions such as connectivity, compatibility and modularity should be the antecedents of DDDM for Malaysian HEIs to concentrate on and improve in order to attain superior performance for HEIs. The impact of combining both BDA resources together has formed effective DDDM, thus affecting the performance of Malaysian HEIs in particular. Over and above, the study also examined the effect of DDDM on the performance of HEIs. DDDM was exhibited based on BDATC. Therefore, the purpose of the theoretical framework constructed upon the study is to harmonise the relationship between the BDA resources and BDATC needed for DDDM in a challenging and volatile landscape. The extraction of BDA resources and BDATC was planned to determine their effects of DDDM towards the performance of HEIs.

In summary, the study took another step forward by recommending the examination of RBT in the context of BDATC and DDDM, and also the investigation of BDATC in the context of DDDM from two different viewpoints: i) a developing country which in this case is Malaysia and ii) the higher education sector. The study has added to the body of knowledge by offering three new discoveries as deliberated before, related to BDATC dimensions and the performance of HEIs that will have a huge effect towards the performance of Malaysian HEIs and the necessity of having an effective DDDM when it comes to the relationship between BDATC and the performance of HEIs. In conclusion, the contribution of the study is to highlight the influence of BDATC for DDDM to attain better performance of HEIs in Malaysia as well as assisting the policy-makers in Malaysian higher education industry to understand the role of BDATC in influencing the DDDM towards achieving the vision and mission set by Ministry of Education (MOE), Malaysia.

5. References

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