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# Exploring the Role of Big Data Analytics in Driving Financial Innovation: An Affordance Actualisation Perspective

## Research-in-progress

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## Abstract

While Big Data Analytics (BDA) is attracting business investment, the investment may not translate into business value. While prior studies indicate that BDA capability leads to performance gains, there seem to be an implied understanding that firms must follow a prescribed approach in BDA implementation without insight into why and how BDA can create value for a specific business. As BDA is an evolutionary technology, its role and benefits are not comparable to every industry context. To expand knowledge on the role of BDA in particular industries, this study explores the role of BDA in driving financial innovation in the banking industry and its successful implementation through the Affordance Actualisation lens. Preliminary results show that the various actualising activities that change the way actors work in the bank are necessary to realise the value of BDA. It also indicates the necessary changes in structure and the need to engage external sources in collaboration to mitigate the constraints in BDA value realisation within this industry.

**Keywords** (Big Data Analytics, Financial Innovation, Affordance, Collaboration, Exploratory Research)

## 1 Introduction

'Megatrends' such as rapidly changing technology, globalisation, wider social change and exogenous events such as the Covid-19 pandemic have caused major industry disruption (Ernst & Young 2020). To leverage opportunity from disruption and to gain competitive advantage, businesses invest in cutting-edge technologies with data analytics being among the top priorities for technology investment (PWC 2017). Big data analytics (BDA) is a holistic approach to managing, processing and analysing data dimensions (volume, velocity, variety, veracity, and value) to create business value and achieve competitive advantage. While firms are seeking to leverage the cost-saving and revenue potential of BDA (Kiron et al. 2014), it was reported that only 40% of BDA projects progress beyond the piloting stage (Heudecker and Hare 2016). A more recent report found that senior managers have mixed perceptions on the ability of BDA in contributing to performance gains (Davenport and Bean 2019). While BDA technology investment contributes to increased firm performance (Müller et al. 2018), recent findings show that businesses fail to derive meaningful insights from data due to obstacles from people and process (Davenport and Bean 2019). This is consistent with earlier evidence that shows that the BDA technology alone does not contribute to performance gains and it is the interplay between organisational resources; namely:- employee skills, organisation structure, data-driven culture and the technology; that leads to BDA value realisation (Akter et al. 2016; Gupta and George 2016; Mikalef et al. 2019a; Wamba et al. 2017). While studies show that that deriving value from BDA requires the orchestration of complementary organisational resources, there is still lacking empirical evidence and theoretical foundations with which to illuminate on how an organisations' actions lead to the realisation of BDA value (Mikalef et al. 2019a; Tim et al. 2020; Vidgen et al. 2017).

While there seems to be a consensus that it is the combined effect of resources and its effective orchestration that will lead to value realisation of BDA (Akter et al. 2016; Gupta and George 2016; Mikalef et al. 2019a; Wamba et al. 2017), Mikalef et al., (2019b) show that different combinations of big data-related resources have a greater or lesser significance depending on the context they are used in. The literature also argues that BDA should be viewed in the context of the wider business model, thus enabling more efficient management of massive information flows, facilitating translation of market knowledge into products and services that meet customer demands timely (Tim et al. 2020; Vidgen et al. 2017). Despite the importance of BDA for organisational strategy in particular contexts, the literature is dominated by multi-industry research with generalised firm-level performance measures (Mikalef et al. 2019b; Wamba et al. 2017). However, BDA strategy, implementation and performance benefits vary by context due to unique structures, tasks (Orlikowski and Iacono 2001), and relationship forms (Benbasat & Zmud, 2003). Therefore, different industries (e.g. entertainment, financial, automotive) with different business processes, regulations, norms and routines, will offer different applications of BDA. Therefore, this study focuses on a particular industry context, answering calls for deeper insight into the strategic value of BDA (Mikalef et al. 2019b). We focus on the banking industry, and the role of BDA in financial innovation, focusing on reduced cost and risk, and improved stakeholder benefits resulting from new products, processes, services and organisational forms. Focusing on innovation in a particular industry provides insight into the strategic value of BDA to organisations within that industry, and avoids the confounding effects of industry variation.

In short, the knowledge of how BDA is leveraged in each industry and the mechanism through which it produces value is still in a nascent stage (Dremel et al. 2020; Mikalef et al. 2019b, 2019a). Hence, the overall objective of this study is to improve the understanding of how BDA can be effectively leveraged and actioned to drive financial innovation in the banking industry. We adopt the Affordance Actualisation (AA) theory (Strong et al. 2014) as our theoretical lens to capture the underlying mechanisms of BDA implementation in banks. The AA perspective assists in recognising the potentials of technology and posit the actions required to actualise these potentials in achieving the desirable outcome (Majchrzak and Markus 2012; Strong et al. 2014). The banking industry is an interesting context to study the implementation of BDA due to its unique complexity as a service providing sector that operates in a highly regulated environment. While regulations are in place to safeguard the interest of the many stakeholders, this sector is a service providing one where meeting customer demands effectively and efficiently is of utmost importance. The various transactions inherent in the banking industry, such as deposits, loans, investments, and currency exchange contributes to large volumes of data in diverse formats. Efficient and effective management of these data could help reduce uncertainty as the increased visibility will enable the gathering of meaningful insights (Srinivasan and

Swink 2018). From an AA perspective, BDA technologies and tools provide the means to collect, store and process a large volume of data which will lead to affordances that can be actualised to achieve a desirable outcome.

Based on the discussion above, we raise the following research questions:

1. What are the affordances of BDA in the banking industry?
2. How are the BDA affordances actualised to drive financial innovation?

The paper proceeds by briefly reviewing current knowledge relating to BDA conduct and performance, and innovation in the banking industry. Next, the methodology is discussed, followed by the presentation of preliminary findings.

## 2 Background

### 2.1 Big Data Analytics (BDA)

Big data analytics (BDA) is defined as a holistic approach to managing, processing and analysing these five data related dimensions (volume, velocity, variety, veracity and value) to gain actionable insights in creating business value and obtaining competitive advantage (Fosso Wamba et al. 2017). Early evidence display that BDA value realisation requires an interplay between various organisational resources such as employee skills, organisation structure, data-driven culture and technology (Akter et al. 2016; Gupta and George 2016; Mikalef et al. 2019a; Wamba et al. 2017). As such, scholars started utilising the term BDA capability, which is broadly defined as a firm's ability to assemble, integrate, and deploy its big data-specific resources (Gupta and George 2016). BDA capability has been widely conceptualised as a combination of human skills (technical and business skills), tangible resources (infrastructure, data and financial resources) and intangible organisational resources (data-driven culture and organisational learning) that leads to performance-related outcomes (Gupta and George 2016; Mikalef 2019). However, previous studies show that BDA capability alone does not lead to enhanced performance; it is the mechanism that enables value generation from BDA is a focal point of interest. Dynamic capability of the firm and organisational flexibility have been identified to contribute significantly to BDA business value (Mikalef et al. 2019b; Srinivasan and Swink 2018; Wamba et al. 2017). However, these studies are largely multi-industry, quantitative survey-based studies that do not explicitly trace the mechanism and processes through which organisations derive value from BDA. Hence, single industry case study methods were called for to enable observation of mechanism that organisations undergo in acquiring, orchestrating, and deploying BDA resources in achieving performance gains (Mikalef et al. 2019a).

Using an affordance lens to study information systems (IS) phenomena has become quite popular among IS researchers (e.g., Du et al. 2019; Strong et al. 2014). Introduced by Gibson (1979), the term 'affordances' was originally coined in the study of animal's perception of their environment. In the IS literature, affordances are based on the relationship between the actor and the object (Strong et al. 2014). By establishing Affordance-Actualisation (A-A) theory, Strong et al. (2014) integrated an organisational perspective and separated affordances, their actualization, and outcomes. In this context, affordances are possibilities for action that an information technology (IT) object offers to a goal-oriented actor (Volkoff and Strong 2013). Scholars have used the concept of affordances actualisation to explore the process of realising the value of BDA capability and analyse its affordances on an organisational level (Dremel et al. 2020; Lehrer et al. 2018; Tim et al. 2020). From an affordance perspective, BDA technologies and tools provide the means to collect, store and process a large volume of data which will lead to affordances that can be actualised to achieve a desirable outcome. Dremel et al., (2020) illustrates how organisational actions in enacting four general mechanisms contribute to actualising BDA affordances in an automotive company while Tim et al., (2020) demonstrates that that realising value from BDA requires rearrangement of organisational process and structure. A multiple case study within the services industry that includes a bank, by Lehrer et al., (2018) illustrated how material features of BDA technology is a key organisational resource that affords service innovation. However, while they exemplify that the technological features of BDA technology afford service innovation, they lack in the explanation on the process through which the affordances are actualised.

## 2.2 BDA and the Banking Industry

The banking industry is data-rich and harnessing BDA is pivotal to this industry, especially amidst the current disruption that the industry is facing. The current emergence of alternatives to conventional financial services is considered one of the major disruptors for the banking industry, particularly the consumer banking sector (PWC 2016). To further intensify the disruption, regulators around the globe are looking into an open banking system that may usher in an entirely new financial services ecosystem, which brings more competition and innovation to the market (Deloitte 2019a). To capture new opportunities and to stay relevant, banks will have to re-invent themselves to be customer-centric and data-driven. Hence, effective decision making with regards to innovation, business transformation, and strategic change has become more imperative than ever for players within this field (Deloitte 2019b). The banking industry is responding to the challenges by investing heavily in technology (Greer, Gareth, Mazzini, & Eiichiro, 2019), with data analytics being amongst the priority for technology investment (PWC 2017).

However, to date, there appears to have been little attention to the organisational implementation of BDA in the banking industry. This lack of research might be attributed to misconception that BDA is just a technological system where mere access to data and tool will ensure value generation (Vidgen et al. 2017). In this light, the knowledge on how BDA can be implemented in the banking practise and its impact on its innovative performance is essential as BDA is increasingly being validated for its potentially crucial role in addressing the financial technology disruption in the financial services sector (Deloitte 2019a; McKinsey & Company 2019). However, little attention has been paid the role of BDA in driving financial innovation, the focus of this study.

## 2.3 Conceptual Framework

Our conceptual framework adopts the AA theory (Du et al. 2019; Strong et al. 2014) to distinguish actualisation activities by capturing how the actions of the organisation affect the realisation of affordances. The focus of this research is on the organisation-level affordances and regard both organisations and organisational entities as goal-oriented actors. Affordances are action potentials at the interaction between the actors and BDA. BDA, as the information technology artefact in studies, has been conceptualised in various ways. Orlikowski & Iacono (2001) called for developing and incorporating conceptualisations and theories of information technology artefacts in studies. They report five different views of IT artefacts conceptualisations. In this study, we take the *tools* of the IT artefact that portrays BDA as a technological tool to manipulate data. As affordances are possibilities for action, rather than actions in themselves, goal-oriented actors must actualise these possibilities in order to transform potential into results. Actualisation is defined as “the goal-oriented actions taken by actors as they use a technology to achieve an outcome” (Du et al. 2019). This definition is adopted from of Du et al. (2019), who propose to avoid using the term ‘immediate concrete’ which was originally introduced by Strong et al. (2014) in defining outcomes of actualisation actions. This is so as the term “concrete” is ambiguous, and not all (organisational) outcomes occur instantly (Du et al. 2019). As the banking industry operates in a customer-centric service providing industry within a highly regulated environment, we expect to see how the actors mitigate the constraints within the context in the realisation of BDA affordances.

## 3 Research Methods

By drawing on the theoretical foundations discussed in the section above, this work aims to investigate how affordances related to the BDA phenomenon are actualised in the context of the banking industry. This study falls in the critical realism research paradigm as it entails a realist ontology with an interpretative epistemology. Due to the exploratory nature of this research as well as our aim to develop explanations of actualisation of affordances, a qualitative research approach is considered to be the appropriate method (Eisenhardt and Graebner 2007; Yin 1994). The case study method is appropriate for this objective as it allows uncovering the process or mechanisms (Reed et al. 2006) through which affordance perceptions and its actualisations occur in a real organization. We conduct a single-case study, the implementation of BDA to uncover the process of affordance actualisation by studying the phenomenon in its natural setting (Stake 2005). Single case studies are well represented in top IS journals [e.g., Bygstad et al. (2016); Seidel et al. (2013); Dremel et al. (2020)] because of their potential to discover new insights as they allow researchers to develop a deep understanding of ISs in use in their socially embedded contexts (Orlikowski and Iacono 2001). According to Yin, (1994), a

single case study is appropriate in five situations where two of those situations fits the current study: (1) represents an extreme or unique instance, (2) is a revelatory inquiry. The banking industry has a unique complexity as a service providing sector that operates in a highly regulated environment. While regulations are in place to safeguard the interest of the many stakeholders, this sector is a service providing one where meeting customer demands effectively and efficiently is of utmost importance.

We started our research by conducting an exploratory pilot case study to pre-test the open-ended survey, interview format, conceptual framework and operationalisation of the context variables, and to refine our case-study methodology for the second stage of the study. Our case site for the pilot study is the two largest Malaysian banks, one large international Islamic bank and one large international conventional bank; operating in Malaysia. Malaysia is an emerging economy; hence the study contributes insight beyond the mature market, the Western view that dominates the literature. Globally 31% of adults are unbanked, and two-thirds own a mobile device (Demirgüç-Kunt et al. 2018). In South-East Asia, over four hundred million adults are unbanked, and a substantial number of small and medium enterprise owners struggle to access loans or payment services (Intan and Zainul 2019). The high number of unbanked consumers make the region attractive to financial disruptors and innovators seeking market expansion. In Malaysia, the virtual bank framework (Exposure Draft) was released in December 2019, intensifying competition and encouraging innovation. With the shift in regulation and the high potential for financial technology disruptors in the scene, Malaysia offers a window on future events in established markets.

### 3.1 Data Collection

Three methods were employed in the pilot study to collect data from major players in the banking industry in Malaysia. Table 1 provides more detailed information about the data collection methods and its purpose.

Method	Participants	Use in analysis
<b>Open-ended survey (8 May 2020- 15 August 2020)</b>	Bank 1- Executive VP- Strategy, Director- Risk Management, Senior Manager Bank 2- CEO, Assistant VP- Modelling and Portfolio Analysis, Manager- Internal Audit, Relationship Manager, Director Bank 3- VP-Treasury, VP- Corporate Affairs, VP- Retail Banking Bank 4- System Analyst, Assistant Manager- Business Support	Familiarise with BDA usage and its affordance related to innovation. Identify formal processes and informal routines through which BDA gets translated into innovation.
<b>Interview (August- September 2020)</b>	Two analytics service providers (one face to face and one online)	Improve understanding of the BDA driven innovation process. Triangulate and integrate with evidence from the open-ended survey and secondary data.
<b>Secondary source analysis</b>	2019 annual reports-corporate section of all four banks	Gain an understanding of the corporate mission and vision, insights into the strategy of the organisation and the organisational aspirations with regards to BDA use and innovation.

Table 1: Data collection methods

### 3.2 Data Analysis

As the aim of this study is to understand how the BDA affordances are actualised to drive financial innovation, we plan to adopt a critical realist data analysis approach focused on uncovering the generative mechanisms that explain empirical outcomes. The identification of affordances assists researchers to specify mechanisms that explain the outcomes of new technology in organisations (Volkoff and Strong 2013). Taking the lead from previous literature that employed the critical realist approach in the analysis of data, (Bygstad et al. 2016; Leidner et al. 2018), this study undertakes a five-step process beginning with open coding of all statements in the open-ended surveys, corporate annual report section, and interview transcripts and notes to identify key events in financial innovation following the utilisation of BDA.

## 4 Findings

Preliminary analysis of the data revealed emerging themes illustrated in Table 2. We identified first-order concepts that were further refined into affordances which arose from the relationship between BDA and actors of the respective organisation. We also find that actualisations of some affordances are contingent upon actualisation of other affordances. Constraints inherent to the regulated industry, such as central bank regulation against the usage of cloud computing, large legacy system, and data integration problems due to data governance policies also emerged. Some enabling activities to actualise affordances and to mitigate these constraints also came to surface, but more data is needed to establish the mechanism of organisation in actualising affordances. The outcome- financial innovation in the form of products, processes and organisational forms also emerged. Based on our findings from the pilot study we concluded that (1) foreign banks operating in Malaysia are to be excluded as they are dependent on instructions, activities and directions from parent bank which brings differences in routines, (2) to capture the richness of activities, we have decided to concentrate on one local bank only, (3) the required data are too difficult to obtain from an open-ended survey, and some questions in the survey were found to be redundant, as such further interviews will be conducted with bank employees to unravel the actualisation mechanisms, (4) the interview questions are to be amended to be more probing towards constraint mitigation activities.

Affordances	Constraints	Enabling Activities	Outcome (Financial Innovation)
<ol style="list-style-type: none"> <li>1) Establishing a targeted marketing approach</li> <li>2) Enhancing Artificial Intelligence capability</li> <li>3) Managing the current Covid-19 pandemic</li> <li>4) Risk Diagnosis</li> <li>5) Deliver superior customer experience</li> <li>6) Data-backed product and service development</li> <li>7) Enhanced performance management</li> <li>8) Data backed pricing strategies</li> </ol>	<ol style="list-style-type: none"> <li>1) Central regulations</li> <li>2) Legacy systems</li> <li>3) Data silos</li> <li>4) Trouble in between team data collections (data integration)</li> <li>5) Data quality</li> </ol>	<ol style="list-style-type: none"> <li>1) Redefining operating culture policies, process and infrastructure</li> <li>2) KPI used to shape culture</li> <li>3) Strong management support</li> <li>4) Data Office- Enterprise-wide data transformation-overall data vision, strategy, supporting business function, policy refining</li> <li>5) Reskilling employees</li> <li>6) Expanded data warehouse to increase data storage</li> <li>7) Acquisition of new employees with needed talent</li> <li>8) Collaboration with start-up Fintech companies</li> <li>9) Rebuilt customer experience measurement ecosystem to determine key metrics that are vital to customers</li> </ol>	<p><b>Product:</b></p> <ol style="list-style-type: none"> <li>1) Cross-selling</li> <li>2) Bespoke products</li> <li>3) Personalised solutions</li> <li>4) Proactive Financing</li> <li>5) Customised products</li> </ol> <p><b>Process:</b></p> <ol style="list-style-type: none"> <li>1) Robotic process automation</li> <li>2) Early Warning Indicators (EWI)</li> <li>3) Live-Chat</li> <li>4) Net-Promoter Score</li> <li>5) Alternative Credit-Scoring</li> <li>6) Payment platforms- E-Wallet, Tap 2 Phone</li> <li>7) Better audit and compliance</li> <li>8) Real-time customer pre-screening</li> <li>9) Online account opening</li> </ol> <p><b>Organisational form:</b></p> <ol style="list-style-type: none"> <li>1) Fully digital bank</li> </ol>

Table 2: Emerging Themes

## 5 Discussions

This research aimed to explore the role of BDA in driving financial innovation, drawing on a case study. Most previous studies examined the business value of BDA, using generalised performance measures across multiple industries. While these studies provide an overall insight into the logic of investing in BDA technologies, insight into the role of BDA in particular industries, concerning the particular tasks that drive performance is lacking (Benbasat and Zmud 2003). The way BDA is used or can be used in the banking industry as opposed to other industries may differ significantly. As such, the present study does not assume a direct association with performance, but rather, examines the role that BDA plays in the regenerating mechanisms of banks, which is financial innovation.

Preliminary findings indicate that actualising BDA affordances are crucial to innovating product, process and organisational forms in the banking industry. Supporting Lehrer et al. (2018), BDA technologies are a key organisational resource that enables service automation and enable managers to personalise customer service (e.g. suggesting credit cards for students and home mortgages to young working adults). The present study reiterates the ability of BDA to offer personalised services. It provides further knowledge that BDA not only serves as a trigger to personalise marketing efforts but also to customise products that are offered to customers, personalise pricing of products, afford better risk management by sending early warning indications, promotes financial inclusion and paves the way for a fully digitalised bank.

The preliminary results show that the various actualising activities that change the way actors work in the bank are necessary to realise the value of BDA. Early findings also indicate the necessary changes in structure and the need to engage external sources in collaboration to mitigate the constraints inherent in this industry. While previous studies concentrated on the orchestration of internal resources, this study highlights the collaborative or networking capability of a firm is important as there are various resources and capabilities that exist outside the banks (for example, FinTech start-ups) that can be leveraged in the creation of value. Besides leveraging on external sources to enable innovation, being a highly regulated industry, data governance and a structured transformation process are also found to be an important aspect of BDA implementation in the banking industry.

We examine the role of BDA in financial innovation. It contributes to emerging literature related to financial innovation. The study also seeks to enrich the perspective of technological affordances in IS literature. The present study contributes to understanding the actualisation of BDA affordances in the presence of external constraint in the form of regulations and how the actualisation of the affordances within the constraint leads to more affordances. These findings, whilst preliminary, may serve to extend current insight into the business value of BDA, supporting the more detailed investigation of BDA implementation in the banking industry.

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