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Business Analytics (BA) - powered transformation for environmental and social sustainability in organisations: A dynamic capabilities perspective

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Business Analytics (BA) - powered transformation for environmental sustainability in organisations: A dynamic capabilities perspective

Research-in-progress

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Abstract

The impetus to address issues of global warming, pollution, and biodiversity is urging organisations to focus on their environmental sustainability goals (ESGs). This has a direct impact on how organisations operate and define their competitive advantage. This study seeks to provide insights into the BA-powered capabilities that are leveraged by organisations to achieve their ESGs. Previous studies have explored the role of BA in strengthening dynamic capabilities (DCs), and the positive relationship between DCs, environmental, social, and economic sustainability, yet further exploration on the BA-powered capabilities that transform organisations for sustainability is required. Our research examines how BA can facilitate the development of socio-technical capabilities that power organisations to adapt, reconfigure, and transform their internal processes to achieve sustainability. Our findings aim to advance understanding of the capabilities required to (i) unlock sustainability-related insights from analytics, and (ii) transform insights into value-creating activities to help organisations attain their ESGs.

Keywords business analytics, big data, environmental sustainability goals (ESGs), environmental sustainability, dynamic capabilities (DCs)

1 Introduction

The public demand for organisations to be environmentally conscious has reached a threshold at which organisations must consider the impacts of their operations at the core of their decision making. To date, organisations have done little to proactively incorporate sustainability measures into their business models. However, the emergence of sustainability frameworks such as Environmental-Social-Governance is driving organisations to reconsider their sustainability position from a strategic perspective. Driven by the advancement of digital technology, research increasingly emphasises the need for leveraging information systems (IS) to attain sustainable development goals. Organisations have harnessed sustainability management IS to control their environmental impacts, for example, CO_2 emissions. Despite the centrality of IS to sustainability imperatives, there is a lack of clarity regarding the information needs of decision-makers in relation to sustainability-related decisions. In turn, this can limit the value generation opportunities if the right information is not available at the right time and most importantly, to the right people (Stefan & Letier 2014). We need an in-depth understanding of the iterative process of deriving and leveraging data-driven insights to power effective actions that adapt to external factors, coordinate internal resources and capabilities, and attain their sustainability goals.

Over the past decade, studies exploring Green IS initiatives for environmental sustainability have increased in number, and have focused on eco-efficiency, eco-equity, and eco-effectiveness dimensions. Whilst studies propose that Green IS artefacts can improve decision making and knowledge creation, there is still a need for further empirical evidence to illustrate the capabilities required for organisational stakeholders to generate actionable insights for sustainable transformation (Hedman & Henningson 2016). More and better-quality data is required for organisations to measure and assess their impact on the environment, identify problems with current processes, and continuously monitor the outcomes of their sustainability initiatives. Business analytics (BA) has become an essential capability for digital transformation in organisations (Gust et al. 2017), with the focus on the impact of BA on firm performance such as productivity and annual growth rates (Müller et al. 2018). However, the BA capabilities required to identify new opportunities and harness them to reshape and transform business models and processes in the pursuit of attaining sustainability goals remain elusive. Researchers have called for a greater understanding of how BA capabilities can be leveraged to power and support organisational capabilities (Mikalef et al. 2020), which can be extended to the sustainability domain. Outlining the end-state of a technology-powered transformation is important, yet how organisations continuously adjust their capabilities to achieve such a transformation is imperative (Yeow et al. 2018).

Existing BA research often adopts a static view to investigate BA value realisation through a variance model. To attain their environmental sustainability goals, we need a more dynamic view to explain how BA powers organisations to adapt to internal and external changes. The dynamic view of pursuing environmental sustainability requires organisations to become proactive in their strategic endeavours, which have been associated with improved performance and competitive advantage (Aragón-Correa & Sharma 2003). The proactive approach relies on the effective use of BA to influence organisational technical and business environments.

The aim of our study is to understand the capabilities generated by BA-based digital innovation, and how these capabilities lead organisations to transform their business processes to achieve environmental sustainability goals. Specifically, our research addresses the following research questions: i) What are the BA-powered dynamic capabilities (DC) used by organisations? and ii) How do BA-powered dynamic capabilities transform organisations to attain environmental sustainability goals? Drawing on DC theory (Teece et al. 1997; Teece 2007), we use a case study approach to develop a theoretical model of BA-powered organisational transformation for sustainability. We collect data from Envizi, a company that produces BA-based digital innovation, and client organisations that use the innovation for their sustainability initiatives. Our primary data consists of semi-structured interviews and secondary data including organisational documents, business blogs, etc. We conduct interviews at an Australian-based company that has developed the BA-based software for tracking environmental sustainability data (such as greenhouse gas and energy consumption data), and its client organisations that use the developer company's software. Our data analysis seeks to identify the relationship between BA-capabilities, DC, sustainability goals, and the external and internal organisational environment.

While prior research has examined using BA to generate insights that strengthen DC, relevant insights have not yet been applied to the sustainability context in organisations. This research-in-progress study seeks to contribute to the literature by examining BA for environmental sustainability in the organisational context, an area of increasing interest, and one which has not been extensively addressed in prior studies. Our research is one of the few empirical studies that develop a process model to explain the attainment of environmental sustainability in organisations. Our research will specifically explore

this area by examining how BA measure organisational-specific sustainability factors and their progress, enabling sustainability champions in organisations to sense opportunities, seize them, and transform the way they operate.

2 Background Literature Review

2.1 Dynamic Capabilities Theory

Dynamic capabilities theory extends the resource-based view of an organisation, proposing that capabilities, rather than resources, are necessary to create renewable and sustainable value (Witschel et al. 2019). The theory was proposed by Teece, Pisano and Shuen (1997) to account for the discrepancy between organisations that are able and not able to harness their resources to sustain competitive advantage. Resources and strategy alone are insufficient to gain competitive advantage - capabilities are necessary to effectively coordinate and reconfigure internal and external competencies to enable timely responsiveness and rapid innovation (Teece et al. 1997). In other words, 'dynamic' entails the organisational capacity to renew existing competencies in changing business environment, and 'capabilities' denotes the adaption, integration, and reconfiguration of internal and external organisations skills, resources, and functional competencies (Teece et al. 1997). Specifically, DC refer to "the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments", and further suggested that these capabilities can be disaggregated into 'sensing', seizing' and 'reconfiguring' (Teece 2007). Because achieving sustainability requires organisations to continuously sense and seize opportunities to address environmental challenges, DC theory will enable us to investigate the phenomenon from a process perspective (Warner & Wäger 2019).

Prior research posits that BA has a positive impact on the development of DC in organisations (Mikalef et al. 2020). The process model to be developed will leverage prior findings to build an approach for the effective use of BA in attempting to become more sustainable, aligning with sustainability frameworks in industries. Drawing on DC (Teece et al. 1997; Teece 2007), we understand how BA powers organisations to sense and seize opportunities or challenges, thereby continuously creating value in the sustainability domain. Specifically, we unpack the processes by which organisations can identify opportunities and re-configure their resources and strategy to adapt to changing environments (Yeow et al. 2018). As this study employs case studies of different organisations that commenced their sustainability journey at different points in time, the underlying processes by which the use of analytics contributes to DC development can be distinguished between more proactive, earlier adopters of analytics-based sustainability initiatives in comparison with more reactive, later adopters.

2.2 Digital Sustainability in the Environmental Dimension

Increasing awareness of environmental issues such as climate change has driven consumers, investors, organisations, and governments to recognise the pressing need for sustainable development in our day-to-day lives. Sustainability refers to the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). Sustainability is viewed through the triple-bottom-line principle (TBL) in environmental, social, and economic dimensions (Elkington 1998), encouraging organisations to evaluate business performance through the environmental and social impact of their activities, in addition to their economic obligations (Dao et al. 2011). Large organisations play an essential role in supporting and addressing sustainability challenges, which derive from pollution (e.g., greenhouse gases), depletion (insufficiently reusing and recycling materials), and poverty (e.g., minority unemployment) (Hart 1997). Whilst the profit motive strongly drives business actions, research suggests that profits and profitability alone no longer ensure the long-term success of a company (Kleindorfer et al. 2005).

Environmental sustainability refers to "stakeholder behaviour impacting on the natural environment that meets the needs of the present without compromising the ability of future stakeholders to meet their own needs" (Elliot 2011). Strategies for environmental sustainability in organisations include pollution prevention, product stewardship, and harnessing cleaner technology. Many organisations, however, perceive environmental sustainability and green management as a costly responsibility or a compliance issue. This inhibits initiatives to gain traction with key stakeholders and results in poor actualisation of ESGs (Lokuge et al. 2020). Alternatively, organisations that have proactively followed environmentally sustainable practices and incorporated them into their strategy have realised benefits, and have gained external support from governments, non-government organisations and the public as they prioritise their environmental concerns (Lokuge et al. 2020). The application of Green IS to address environmental issues has gained growing attention in research, through the creation and implementation of IS/IT. Whilst the focus of Green IS remains "the design and implementation of

information systems that contribute to sustainable business processes" (Boudreau et al. 2008 p.2), the focus of this study is on the implications and outcomes of an emerging IS technology, BA, and how the use of BA-powered capabilities facilitates organisational transformation.

2.3 BA-powered Digital Transformation

It is imperative for organisations to transform and attain a more environmentally sustainable business model. The emergence of digital technologies such as analytics has provided a range of avenues for organisations to transform their businesses, sparking interest in digitalisation and digital transformation. Digital transformation refers to "the use of new digital technologies (social media, mobile, analytics or embedded devices) to enable major business improvements (such as enhancing customer experience, streamlining operations, or creating new business models)" (Fitzgerald et al. 2014, p.2). Research on digital transformation focuses on triggers and contextual conditions (Wessel et al., 2020), transformational dimensions and the transformation process (Yeow et al. 2018), the outcomes of the transformation (Hanelt 2021), and enablers and barriers of the transformation (Singh & Hess 2017). Much of the existing literature on transformation outcomes has focused on the economic consequences such as cost reductions, but little has focused on the environmental or social benefits. Transformation occurs at both the strategic and operational levels of an organisations, which involves exploring and leveraging digital capabilities to transform a business model or process (Hausladen & Zipf 2018).

BA has become an essential capability for digital transformation in organisations. Prior literature has highlighted that investment in BA infrastructure proves futile unless complemented by other capabilities and factors that enable the effective and efficient use of such technologies (Gust et al 2017). Researchers have called for a greater focus on how BA capabilities can be leveraged to both enable and support organisational capabilities (Mikalef et al. 2020). Research on BA capabilities has primarily focused on their direct effects on firm performance. For example, four BA capabilities are important for digital transformation and sustainability societies: technical/managerial skills, data-driven culture, technology, and organisational learning (Mikalef et al. 2020). Driven by an analytics culture, organisations shift from traditional intuition and experience-based decision making to a data-driven approach, with top management becoming crucial in driving big data initiatives (Mikalef et al. 2020). Analytics capabilities are therefore dependent on both human and non-human elements.

Human capabilities comprise both skills (technical and managerial) and knowledge (technical management and relational knowledge) that should be acquired to fully strengthen an organisation's capability. Non-human capabilities involve data, basic resources, BDA infrastructure capabilities, organisational learning, and a data-driven culture (Pappas et al. 2018). A data-driven culture enables decision-makers to leverage insights rather than instinct (McAfee & Brynjolfsson 2012) and facilitates firms to align their analytics capabilities with their business strategy (Vidgen et al. 2017). Organisational learning is an important aspect in spurring the success of big data initiatives, enabling individuals to exploit existing knowledge and continuously explore new knowledge to keep up with market changes. Despite the increasing importance of BA, evidence from empirical studies operationalising BA is scarce (Mikalef et al. 2018).

Investing in BA has enabled firms to be more proactive in identifying new business opportunities and in gaining competitive advantages. However, BA capabilities required to identify new opportunities, harness them to reshape and transform business models and processes in the pursuit of attaining sustainability goals are unclear. Moreover, the dynamics between BDA capabilities and other existing or developing organisational capabilities for sustainability is unknown. Recent empirical research adopts variance approaches to investigate how BA interact with existing organisational capabilities, suggesting that BA positively affects a firm's DC, which strengthens both marketing and technology capabilities through a variance model (Mikalef et al. 2020). In our research, we explore the dynamic process of continuously leveraging BA to sense, seize, and transform a business in a sustainability context and examine the external organisational conditions that impact this process.

3 Research Design and Methodology

We use the case study method to develop insights into BA-powered transformation for sustainability. The study will use semi-structured interviews and archival data from a developer company (Envizi), and two client organisations using the Envizi software. Our literature review has identified a paucity of empirical studies that explore how organisations can develop BA-enabled capabilities to create value

within the sustainability context. We use an exploratory case study to examine the mechanisms through which organisations use BA to inform decision making for sustainability initiatives. We draw on dynamic capabilities theory to theorise empirical findings.

3.1 Data Collection

We have conducted interviews with 18 participants, with 5 participants from the developer company, and 13 across the two client companies (PropertyEx and BankEx). Following the principle of theoretical saturation, no new information is yielded from any additional interview data collected. Overall, our data collection focuses on the quality, depth, and variety of informative perspectives that inform us to develop concepts for BA-powered sustainability.

3.2 Data Analysis

We use NVivo 11 to analyse our data. We apply a three-level coding approach to develop theoretical concepts (Gioia et al. 2013). We address our research questions by theorizing key capabilities powered by business analytics software for organisations to continuously achieve their ESGs.

3.3 Preliminary Findings

Based on our preliminary data analysis, we identify two types of BA-powered capabilities: BA-powered *sensing* capabilities, and BA-powered *seizing* capabilities. We provide examples from data collected from both client organisations that use Envizi, PropertyEx and BankEx. We then outline how each capability enables organisations to undertake activities to address challenges in attaining their ESGs.

3.3.1 BA-powered Sensing Capability

PropertyEx developed a new outcomes-based reporting methodology to provide more accurate measures to assess their performance against sustainability objectives for materials and waste management. The shift from an input-based to an outcomes-based methodology occurred as the sustainability team needed to better understand the end-of-life outcomes of their waste. The widely used 'input-based' reporting across all industries focuses on the measurement of waste at the point of disposal. In comparison, PropertyEx's novel 'outcomes-based' reporting approach traces waste all the way to its end destination, as most waste in recycling streams ends up in landfill. Furthermore, PropertyEx developed their bespoke BA-powered dashboard, and manipulated the current database structure to capture the more granular outcomes-based waste information in collaboration with Envizi. This allowed the sustainability team to categorise and visually display their waste data according to grades, either an 'A-grade' (materials met a closed-loop objective), a 'B-grade' (materials are downcycled), a 'C-grade' (materials have a one-off end use), or as landfill. Visualised dashboard highlighted the volume of C-grade materials and waste ending up in landfill, enabling the sustainability team to *sense* the need to increase the procurement of higher-grade, closed-loop materials.

"The real trick is going to be, how do we get that measurement of the materials in the first place? Of the materials that we control, what percentage of them are actually in a closed-loop process … But then … when you measure that, you go, well, we need to look at the other side of the equation, what we [also] buy, not just what we manage through a waste contract."
- *Head of Sustainability and Energy, PropertyEx*

BA also drives the sustainability team at BankEx. For example, when reviewing their emissions relating to office paper consumption, the team *sensed* that collaborating with the procurement team could assist in driving down their scope 3 emissions.

"We need to source more carbon neutral paper to reduce our emissions … we can give that insight to our procurement team to reach out to the vendors to update some of their new tenders and contracts …we do give those insights to other departments, but we don't necessarily directly make decisions."
- *Energy & Sustainability Analyst, BankEx*

3.3.2 BA-powered Seizing Capability

PropertyEx was able to *seize* new opportunities around the application of renewable energy through manipulating their historic BA data. In pursuing their ambitious sustainability targets, competition for capital is a key challenge. The sustainability team at PropertyEx relies heavily on measurement and verification (M&V) for piloting and implementing new initiatives. They explored alternative renewable energy sources, such as solar panels, and exploited their data-driven capabilities by manipulating historic data to create synthetic datasets. This enabled them to identify the potential impact on the

annual performance of their proposed initiatives. Taking solar energy as an example, PropertyEx combined several datasets including the actual energy consumption and efficiency of the solar cells. PropertyEx then analyzed the market information to identify the most cost-efficient option and the optimal timing to implement renewable initiatives. PropertyEx was able to *seize* new sustainability opportunities by leveraging BA to secure buy-in and funding from senior leadership and ensure that they are "doing the right thing" in a way that maximises both financial and environmental outcomes; thereby giving credence and credibility to the work of their sustainability team.

"... sometimes you can make a synthetic dataset to run your modelling in advance.... So, we don't necessarily even need to do something before we can test it. So I want to change X to Y, I know the difference when I peel it back to fundamentals is a certain change. Apply that across existing data sets and the outcomes, your savings equation, there's your business case being built!"
- *Head of Sustainability and Energy, PropertyEx*

BankEx also used BA to *seize* opportunities to justify investment in ESG initiatives. Given the potential of IoT sensors to increase building efficiency, BankEx identified the opportunity to rollout a sensor pilot across many of their branches. In doing so, they created a proof-of-concept for further emission reductions, justifying the investment for sensors to be implemented across their other branches. Having IoT sensors enabled them to remotely control the building in real-time, increasing both workforce efficiency and their ability to attain their scope 1 and 2 emission reductions targets.

"If everything is smart, right, then we can remotely control the building…if we had IoT we could dial in and see whether all the AC's [air conditioners] are on. If [they] are operating well then, we can just tell the branch manager [that] and we have another sensor showing the outdoor temperature.... We won't spend [money] dispatching a technician because he'll just go and say everything's working."
- *Energy & Sustainability Manager, BankEx*

4 Next Steps and Conclusion

Regarding next steps for our research, we will analyse data to theorise key BA-powered sensing and seizing capabilities at each company. Based on our preliminary analysis, we find that the banking industry has established frameworks for BankEx to apply and follow. In contrast, PropertyEx needs to develop its own frameworks and methodologies to measure sustainability initiatives. Such differences require the two companies to develop different capabilities when using BA to attain their ESGs. Our further analysis will examine the capabilities required for early-stage companies that are just starting to address the sustainability imperative using BA, and for more mature companies who have leveraged BA to generate insights for a longer period. We expect to see that early-stage companies adopt a reactive approach to respond to industry requirements for ESGs, whereas mature companies adopt a proactive approach to drive their sustainability initiatives.

Furthermore, we will examine BA-powered capabilities from both strategic and operational perspectives. Using the insights gained from our data analysis and prior literature, BA-powered operational capabilities lead to environmental sustainabilities outcomes such as eco-efficiency, whereas BA-powered strategic capabilities lead to outcomes such as eco-equity. We will develop a model to explain the process of using BA to facilitate organisations to identify and leverage opportunities for achieving these outcomes. Our model will also highlight the contextual conditions that trigger organisations to use certain BA-powered capabilities to address the challenges that a company face to attaining ESG.

In summary, this research-in-progress paper investigates the use of BA-based digital innovation for sustainability in two organisations and the capabilities that are powered by BA. Our preliminary findings have suggested that these two organisations have experienced positive outcomes from adopting the software, which enables them to achieve their sustainability goals through the development of dynamic capabilities in sensing and seizing. The study posits that clients reap greater benefits from implementing the software when developing both human capabilities (such as technical and managerial skills), and non-technical capabilities (such as organisational learning and data-driven culture). Successful sustainability practices use BA to develop capabilities to achieve operational and tactical outcomes, as well as to generate strategic implications for long-term organisational viability.

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