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Realising Value from Big Data Technology Adoption: Understanding the Role of Organisational Capabilities in the Affordance Actualization Process

Completed Research Paper

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Abstract

The adoption of big data technologies presents organisations with many value creation opportunities that can transform and improve their business. Much of the research today focuses on big data value creation (what value big data technologies offer), whereas limited research focuses on big data value realisation (how big data value is realized). We aim to fill this research gap by addressing the following research question: how do organisations effectively realize value from the adoption of a new big data technology? We do so by adopting an affordance theory lens and empirically examine the adoption of smart meters (a big data technology) in the UK energy sector. We introduce the concept of actualization enablers, and our findings provide empirically grounded insights into the role of organisational capabilities and actualization enablers in the big data value realization process (affordance actualization). Furthermore, our findings provide important and relevant theoretical and managerial implications.

Keywords: Value realization, big data technology, organizational capabilities, affordance theory

Introduction

Big data technologies are advanced technologies that enable data to be collected in real-time, at large volumes, and with low costs (Ringel and Skiera 2016). Anecdotal evidence suggests that insights derived from big data technologies have the potential to transform business strategies and business models and thereby improve marketing, product and service development, human resources, operations, and other core business functions (Chen et al. 2015). Extant research has highlighted that there are many value creation opportunities that arise from big data technologies and they include: better understanding consumer behavior (Du et al. 2015; Fróes Lima et al. 2016; Hajli et al. 2020), making more informed business decisions (Danaher et al. 2014; Steinberg 2020), improving business processes (Côrte-Real et al. 2020; Galetsi and Katsaliaki 2020; Malik et al. 2018), developing business model innovation (Bharadwaj and Noble 2017; Mikalef and Krogstie 2020; Toubia and Netzer 2017), and better understanding the competitive marketplace (Nathan and Rosso 2015; Ringel and Skiera 2016). Alongside this enthusiasm, there has also been concern that many organisations are failing to reach their strategic goals despite investing substantial

resources in big data technologies (Grover et al. 2018). To respond to this practical issue, researchers have started to investigate *how* organisations realize value from the adoption of new big data technologies (Fosso Wamba et al. 2015; Grover et al. 2018; Günther et al. 2017; Mikalef et al. 2018). By doing so, these insights can also help organisations understand why their technology investment efforts may be falling short of anticipated expectations.

A number of studies have shown the benefits of using big data technologies in different contexts (Bag et al. 2021; Côrte-Real et al. 2017; Gu et al. 2021; Gupta and George 2016; Gupta et al. 2020; Mehmood et al. 2017; Mikalef et al. 2020; Shamim et al. 2019), still there is a lack of theoretically driven research on how to effectively utilize and manage them in order to gain competitive advantage (Mikalef et al. 2018). In essence, this is because much of the literature has focused on the value creation element (what value big data technologies can offer), as opposed to the value realisation element (how value from big data technologies is realised). This is further exemplified by the large number of quantitative studies (e.g.,Bag et al. 2021; Lam et al. 2017; Reis et al. 2020; Vitari and Raguseo 2020) and a limited number of qualitative studies (Dremel et al. 2020; Lehrer et al. 2018), see table 1 on pages 4-5. For this reason, the current literature on big data value realization has been described as "a limited number of empirical studies and some repackaging of old ideas" (Günther et al. 2017). In fact, the majority of studies in the field seek to test the relationship between a wide range of antecedents and outcomes of big data investments on firm performance, as opposed to seeking to understand and explain how big data value creation is effectively managed and realised. As such, there is consensus amongst scholars that the literature on big data value realisation is still at a nascent stage whereby theoretical frameworks and empirical evidence on how organisations realize value from the adoption of big data technologies remain limited. For this reason, there has been a call for more research that looks into understanding the processes, mechanisms, and capabilities through which organisations realize value from big data technology adoption (Chen et al. 2015; Fosso Wamba et al. 2015; Grover et al. 2018; Mikalef et al. 2018).

In the last decade, affordance theory has emerged within the field of information systems as a predominant way to theorize on the process of technology adoption by leading researchers in the field of information systems (Dremel et al. 2020; Lehrer et al. 2018; Leonardi 2013; Strong et al. 2014; Volkoff and Strong 2013). Affordances represent possibilities for action: they are what organisations with certain goals and capabilities can do with a new technology (Strong et al. 2014; Volkoff and Strong 2017, 2013). The concepts of affordances (value creation) and affordance actualization (value realisation) have been utilized as a way to better understand how organisations effectively *realize* value from the adoption of big data technology. Affordance theory does so by allowing researchers to examine the rich and complex relationship between actors/users and technology artefacts/new technology adoption. A handful of studies have investigated the value realisation process of big data technologies by investigating the role of organizational actions (Dremel et al. 2020), and technological features (Lehrer et al. 2018) in the value realisation process. However, a holistic view of big data value realisation including the role of organisational capabilities has not yet been advanced (Chen et al. 2015; Günther et al. 2017; Mikalef et al. 2018; Meriton et al. 2020). Despite capabilities being one of the key principles of affordance theory, whereby having certain capabilities is a necessary condition for affordance actualization to take place (value realisation), no study has so far investigated the role of organisational capabilities in the value realisation process.

Against this backdrop, this study aims to fill the above outlined research gap by addressing the following research question: how do organisations effectively realize value from the adoption of a new big data technology? More specifically, this research aims to empirically examine the role of organisational capabilities in the affordance actualization process. To do so, we adopt an affordance theory lens and empirically examine the adoption of smart meters (a big data technology) in the UK energy sector.

This research makes important empirical, theoretical, and managerial contributions. Firstly, we introduce the concept of *actualization enablers* as the pathways through which organisational capabilities enable affordance actualization (big data value realisation). Moreover, we provide empirically grounded insights into five key organisational capabilities and thirteen actualization enablers necessary for big data value realisation to take place. As a result, we provide a holistic understanding of how organisations realize value from the adoption of big data technologies that move beyond the technical aspects of big data value realisation. Secondly, we extend affordance theory to an under researched but highly relevant research context: the adoption of smart meters in the energy sector and provide empirical evidence into the role of organisational capabilities and actualization enablers in the affordance actualization process. Lastly, we

provide rich and practical insights into how managers can effectively realize value from the adoption of big data technology, especially within incumbent firms.

Research Background

Smart Meter Technology Adoption

In 2008, the UK government passed the energy act (*Energy Act* 2008) which gave powers to begin the process of adopting smart meters in the UK energy sector. A few years later, in 2011, the smart meter mandate was in force, which obliged energy suppliers to offer every home and business in the UK a smart meter by 2020. Smart meters are advanced electricity and gas meters that offer a range of intelligent functions to consumers, operators, and networks by providing the means to automatically record and communicate energy consumption data in near real-time (Hinson 2019). They are the biggest and most important digital transformation upgrade to the national energy infrastructure in the UK (Ofgem 2017), with the aim to build a flexible and resilient energy system that is fit for the 21st century (BEIS 2018). Smart meters are intended to create a digital and data-driven energy system that will provide many intended benefits for energy consumers (e.g., accurate bills, easier switching), energy suppliers (e.g., reduced customer service overheads, reduced site visits), and energy networks (e.g., balancing the grid) (Hinson 2019). Moreover, smart meters encourage the emergence of innovation opportunities within and beyond the energy sector and allow for the seamless integration of new technologies and services into the energy system (BEIS 2018). The combined benefit of smart meters to consumers, suppliers, and networks is estimated at £19.5 billion (BEIS 2019).

Affordance theory

Gibson (1986), an ecological psychologist, developed the concept of affordances in his study of animals' perception of their surroundings. According to Gibson, humans, along with animals, orient to objects in their world (rocks, trees, rivers) in terms of what he called their *affordances*: the possibilities that they offer for action. The concept reflected his belief that animals and humans do not perceive the many minute details of an object, but directly and holistically perceive what the object will enable them to do. Gibson defined affordances as *"what is offered, provided, or furnished to someone or something by an object."* For example, a fallen log affords a person the opportunity of sitting. Therefore, an affordance arises from the relationship between the ability of the person and the features of the artefact. Affordance theory offers the building blocks to provide explanations of a phenomenon we observe and want to understand by explicitly incorporating the IT artefact into the analysis. It provides "a *new way of thinking about the artefact/user relationship that can be useful for generating new socio-technical theories"* (Volkoff and Strong 2017). Importantly, it is aligned with the way practitioners who deploy and use IT think about adoption challenges (Volkoff and Strong 2017).

Volkoff and Strong (2013) translated affordance theory from the field of ecological psychology into the field of information systems. As such, they offer a more contextualized definition of affordances as *"the potential for behaviors associated with achieving an immediate concrete outcome and arising from the relation between an object (e.g., an IT artefact), and a goal-oriented actor or actors"* with the necessary capabilities (Volkoff and Strong 2013). Therefore, the focus is not on "*what features digital tools or artefacts possess, but how actors' goals and capabilities can be related to the inherent potential offered by the features"* (Nambisan et al. 2017). Affordances can operate at the individual level (one person) as well as on the organisational level (a group of people) because they can involve multiple actors doing different things to accomplish a joint goal (Volkoff and Strong 2017). Organisational affordances have been defined as *"the extent that the potential actions enabled are associated with achieving organisational-level concrete outcomes in support of organisational-level goals"* (Strong et al. 2014). Simply put, organisational affordances are the possibilities for action that organisations with specific goals and capabilities can achieve by adopting a new technology.

While affordances are the *possibilities for action*, affordance actualization is the *action itself*. As such, in order for an affordance to be actualized someone must exist with the necessary capabilities and a goal that is served by actualizing the affordance (i.e., actioning the possibility for action) (Volkoff and Strong 2013). On the other hand, organisational affordance actualization is about the organisational actions taken by an organisation with the necessary capabilities to achieve organisational outcomes that serve an

organisational-level goal (Strong et al. 2014; Volkoff and Strong 2017, 2013). While affordances can be somewhat abstract and applicable across potential actors with a shared goal and associated capabilities, the affordance actualization is specific and relates to a particular user group and details the specific action they will take or have taken place (Volkoff and Strong 2017).

Big Data Value Creation and Realisation

The concept of technology value creation has a long-standing history within the information systems' technology adoption literature. Research on this topic dates to the 80s and 90s (Barua et al. 1995; Bharadwaj et al. 1999; Teece 1986). Over the last 30 years, there has been a long-standing debate about whether and under what conditions IT investments and assets can contribute towards firm performance. As such, the focus has been on what value technology can offer as opposed to how technology value can be realized. Along similar lines, the literature on big data technology adoption has followed a similar trajectory. Whereby, much of the research that exists today focuses on examining the relationship between big data technology investments and firm performance (value creation) with limited attention paid towards understanding how big data technology investments are realized (value realisation).

Big data value creation is about the potential benefits that arise from the adoption of a big data technology. Whereas big data value realisation is the process through which big data value is effectively managed and realized (Grover et al. 2018). The table below provides a summary of key research carried out in the field. Much of the literature tends to focus on the value creation element (what value big data technologies can offer), as opposed to the value realisation element (how value from big data technologies is realised). We observe from the literature that there is widespread utilization of strategic management theories (e.g., resource-based view, dynamic capabilities) and limited utilization of information management theories (e.g., affordance theory). As such, much of the literature tends to focus on examining the relationship between big data investments and firm performance. They do so by examining the role of various organisational antecedents, mediators, and organisational outcomes on firm performance. Examples of organisational antecedents include environmental features (Vitari and Raguseo 2020), contextual factors (Mikalef and Krogstie 2020), and employee ambidexterity (Shamim et al. 2020). Examples of mediators include organisational agility (Côrte-Real et al. 2017), customer satisfaction, and market performance (Raguseo and Vitari 2018). Examples of organisational outcomes include business process innovation (Mikalef and Krogstie 2020), decision making quality (Shamim et al. 2019), and business model innovation (Ciampi et al. 2021). In this instance, big data is viewed as a strategic resource that firms must invest in order to gain competitive advantage.

In contrast, limited attention has been paid towards utilizing information systems theories such as affordance theory. As such, there is limited understanding of how firms realize the value potential from the adoption of a big data technology. Studies utilising an affordance theory lens have shed some light on how organisations realise business value from big data technologies. They've done so by highlighting the process through which organisational actions (Dremel et al. 2020), technological features (Lehrer et al. 2018), and marketing affordances (De Luca et al. 2020) enable superior firm performance. However, a holistic view of big data value realisation including the role of organisational capabilities has not yet been advanced (Chen et al. 2015; Günther et al. 2017; Meriton et al. 2020; Mikalef et al. 2018). Despite organisational capabilities being one of the key components of affordance theory, no study has so far empirically examined the role of organisational capabilities in the affordance actualization process. As such, this research aims to fill this research gap by examining the role of organisational capabilities in the big data value realisation process (affordance actualization).

	Research paper	Theoretical framework	Research type	Research contribution	Research focus
1	(Gupta and George 2016)	Resource based view	Quantitative	Big data analytics capability & firm performance	value creation
2	(Raguseo and Vitari 2018)	Resource based view	Quantitative	Role of customer satisfaction & market performance on big data analytics (BDA) & firm performance	value creation
3	(Grover et al. 2018)	Resource based view	Conceptual	BDA & organisational value	value creation & realisation
4	(Dubey et al. 2019)	Resource based view	Quantitative	Role of external pressures in building a BDA capability	value creation

5	(Vitari and Raguseo 2020)	Resource based view	Quantitative	Role of environmental features on BDA & firm performance	value creation
6	(Zhang et al. 2020)	Resource based view	Quantitative	BDA on customer relationship management performance	value creation
7	(Mikalef and Krogstie 2020)	Resource based view	Quantitative	The role of contextual factors on BDA & business process innovation	value creation
8	(Cappa et al. 2021)	Resource based view	Quantitative	Big data characteristics and firm performance	value creation
9	(Shamim et al. 2019)	Dynamic Capabilities Theory	Quantitative	Big data decision making capability on decision making quality	value creation
10	(Cao et al. 2019)	Dynamic Capabilities Theory	Quantitative	The mechanisms of marketing analytics that enable competitive advantage	value creation
11	(Gupta et al. 2020)	Dynamic Capabilities Theory	Quantitative	Big data based organisational capabilities & firm performance	value creation
12	(Shamim et al. 2020)	Dynamic Capabilities Theory	Quantitative	Big data value creation at employee level (employee ambidexterity)	value creation
13	(Meriton et al. 2020)	Dynamic Capabilities Theory	Systematic Review	Generative mechanisms of value creation in supply chain management	value creation
14	(Mikalef et al. 2020)	Dynamic Capabilities Theory	Quantitative	Big data analytics capability and competitive performance	value creation
15	(Reis et al. 2020)	Dynamic Capabilities Theory	Quantitative	The drivers of business value from big data analytics	value creation
16	(Fosso Wamba et al. 2020)	Dynamic Capabilities Theory	Quantitative	BDA, supply chain ambidexterity, environmental dynamism (moderator)	value creation
17	(Gu et al. 2021)	Dynamic Capabilities Theory	Quantitative	The role of BDA capability on supplier procurement and firm performance	value creation
18	(Ciampi et al. 2021)	Dynamic Capabilities Theory	Quantitative	Big data analytics capabilities on business model innovation	value creation
19	(Mehmood et al. 2017)	Absorptive Capacity	Quantitative	Improve transport efficiency	value creation
20	(Lam et al. 2017)	Absorptive Capacity	Quantitative	Big data characteristics & service quality/ costs	value creation
21	(Duan et al. 2020)	Absorptive Capacity	Quantitative	Mechanisms of big data analytics to firm's innovation success	value creation
22	(Côrte-Real et al. 2017)	Knowledge Management Theory	Quantitative	The mediating role of organisational agility	value creation
23	(Merendino et al. 2018)	Knowledge Management Theory	Qualitative	Impact on board level decision making	value creation
24	(Bag et al. 2021)	Knowledge Management Theory	Quantitative	Knowledge creation & rational decision making	value creation
25	(Lehrer et al. 2018)	Affordance Theory	Qualitative	The role of BDA features on service innovation	value realisation
26	(Dremel et al. 2020)	Affordance Theory	Qualitative	The role of organisational actions in BDA affordance actualization	value realisation
27	(De Luca et al. 2020)	Affordance Theory	Quantitative	The role of marketing affordances	value realisation

Table 1. Overview of Big Data Literature

Research Methodology

This study employs a qualitative research methodology structured around a case study approach. Utilizing a case study design allows us to conduct an in-depth investigation of a new and emerging phenomenon within its real-life context by producing thick descriptions (Easton 2010; Yin 2014). To carry out the data collection, we followed the principles for case study design as outlined by Yin (Yin 2014). To carry out the data analysis, we borrow on the principles of grounded theory as outlined by Strauss and Corbin (1998).

Data Collection

Data collection took place over a period of 10 months in two major UK based energy companies which we refer to with the pseudonyms of 'BlueHouse' and 'GreenWorks'. The rationale behind the inclusion of two cases as opposed to one case is that it allows for conclusions to be drawn out more effectively (Ackroyd and Karlsson 2014), and helps avoid the risk of micro level analysis (Kessler and Bach 2014). We started our

data collection at GreenWorks 3 months prior to BlueHouse. As such, the format of the first nine interviews were explorative in character and flexible in nature. This enabled us to build an understanding of the smart meter context as well as provide us with an opportunity to test our interview guide and sampling strategy. Interviews continued to be conducted at both companies until we reached a point of theoretical saturation (Strauss and Corbin, 1998)., whereby no additional insights, issues, or conceptual categories were emerging from conducting additional interviews. As such, we concluded our data collection at 47 interviews

Interviews took place with various personnel that were involved in the smart meter technology adoption process. This included data analysts, project managers, heads of infrastructure, and experts working in innovation, customer service, customer experience, and data science. 28 interviews took place at GreenWorks whereas 19 interviews took place at BlueHouse. Interviews were carried out through the aid of an interview guide. Each interview began with a brief introduction of the research objective and the interviewees were provided with an informed consent form. This was important for establishing rapport and gaining permission to record our conversation. As much as possible, interviews were conducted face-to-face in the participant's natural work environment. On the few occasions where face-to-face meetings were not possible, they were conducted via telephone or via a video conferencing application (e.g., Skype, Zoom). All interviews were conducted in English (the respondents' native language), audio-recorded, and subsequently transcribed. Interviews lasted between 24 minutes and 87 minutes, which generated 33 hours of recordings and 581 pages of transcripts.

Case Descriptions

GreenWorks

GreenWorks was formed in 1998 as a result of a merger and is one of the largest British-owned energy companies in the UK, part of the so-called "big six", more recently the "big five". GreenWorks is part of GreenWorks Group, an owner and operator of low-carbon energy assets and businesses. GreenWorks supplies gas and electricity to UK households and businesses. They also offer phone and broadband packages, boiler care and cover services. The company emphasizes its fair and comprehensive customer services. As of 2018, GreenWorks owned 7.3% of the market share and served 5.7 million household customers (3.9 electricity, 2.6 gas), and employed 20,785 employees (Statistica 2018). In 2018, GreenWorks Group generated a total profit of 31,226 million, whereas GreenWorks generated a total profit of 260 million. In early 2018, GreenWorks Group decided to sell GreenWorks in order to enable it to operate with greater day-to-day autonomy and independence. In July 2019, it was confirmed that GreenWorks was considering a merger with a smaller energy supplier that has a high percentage of renewable electricity sources. In January 2020 this merger was confirmed and completed. The rationale behind the decoupling is that it will help GreenWorks stabilize its overall customer base to help facilitate longer-term growth. As a result of the demerger, GreenWorks would be able to drive additional efficiencies by investing in digital resources.

BlueHouse

BlueHouse was formed because of a demerger in 1997 and is part of the so-called "big six", more recently the "big five". BlueHouse is a subsidiary of BlueHouse Group, a multinational energy and services company. The company's strategy is heavily focused on excellent customer service as well as driving for higher returns on investment through greater efficiency. As of 2018, BlueHouse owned 13% of the market share and served 12 million household customers (5.5 electricity, 6.9 gas), and employed 31,780 employees (Statistica 2018). In 2018, BlueHouse Group generated a total profit of 29,686 million, whereas BlueHouse generated a total profit of 556 million. BlueHouse have been developing their internet-based customer services as well as mobile phone applications. Both of which better enable their customers to self-service. As a result, in 2018, 25% of all their website contacts were being made through mobile devices. BlueHouse was one of the first energy companies to start installing smart meters and were industry leading in installation numbers whereby in 2012 they had installed one million smart meters. In 2017, a new CEO was appointed and promised to reinvent BlueHouse as a technology services powerhouse.

Data Analysis

Our data analysis strategy is very much driven by the aims of the study: the identification of organisational capabilities for the actualization of smart meters affordances. To do so, we draw on the principles of grounded theory namely *open coding, axial coding, memos, and constant comparison* (Corbin and Strauss 1990). It is important to note that we utilize grounded theory here as a data analysis tool as opposed to an all-encompassing research methodology. Our rationale for doing so is that grounded theory and its principles encourages a thorough and and systematic scrutiny of the data and analysis, and helps researchers avoid the risk of premature closure (Goulding 2002).

Qualitative data produces large and cumbersome amounts of data to analyse (in this case: 581 pages of interview transcripts). As such, we carried out a staged approach to data analysis and utilized the concepts of *constant comparison* and *memos* throughout our data analysis process. *Constant comparison* is a procedure in which each finding and interpretation that emerges from the data is compared with existing codes and categories (Strauss and Corbin 1990). Whereas, *memos*, which are brief notes designed to capture emerging information (Bryman and Bell 2011, p. 581). The coding process was carried out by two coders who met every week to discuss emerging codes, themes, and concepts as well as settle any ambiguities. The coding process was very much an iterative one of moving between the data and the labels/codes, and the literature, whereby extant literature was consulted frequently to ensure that labels generated were consistent with those articulated in literature.

The coding process took place over two key stages. The first stage of analysis entailed *open coding*. Open coding is the process of breaking down, examining, comparing, conceptualizing, and categorizing data(Corbin and Strauss 1990). We commenced the first round of open coding with five interviews by assigning labels and documenting our thoughts and reflections in the form of *memos*. Through *constant comparison*, we reviewed and subsequently simplified the emerging labels. This ensured that assigned labels moving forward would be consistent with those already generated. We repeated the process of open coding and constant comparison on an additional 5 interviews until all 47 interviews were coded in a similar manner. Examples of the labels that were generated at this stage were descriptive and lengthy in nature and include "data science being able to disaggregate the data", "the ability to develop a predictive model for energy fraud", and "having senior leadership that drive collaborative working to address business problems".

The second stage of analysis entailed *axial coding*. Axial coding is a set of procedures whereby data is put back together in new ways after open coding, by making connections between categories (Strauss and Corbin 1990). This is done by linking codes to contexts, consequences, patterns of interaction, and causes (Bryman and Bell 2011). Because the process of open coding produced a large number of labels and codes, the aim of axial coding and constant comparison was to reduce these codes to a small number of categories. Organisational capabilities were reduced to five key categories, examples include "big data management capability", and "innovation capability".

Research Findings: Organizational Capabilities and Actualization Enablers

Organisational capabilities are defined as an organization's capacity to deploy its assets to perform a task or activity to improve performance (Maritan 2001). In this research, we introduce the concept of **actualization enablers** as the pathways through which organisational capabilities enable affordance actualization (value realisation), and we argue that actualization enablers are the intermediate link between organisational capabilities and affordance actualization. Figure 1 below highlights five organisational capabilities that give rise to thirteen actualization enablers that enable affordance actualization and big data value realization. The organisational capabilities and actualization enablers that our research identifies are as follows: 1) big data analytics capability (data-driven culture, experimentation culture), 2) customer engagement and communication capability (customer trust, customer-technology interaction), 3) innovation capability (innovation conceptualization, innovation experimentation, innovation commercialization), 4) collaboration and communication capability (data-driven organization, use of external competencies, stronger business alignment), and 5) strategic management capability (strategic awareness, strategic commitment, strategic flexibility. In this section, we provide empirical evidence to support our research findings.

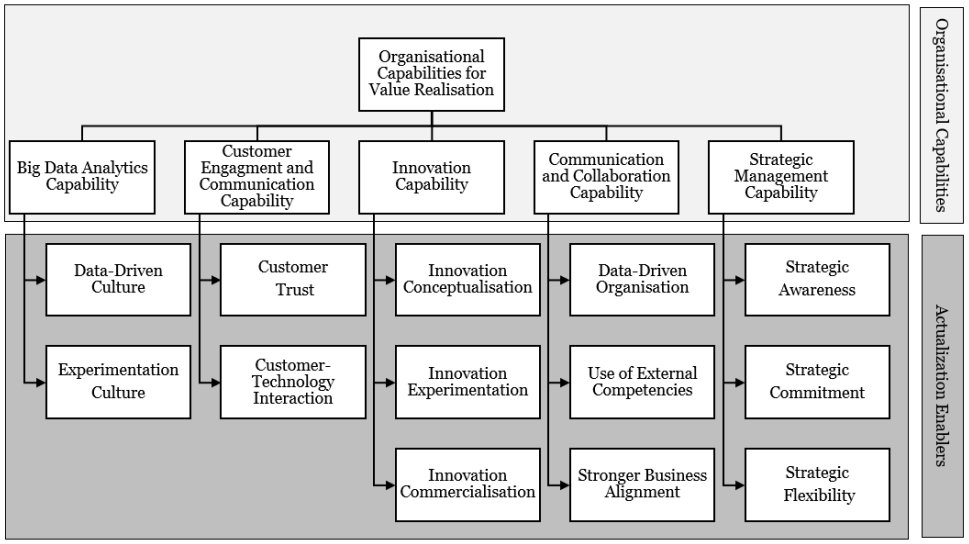

Figure 1. Organisational Capabilities and Actualization Enablers

1. Big Data Analytics Capability

Big data analytics capability refers to the techniques used to analyse and acquire intelligence from big data (Gandomi and Haider 2015). Our findings suggest that big data analytics capability is an important and key capability for affordance actualization because it provides firms with two key actualization enablers: data-oriented culture and experimentation culture.

Interview data highlighted that having a big data analytics capability provides firms with the ability to foster a **data-oriented culture**, whereby the entire organisation recognizes the value in data-driven analysis and decision making (Davenport et al 2012). The following quote highlights how a big data analytics capability provides firms with the actualization enabler of data-oriented culture:

It really sits with the data; it sits within our data strategy and data capability. That's where the real value sits because we need to be a business that understands that data better than the customer, and that can advise the customer and that can look at trends. That's just the real advantage and we can personalize for the customer. (Interview 23A)

Big data analytics capability enables an organisation to foster an **experimentation culture**. An experimentation culture - amongst many other things - is one that emphasizes the importance of experimentation and one that establishes the organisational structures and incentives that encourage it (Khanna et al. 2016). It is one that views failure as an integral part of exploratory learning, and advocates for the "fail fast, fail often" principle (Khanna et al 2016). The following quote highlights how not having a culture of "failing fast, failing often" will result in not knowing when to draw the line on a failing project or overfunding a project that may never become successful or come to fruition:

The project has been going for so long. And they've been funding it so long that they put too much money into it. So, they are not allowed to let it fail. So, they are just going to keep at it until it works. Whereas it might have been better a year ago to say okay we can't do this here. Let's stop it. (Interview 10B)

2. Customer Engagement and Communication Capability

Customer engagement and communication capability is about the extent to which an organisation utilizes different forms of communication to provide their customers with knowledge and understanding about its offerings in order to create a long-term relationship with its customers (Finne and Grönroos 2017; Sashi

2021). Our findings suggest that customer engagement and communication capability is an important and key capability for affordance actualization because it provides firms with two key actualization enablers: customer trust and customer-technology interaction.

Our findings highlight that increasingly energy consumers have a negative impression and a general lack of trust in energy companies and industry. So much so that energy companies wanting to offer smart meters to customers for free can be faced with reluctance and suspicion where "people feel suspicious about why an energy company would want to do something nice for them" (Interview 14B). The energy industry has acknowledged the need for the shift towards becoming more data-driven in customer engagement and communication as it will enable energy companies to generate **customer trust**, as highlighted in the following quote:

There is a real shift for the industry, and I think it will take a while before we actually start to work out in the industry how we best make use of that information. But doing that is key to actually engaging with customers and gaining their trust. You look at people like Amazon who are really good at taking data interpreting what their customers are interested in, what they want and actually seem to have the trust of their customers in what they do. All the monitoring of your shopping history in the background which you don't really think about or pay any attention to. They seem to have a great deal of trust with their customer base, and you go back to them for more. (Interview 13B)

Interview data highlighted that there is a problem with the long-term engagement of customers with the smart meters and in-home displays (IHD). Energy customers tend to engage with the technology for the first few weeks, following which they turn off their IHDs and put them away. Customer communication and engagement capability enables an organisation to encourage its customers to have a positive and long-term interaction with the technology and promote **customer-technology interaction** by continuously providing their customers with the information that is both relevant and interesting to their varying needs.

3. Innovation Capability

Innovation capability is about the resources possessed by an organisation that are devoted to identifying and creating new value creation opportunities by transforming knowledge and ideas into new products, processes, and systems for the benefit of the customer, the firm, and its stakeholders (Lawson and Samson 2001). Our findings suggest that innovation capability is an important and key capability for affordance actualization because it provides firms with three key actualization enablers and they include: innovation conceptualization, innovation experimentation, and innovation commercialization.

Innovation conceptualization is about the creation, recognition, elaboration, and articulation of innovation opportunities (O'Connor et al. 2018). One way to incentivize innovation conceptualization at the individual/employee level is by encouraging employees to allocate slack time to exploratory innovation. At BlueHouse, employees are encouraged to spend 80% of their time on core projects and use the remaining 20% of their time on innovation activities that speak to their personal interests and passions. This facilitates the development of an organisational innovation capability because it allows for creativity in the recognition, creation, and articulation of innovation opportunities. A key aspect of innovation conceptualization is the ability to research and understand the competitive marketplace. As well as engage in the process of external hunting for innovation opportunities. One way to achieve this is by setting up a competitor intelligence team for market intelligence generation whose key focus is to conduct environmental scanning for innovation opportunities and communicate these findings in the form of regular workshops and weekly newsletters.

Innovation experimentation is about evolving a customer-centric innovation opportunity into a business proposition (O'Connor et al. 2018). Interview data highlighted that one way to develop such a capability is by building an Innovation Lab specialized in the development and testing whereby "ideas can be quickly tested" (Interview 4B). There are three key competencies of the innovation lab. The first lies in their ability to understand both the technical and non-technical aspects of a product. They do so by having user experience designers (UX designers) to complement the technical work of the data scientists and analysts. The second key competency lies in their ability to develop a minimal viable product (MVP) in order to demonstrate that a product does work, before fully developing it. This process usually includes several iterations, before it reaches a point where it can be deemed fit for its purpose. The third key competency lies in their ability to demonstrate that a product achieves the desired outcome at scale, through a process

of rigorous testing. This process usually requires vast amounts of data to be collected. BlueHouse did so by setting up a simulation lab within the innovation lab to be able to rigorously test innovation propositions at scale. The simulation lab has been used to simulate boiler failure and white goods appliance failure. This is a necessary step to be able to use this data to build – for example – new algorithms and models for new services based on predictive maintenance.

Innovation commercialization is about ramping up the innovation opportunity to stand on its own (O'Connor et al. 2018). Interview data highlighted that one way to develop such a capability is by building an Innovation Accelerator specialized in scaling and commercializing innovation by "launching them out into the world" (Interview 4B). The following quote highlights how the innovation accelerator was set up to transform the way in which BlueHouse delivers its propositions for innovation commercialization:

We were set up about two years ago to transform the way that [our company] delivers props, so to be more lean, agile, digital-led, get your buzzword bingo card out, we know all of them! And we kind of did that on a really small scale and piloted really well by doing a couple of design centered sprints…Our key focus since was to work out ways in which we would deliver them. So, would they be by ventures? So, setting them up as totally separate businesses outside of BlueHouse? Do we set them up as a ring-fenced venture within BlueHouse? Or do we find a product team and a product owner to do it completely conventionally within BlueHouse? So, we help core product teams to experiment with brand new ideas that they have. So, we will do a smoke test for them, and give them the kind of propensity to buy Google Analytics that sits behind that. (Interview 9B)

4. Customer Communication and Collaboration Capability

Communication and collaboration capability is about a firm's ability to exchange information between individuals, teams, or departments in such a way that they can work together, have a mutual understanding, a common vision, and share resources to achieve a collective goal (Kahn and Mentzer 1998). Such an exchange of information can take place via meetings, newsletters, conferences, and the exchange of standard documentation. While extant literature views collaboration and communication as two separate capabilities, this research views them as two sides of the same coin. As such, our findings suggest that communication and collaboration capability is an important and key capability for affordance actualization because it provides firms with three key actualization enablers: data-driven organisation, use of external competencies, and stronger business alignment.

Our findings highlight that organisations can develop their communication and collaboration capability by setting up a structured way for different parts of the business to meet, and by enabling greater job rotation for individuals amongst teams. Developing a communication and collaboration capability enables **a data driven organisation** because non-data-driven departments (e.g., operations) in an organisation learn to become more data-driven by interacting with the departments in the business who are (e.g., data science). The following quote highlights this idea:

In field operations we now have a two-year multimillion program where we are working with them to look into how they manage engineer workload, to figure out how to do scheduling, how to do rostering, how to build simulations, all that kind of stuff. So, in that part of the business, they've accepted that they have to use data. It's going to make them succeed or fail. Other parts of the business I think we'll get there bit by bit. (Interview 4B)

Communication and collaboration capability enables an organisation to **use external competencies** by setting up partnerships with external companies. As such, this reduces the need to develop these competencies internally which can be a somewhat ineffective, inefficient, and resource-intensive process to do. Interview data highlighted that developing internal competencies in incumbent firms can involve a lot of bureaucracy, red tape, and organisational politics to navigate. As such, tapping into readily available external competencies can be a more efficient way to do so by having a strong communication and collaboration capability.

Communication and collaboration capability helps build **stronger business alignment** between business functions. Interview data highlighted the active role that senior management play in promoting business alignment. When asked about the biggest challenge in finding and creating value from the smart meter data, one respondent highlighted that the lack of communication from a senior level about the key strategic priorities will result in a lack of collaboration between business functions due to a lack of business

alignment. Traditionally, an energy company's business functions would operate in siloes. Whilst that may have created functional excellence in the past, the adoption of smart meters has challenged the status quo of the efficiency and effectiveness of operating in siloes. The adoption of smart meters has required communication and collaboration between business functions to create alignment in the adoption process. Otherwise, the lack of such a capability will result in "complete and utter chaos" in the technology adoption process. The following quote highlights how GreenWorks fostered stronger business alignment through creating a new role in the business that manages the collaboration and communication between business functions, and manages the end-to-end process:

GreenWorks does have a strong functional hierarchy which people describe as silos. That stems from prior leadership behavior. It also stems from the operating model. We are now changing the way that the business operates because you develop functional excellence, but you have ***complete and utter chaos*** *in any outcome that requires a series of functions to work together to deliver an output. So, we're beginning to modify the operating model and beginning to change the governance structure, introduce new roles, beginning to change the language and the behaviors in the business to be able to understand how functions operate alongside an end-to-end processes and end to end customer journeys to deliver outcomes. We've just made a very significant change in smart. So, we've made one person, my level accountable for smart end to end. So, it doesn't matter where you are marketing, customer services, in the field, we have an end-to-end management of the business.* (Interview 17B)

5. Strategic Management Capability

Strategic management capability is an organization's ability to gain, sustain, and establish a competitive advantage over its rivals (Lee 2001). Our findings suggest that strategic management capability is an important and key capability for affordance actualization because it provides firms with three key actualization enablers: strategic awareness, strategic commitment, and strategic flexibility.

Strategic awareness is about the senior management's attention to - and mindfulness of - the strategic value of a new technology (Swanson and Ramiller 2004). Interview data highlighted that the value of smart meters can only be fully realized when energy firms move beyond viewing the smart meter adoption as a government-mandated project, towards viewing it as a business transformation that will revolutionize that way in which they operate as a business. It is about becoming aware that not fully realising the value of smart meters can increase business risk and threaten competitiveness within the marketplace, as highlighted in the following quote:

It's not just about putting a meter on the wall; it rewrites the rules on how you do business and then gives you a completely different insight on your customer base which you then might be able to leverage value from. (Interview 17A)

Strategic commitment is about the long-term commitment to the adoption of a new technology by allocating enough resources, committing the best resources, and actively developing the processes necessary for the adoption of a new technology (Woiceshyn and Daellenbach 2005). The lack of strategic commitment and allocation of appropriate resources may result in a lack of business momentum to capitalize on business opportunities. Strategic commitment is not only about the commitment towards resources but also a commitment towards developing the processes, culture, and capabilities that enable the organisation to capitalize on the opportunities available to them from smart meters whether that be in the short, medium, or long term. The following quote highlights how the lack of strategic commitment at GreenWorks towards developing a smart customer application beyond the trial phase has resulted in them falling behind the competition in the space of customer experience:

It's fair to say the business has dabbled in this stuff and we've not for whatever reason made a commitment to it and now we're behind all of our competitors in that space. It's the biggest experience gap that we've got. So, if we're pushing subtly the digital team to look at that, we ran up a pilot with an app for a year, and customers loved it. We did develop an app but only for a pilot route. Did it make a difference to the way that they use their energy? Yes. Because it was just much more engaging was the consensus. (Interview 23)

Strategic flexibility is a firm's ability to be proactive or respond quickly to changing conditions, with a wide variety of different internal and external options (Herhausen et al. 2020). Contrary to the term "strategic flexibility" is the term "strategic rigidity", whereby an organisation is resistant to change because

it is operating in a habitual mode of functioning and as a result can be reluctant and slow in adopting new technologies (Nisar et al 2013). Interview data highlights how strategic rigidity and a subsequent lack of strategic flexibility can result in missed opportunities that would have been otherwise profitable had they been pursued and actualized. The following quote highlights how a business proposition that was potentially profitable was turned down by the business due to lack of fit and alignment and hence created an adverse reaction:

We have a couple of... I'm going to call them corporate failures so products that have been brilliant products, and the whole point of how we work is desirability, feasibility, viability. We had a product which was a massive win in desirability. So, we believe that a 6% conversion rate is good. This product got 20%. And then once we took the website down had a viral effect of 7% so it got shared on social media. We've never seen that before. And unfortunately, though it was in short term loans and the business had quite an adverse reaction to going into short term loans. So, we pushed it forward. Through feasibility to see if we could actually do it. We said to the business: we get your concerns but it's unbranded. It's just a trial to 900 customers, we're going to do anyway and just see if we can do it. And then it turned into a massive slug, and it turned an MVP [Minimum Viable Product] which we were hoping to get out in six months into a year-long over budget project which we decided last week to call it a day on this one. Because it's no longer lean, it's no longer agile. (Interview 9B)

Discussion

To summarize, our findings identify five key organisational capabilities that give rise to thirteen actualization enablers which help organisations actualise technology affordances and realize big data value as follows: 1) big data analytics capability (data-driven culture, experimentation culture), 2) customer engagement and communication capability (customer trust, customer-technology interaction), 3) innovation capability (innovation conceptualization, innovation experimentation, innovation commercialization), 4) collaboration and communication capability (data-driven organization, use of external competencies, stronger business alignment), and 5) strategic management capability (strategic awareness, strategic commitment, strategic flexibility.

Our research responds to the call for more research that looks into understanding the processes and mechanisms through which organisations realize value from big data technologies (Fosso Wamba et al. 2015; Mikalef et al. 2018). By doing so, this research makes important empirical, theoretical, and managerial contributions in seven keyways. First, we provide empirically grounded insights into five organisational capabilities that enable big data value realisation. Second, we provide a holistic view of the organisational capabilities for affordance actualization by providing a comprehensive set of organisational capabilities that move beyond the technical aspects of big data value realisation. Third, we introduce the concept actualization enablers as the pathways through which organisational capabilities enable big data value realisation (affordance actualization). Forth, we provide empirically grounded insights into how capabilities provide firms with actualization enablers for big data value realisation (affordance actualization). Fifth, we extend affordance theory to an under researched but highly relevant research context: the adoption of smart meters in the energy sector. Sixth, we extend affordance theory by empirically examining the role of organisational capabilities and actualization enablers in the affordance actualization process. Lastly, we provide rich and practical insights into how managers can effectively realize value from the adoption of a new big data technology.

As outlined in the introduction and research background of this paper, the literature on big data value creation and realisation has two dimensions: a) value creation (what value big data technologies can offer), and b) value realisation (how value from big data technologies is realised). The literature has predominantly focused on the big data value creation dimension, whereas the big data value realisation dimension has received very limited attention (see table 1). Studies that have investigated big data value realisation have mainly utilized an affordance theory lens. The aim of this research was to further extend affordance theory to the context of smart meters and empirically examine how smart meter value is realised within the context of two energy firms. By doing so, we extend the scope and utilisation of affordance theory in the literature on big data value realisation.

Our empirical evidence suggests that there are five key organisational capabilities that enable big data value realization. While previous research has focused on the role of technical capabilities namely big data

analytics capability in the affordance actualization/ value realisation process (Dremel et al. 2020; Lehrer et al. 2018). We extend previous research by providing a more holistic understanding of a diverse set of organisational capabilities needed for big data value realisation. As such, this research emphasizes the idea that *for an organisation to realize the value potential from big data technologies, both technical and non-technical capabilities must be deployed.*

Our research further advances the role of capabilities in the big data value realisation process by introducing the concept of actualization enablers. Actualization enablers are the pathways through which organisational capabilities enable big data value realisation. We provide empirically grounded insights into thirteen actualization enablers that enable big data value realisation. As such, this research emphasizes the idea *that actualization enablers act as an intermediate link between affordances and capabilities in affordance actualization process.* By doing so, this research enriches our understanding into how big data value is realised by shedding light on the specific pathways that organisational capabilities provide for big data value realisation.

Theoretical Contribution

As outlined above, affordance theory has been become a predominant theoretical framework to study the big data value realisation process. The reason behind this is that affordance theory offers researchers with the opportunity to examine the rich and complex relationship between actors/users and technology artefacts/new technology adoption. As a result, a handful of studies (namely two) have utilized the affordance theory lens to exam the role of organizational actions (Dremel et al. 2020) and technological features (Lehrer et al. 2018) in the big data value realisation process. However, given that capabilities together with goals and action possibilities are a core focus of affordance theory, extant research does not explain what organisational capabilities are or how they enable affordance actualization (value realisation). As of yet, no study has empirically examined or conceptually explained the role of organisational capabilities in the affordance actualization process. All that is known so far is that for an affordance to be actualized an actor must exist with the necessary capabilities (physical strength, skills, knowledge), and that an actor might actualize an affordance ineffectively to start with, but over time and with training their skill level will increase (Volkoff and Strong 2017). However, beyond the individual level capability for affordance actualization, not much is known about organisational level capability (conceptually or empirically) for affordance actualization.

In light of the above, this research extends and advances affordance theory by shedding light on the important and key role that organisational capabilities play in the affordance actualization process. We view organisational capabilities as the capacity of an organisation to perform a task or activity in order to actualise a big data technology affordance. Our findings shed light on the nature of organisational capabilities in the affordance actualization process. We view organisational capabilities as non-binary and dynamic in nature. Whereby, it isn't a case of possessing a capability or not, but rather that organisational capabilities are dynamic in nature that can be continually developed, evolved, increased, decreased, and improved to actualise big data affordances. As the technology features of smart meters (as well as other big data technologies) evolve, the number of affordances that can be actualized increases too. This in turn would mean that organisational capabilities will need to be evolved/improved. Not evolving/ improving organisational capabilities will mean the difference between realising (actualizing) and not realising on big data technology value. As such, this helps future researchers clarify the ambiguity surrounding the role of organisational capabilities in the affordance actualization process.

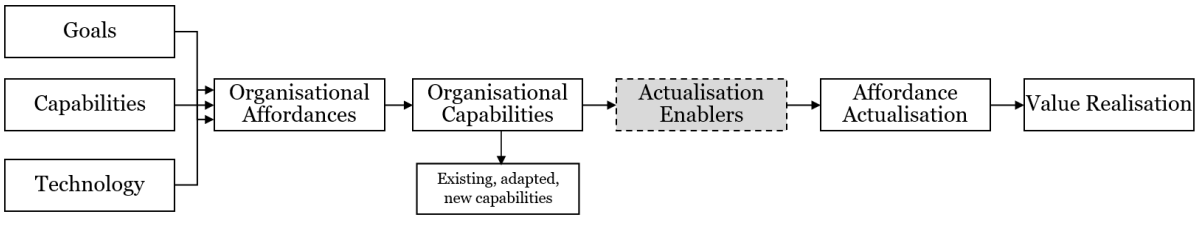

Figure 2. Actualization enablers in the context of affordance theory

In addition to the above, we further conceptualize the role of organisational capabilities by introducing the concept of actualization enablers. Based on our conceptual understanding of affordance theory and our empirical understanding of the research findings, we propose the concept of actualization enablers to be the intermediate link between organisational capabilities and affordance actualization, as illustrated in Figure 2 above. We argue that organisational capabilities alone do not actualise technology affordances. Instead, they give rise to several actualization enablers, which in turn help organisations actualise technology affordances. As a result, this helps future researchers clarify the ambiguity surrounding organisational capabilities by drawing attention to the actualization enablers in the affordance actualization process.

Managerial Contribution

The findings of this research have important and relevant managerial implications. First, by highlighting the idea that to actualise big data affordances, organisations must invest in several organisational capabilities. This research urges managers to consider that big data analytics capability is a necessary but insufficient capability for effective affordance actualization. As such, this research encourages managers to take a more holistic view towards capability development by considering developing all five organisational capabilities for big data value realisation. Second, by providing an extensive list of organisational capabilities that organisations require for effective value realisation, managers in organisations can use it as a benchmark to identify areas that require investment or improvement. As such, it can help managers spark a conversation and take decisive action on the capabilities they need to develop in order to fully realize big data value.

Research Limitations and Avenues for Future Research

This research is subject to limitations that pave the way for future research. This research takes place in the context of two incumbent and traditional energy firms in the UK: BlueHouse and GreenWorks, and therefore does not cover the perspective of newer and more digitally enabled energy firms such as technology start-ups that are emerging in the energy sector. As such, future research would benefit from empirical research carried out in digital native energy firms, as it would offer an interesting contrast to the organisational capabilities and actualization enablers that this research outlines.

The data collection period for this research took place over 10 months. While 10 months is a considerable time to spend in the field, it was not long enough for the research project to be classified as a longitudinal case study, and therefore did not enable us to track and observe the whole affordance actualization process as it unfolded. Instead, we relied on informants' accounts of past and present events to better understand the affordance actualization process. Future research would benefit from a longitudinal case study to observe the affordance actualization process as it unfolds.

Finally, the findings of this research provide a platform for future quantitative research to operationalize the conceptualized organisational capabilities whereby the strength of relationship between actualization enablers, organisational capabilities, and affordances actualization can be tested and examined.

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