
THE ROLE OF TECHNOLOGY IN THE REAL ESTATE INDUSTRY

by

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Abstract

The global real estate industry is said to be five years behind the technology curve. By some estimates, as much as a third of global real estate assets are managed by spreadsheets. Despite this, venture capital firms around the globe invested \$1.5bn in real estate technology during 2015 and a further \$1.8bn in the first half of 2016 (CB Insights, 2016). Within that context, this research seeks to examine whether or not real estate companies leverage technology to achieve best value, what the major benefits of technology are and finally, the key inhibiting and enabling factors impacting technology adoption.

Initially, a theoretical foundation of modern facilities management is laid, including its relationship to real estate. An examination of the most prominent broad and specific technologies follows. A qualitative approach was favoured, specifically, a case study combined with semi-structured interviews of information technology leaders in the global real estate industry.

It was established that real estate companies do leverage technology to achieve best value, but that the degree, nature and extent thereof varies depending on a range of systemic, idiosyncratic and external factors. It was established that the most significant benefits of technology were operational efficiencies and remote accessibility of real-time operational data. The key enabling factors were found to be robust, affordable infrastructure, the consumerisation of technology, scale and technology-focused leadership. The absence of these factors were regarded as having an inhibitory impact.

Definitions & Abbreviations

In the context of this research, the terms and abbreviations below shall have the meaning assigned to it as indicated:

- (1) "\$" – the national currency of the United States, the dollar;
- (2) "API" – abbreviation for application programming interface, a set of programming instructions used to allow one piece of software to communicate with another;
- (3) "Application" – refers to a software program that runs on a PC or smartphone designed for a particular purpose;
- (4) "B2B" – refers to business to business;
- (5) "B2C" – refers to business to consumer;
- (6) "Business Intelligence" – term that refers to software applications used to analyse and interpret organisational raw data;
- (7) "CBD" – abbreviation for city bowl district, often equated with the commercial centre, financial district or focal point of a city;
- (8) "CEO" – abbreviation for Chief Executive Officer;
- (9) "CIO" – abbreviation for Chief Information Officer, the most senior executive responsible for **ensuring that the company's** information technology strategy is aligned with the organisational goals;
- (10) "COI" – abbreviation for certificate of insurance, a document providing information on insurance coverage;
- (11) "CRM" – abbreviation for customer relationship management, in this context referring to the software that manages client relationships;
- (12) "Custom" or "Customised" – in this context refers to software which is created entirely for a single specific organisation looking to achieve a specific purpose, otherwise the anti-thesis of **"off the shelf" or "pre-packaged" software products;**

- (13) **"Ecommerce"** – refers to transactions involving goods or services concluded over the internet;
- (14) **"ERP"** – abbreviation for enterprise resource planning, a system that manages the key operational areas of an organisation;
- (15) **"E-tailing"** – refers to the selling of retail goods and services over the internet;
- (16) **"FM"** – abbreviation for facilities management;
- (17) **"Gamification"** – refers to the process of applying game mechanics and competition to encourage participation and enhance user experience;
- (18) **"GPS"** – abbreviation for global positioning system, referring to 24 well-spaced satellites that orbit earth and make it possible for ground receivers to pinpoint location accurate between 10 – 100 metres (Rouse, 2016);
- (19) **"GSM"** – abbreviation for global system of mobile communications, a standard developed to describe protocols for second generation (2G) cellular networks used by mobile phones (Wikipedia, 2016);
- (20) **"High speed internet"** – also known as broadband, in this case refers to the **Federal Communications Commission's definition as** downloads in excess of 25 megabits per second (NBC News, 2015);
- (21) **"HVAC"** – abbreviation for heating, ventilation and air-conditioning;
- (22) **"iBeacons"** – Apple manufactured hardware that allows Bluetooth devices to broadcast or receive data within short distances;
- (23) **"ICT"** – information and communication technology;
- (24) **"IS"** – abbreviation for information systems;
- (25) **"IT"** – abbreviation for information technology;
- (26) **"Local companies"** – in this context, refers to listed South African real estate companies, whether a real estate investment trusts or not;

- (27) **"Millenials"** – although there is no precise definition, in this context it refers those who follow generation X, born from the early 80's up until early 2000's;
- (28) **"Mobile Application"** – an internet application that run on smartphones and other mobile devices such as tablet;
- (29) **"MRI"** – Management Reports International, a specialist property management and accounting software provider in the United States;
- (30) **"Online"** – a term used to refer to locations on or use of the internet;
- (31) **"PC"** – personal computer;
- (32) **"Real Estate Company"** – means an owner, operator or manager of real estate, including the associated services such as leasing;
- (33) **"REIT"** – refers to an internationally recognised vehicle for holding listed real estate, an abbreviation for real estate investment trust;
- (34) **"RFID reader"** – abbreviation for radio frequency identification reader and refers to a device used to gather data from a RFID tag, used to track individual objects (PC Mag, 2016);
- (35) **"S&P 500 company"** – abbreviation for Standard & Poor's 500, an American index based on the 500 largest companies from a market capitalisation point of view, across the New York Stock Exchange and the NASDAQ;
- (36) **"Siri"** – an Apple iPhone intelligent assistant that allows users to use voice commands to operate the mobile device and associated applications;
- (37) **"South Africa"** – refers to South Africa or South African, as the context may indicate;
- (38) **"Triangulation techniques"** – techniques that determine location through the measurement of triangles and distances between various points;
- (39) **"UK"** – refers to the United Kingdom;

- (40) **"US"** – refers to the United States of America;
- (41) **"Web Application"** – refers to any program accessed over an internet connection and run within a web browser;
- (42) **"WEF"** – abbreviation for World Economic Forum; and
- (43) **"WiFi"** – refers to a technology that allows computers, smartphones, or other devices to connect to the Internet or communicate with each other wirelessly.

Chapter 1: Introduction

1.1 Introduction

This chapter begins by contextualising the background of this dissertation, followed by an overview of the research problem, questions, aims and objectives. Thereafter, various assumptions are set out, as well an outline of the format of this research. After considering various limitations to the report, the research methodology is discussed.

1.2 Background to the Research

Despite being one of the oldest industries in the world (Robertson, 2014), the real estate sector has traditionally been regarded as a laggard from a technology adoption point of view (Smith, 2015). By some estimates, the industry is typically five years behind the technology curve (Ferren, Entin, Millsaps, Cocosa, Edwards & Darragh, 2015). In a recent study, it was established that almost a third of the global commercial real estate sector valued at \$11-trillion is managed by spreadsheets (Altus Group, 2015). The study also found that relative to other industries such as healthcare and financial services, real estate companies typically under-invest in information technology (IT), suggesting that the industry is missing out on an opportunity to gain valuable insight through data analytics (Altus Group, 2015).

While most investors probably do not have the appetite to drive change across an industry, others have spotted an opportunity to make a big impact. Over the last five years, particularly in developed economies, numerous real estate technology companies have emerged. In 2015, global venture capitalist investment in real estate technology amounted to just over \$1.5bn (Nakache, 2015), while in the United States of America (US) alone, the first quarter of 2015 saw approximately \$125m in investment from companies such as Google (Farren *et al.*, 2015). The first half of 2016 has generated \$1.8bn in investment, suggesting that this

trend is accelerating further (CB Insights, 2016). While some industry analysts suggest these patterns are reminiscent of the wildly speculative 2000 dot com bubble, others are more optimistic suggesting that venture capital firms are hedging their bets (Young, Morey, Messaros, Whalen, Gihilani, Schwartz, Stanton & Wallick, 2015). **Whatever one's view**, it is clear that the technology agenda has accelerated in recent years on the back of global consumerisation of technology (i.e. the internet and mobile). Moreover, going forward, it is difficult to argue against the fact that real estate companies who remain resistant to change run the risk of obsolescence (Ferren *et al.*, 2015).

Most of the advancements in the real estate sector and real estate technology has taken place in advanced economies. By most accounts, the US (and specifically New York City), is viewed as the epicentre of commercial real estate and real estate technology (Guttman, 2015). By contrast, developing real estate markets, such as South Africa (SA), have traditionally lagged behind most in the developed world. This is at least partially attributable to underlying operating environment challenges (PWC, 2015a).

To consider the relative use of technology within developed and developing countries, the **World Economic Forum's** Global Information Technology Report 2016 is instructive. As an example of a developing country, SA ranked 65th out of 139 countries, up ten places, as measured **by the "Network Readiness Index"** (World Economic Forum, 2016: xiii). By contrast, developed countries such as the US and United Kingdom (UK) rank 5th and 8th respectively (World Economic Forum, 2016: 16). This **score was established based on a country's information and communication technology (ICT) performance across ten key pillars.**

Using the examples of developing and develop nations above, below is a table comparing SA, UK and US out of 139 countries across ten key pillars:

Table 1: World Economic Forum, 2016

Pillar	SA	UK	US
Political and Regulatory Environment	26 th	5 th	21 st
Business and Innovation Environment	65 th	5 th	3 rd
Infrastructure	44 th	20 th	5 th
Affordability	74 th	53 rd	17 th
Skills	95 th	24 th	27 th
Individual Usage	77 th	5 th	17 th
Business Usage	32 th	16 th	4 th
Government Usage	105 th	10 th	12 th
Economic Impacts	57 th	11 th	7 th
Social Impacts	112 th	5 th	7 th

Other interesting findings within the report showed:

Table 2: World Economic Forum, 2016

Factors	SA	UK	US
Availability of Latest Technologies	41 st	5 th	2 nd
Mobile Subscriptions	20 th	52 nd	79 th
Business to Business Internet Use	35 th	2 nd	17 th
Business to Consumer Internet Use	64 th	1 st	2 nd
Firm Level Technology Absorption	28 th	14 th	3 rd
Internet and Telephone Competition	122 rd	73 rd	1 st

These figures suggest that from a technology perspective, developing nations such as SA are generally behind the curve, relative to developed countries such as the US and UK. Interestingly, there is a much higher rate of mobile phone subscriptions in developing countries. To a large extent, these findings are what one would expect of developing countries. The major contributors to this state of affairs appear to be lack of robust infrastructure, unaffordability, as well as a lack of skills and competition in the industry (World Economic Forum, 2016). Based on these findings it is reasonable to conclude that all things equal, real estate companies in developing countries such as SA appear far less favourably positioned to leverage technology than developed nations such as the UK and US.

Focusing on real estate technology specifically, it is evident that the majority necessarily require high speed internet – from virtual 3D tours to leveraging the internet of things, almost all require broadband internet to a lesser or greater extent. High speed internet should therefore be viewed as a necessary condition for optimal real estate technology adoption. As an example of a developing country, on internet penetration alone, SA ranks only sixth in Africa with a little over 50% penetration (Internet World Statistics, 2015). In terms of internet speed, in 2014, SA ranked 131st out of 195 countries (Alfreds, 2014). These figures together with findings of the **WEF's Global IT Report 2016** suggest that weak operational environments are likely to inhibit technology adoption. Weak infrastructure appears to be offer only a partial account for the lack of investment in technology.

Despite improvements in recent years, many local real estate companies continue to use manual processes and spreadsheets to manage and organise their businesses (SA Commercial Prop News, 2013). Automating these types of processes does not necessarily require broadband internet, suggesting that other factors are contributing to a lack of technology adoption in the industry.

The evidence suggests that in some markets, technology has already had a significant positive impact across all types of real estate, as well as disciplines within. These positive effects include enhanced revenue, lower operating costs, higher lease renewals, improved tenant satisfaction, better visitor and shopper experiences and overall, better quality data leading to better decisions (Farren *et al.*, 2015).

While the evidence of technology advancements is indisputable, the question of whether real estate companies are leveraging technology to achieve best value is unclear. This begs the question as to whether such companies are missing an opportunity to enhance organisational productivity and efficiencies, but perhaps more importantly, adding economic and social value within the sector.

Although not immediately apparent, the use technology to further organisational strategic and operational goals fits neatly within the paradigm of facilities management (FM).

1.3 Facilities Management, Technology & Real Estate

1.3.1 Overview & Theoretical Basis of a Modern Conception FM

The documented theory of FM relates to the fundamental interaction between space, people and technology (Robertson, 2000). FM is said to have emerged from the traditional building manager role into one of greater importance and influence in organisations (Langston & Lauge-Kristensen, 2002: 4). Today, the traditional divide between support and operations appears to be losing favour in many modern organisations. Today, FM is said to encompass a broad range of activities and services, far more than simply building operations and maintenance.

A modern description of FM suggests that it entails “workplace, facility, support services, property, corporate real estate and infrastructure” (Chotipanich, 2004: 365). Although the traditional focus of FM has been to reduce costs, industry trends suggest that nowadays, more decisions are being made with a view to maximising value and competitive advantage

(Langston *et al.*, 2002). Notably, the appearance and manifestation of FM is organisation specific and dependent on a number of factors including business purpose, industry, location and time (Langston *et al.*, 2002). A cursory overview of the literature reveals that there is no uncontroversial or widely agreed upon definition of FM (Tay & Ooi, 2001).

Despite the apparent lack of consensus, most modern FM practitioners and academics tend to agree on three fundamental characteristics prevalent in modern FM:

- (1) it is a supporting management function to the core business of an organisation;
- (2) it concentrates on the area of interface between physical workplace and people; and
- (3) it requires a multi-skill approach (Amarutunga, 2000: 259).

FM is evidently a vital component of modern organisations, facilitating the achievement of both short-term and long-term goals (Chotipanich, 2004). Furthermore, FM would appear to have both a strategic and operational dimension. At a national level, the strategic objective of FM amounts to providing business with improved infrastructure and logistic support. By contrast, at a local or operational level, FM entails effective management of facilities and services (Nutt, 2000).

After an extensive review of prevailing literature, Tay & Ooi (2001: 359) offer a definition of FM that for the purposes of this paper, is instructive:

'The integrated management of the workplace to enhance the performance of the organisation'.

1.3.2 How does Technology Impact as an FM Tool?

Based on a modern understanding of FM as expanded upon above, it would appear that FM is fundamentally about putting measures in place to not only achieve operational and strategic goals, but equally important, to maximise value.

Within that context, technology ought to be viewed as a means to an end, a mechanism that can materially influence the achievement of organisational objectives. This is reflected in the literature, where Quah (1999: 33) stresses that technology is best viewed as an enabler – a tool to be leveraged to improve the effectiveness and efficiency of operational and strategic FM. In that sense, technology is best viewed as a mechanism through which FM practitioners are able to fulfil their duties in a better, faster and more accurate manner.

The literature is unequivocal that leveraging technology within modern FM has plentiful benefits, from enhancing operational efficiencies to process automation (Real Comm Conference Group LLC, 2015).

These potential benefits not only highlight the importance of modern FM in a real estate organisation, but also, the significant impact that technology can have on the realisation of organisational goals and maximising value.

1.3.3 FM & Real Estate

Modern FM, understood as “**The integrated** management of the workplace to enhance the performance of the organisation” (Tay & Ooi, 2001: 359), is industry agnostic. In other words, it can apply across a broad range of organisations and industries. The focus of this research however is FM within the real estate industry.

On that basis, one can conceive that at a basic level, FM within the real estate context is partially about ensuring that the supporting infrastructure such as heating, ventilation and air-conditioning (HVAC), elevators or lighting operate properly. Taking it one step further, it would also include formulating and executing strategies to optimise the performance of the infrastructure and reduction in costs – such as installing timers to ensure the HVAC and lighting only operate when required. Finally, moving into the strategic space, modern real estate FM is also conceivably about creating optimal work conditions to improve

employee productivity or optimising tenants' experience through web-based applications or portals. Within this strategic dimension, less focus is on operational delivery and more on maximising value for the users of real estate space.

Before progressing any further, it is worth clarifying a number of key terms that will be referred to throughout this paper.

1.3.4 "Real Estate Companies" Defined

Within this context, the term "real estate companies" refers to those entities whose core business is owning, operating or managing real estate and further, that are listed on an internationally recognised stock exchange - irrespective of the legal entity. Privately-held real estate companies are specifically excluded because:

- (1) Data on listed entities tends to be more readily accessible compared to private companies; and
- (2) Generally, from a market capitalisation and access to capital perspective, listed companies have the benefit of scale that most **private companies don't. Listed entities tend to be the largest in terms of holdings, provide space to the largest commercial tenants and would likely be better positioned to allocate resources to technology.**

Admittedly, these are generalised assumptions which could be challenged through specific examples in the private sector. However, in the circumstances, they will be assumed to be accurate.

1.3.5 "Technology" Defined

Within the real estate context, "technology" may be construed in a broad sense to include innovative software, hardware, materials, construction and design (The Real Comm Conference Group LLC, 2015). For current purposes, this is too broad an understanding as it necessarily warrants an **extensive discussion of "green buildings" and all associated hardware,**

infrastructure and equipment. This would require addressing issues relating to the materials used, the construction and design process, as well the specialised equipment used to create, track and monitor energy **consumption. Similarly, if “technology” were understood in a broad sense,** a detailed description of hardware would similarly be required and include reference to all innovative infrastructure, foundations, roofing, piping, service equipment, telecommunications, cabling and reticulation, as well as database administration and architecture (National Institute of Building Sciences, 2016). These issues are in themselves research questions and beyond the scope of this paper.

Instead, “technology” in the current context is ascribed a far narrower meaning, limited specifically to the innovative and cutting-edge software solutions either in existence or imminently so. Notably, this may include solutions that are by their **nature “green”, since many attempt to reduce** utility costs. Furthermore, it may also entail a brief overview of certain pieces of hardware. However, this will only be necessary to the extent that they support, reinforce and drive the effectiveness and efficacy of real estate-focused software. Finally, when referring to technologies below, this paper does not purport to provide an in depth account of the mechanics. Instead, a descriptive account and the impact on real estate is offered. To the extent that a brief explanation is warranted, a high level overview will suffice.

1.3.6 Best Value (BV) Defined

BV is capable of numerous interpretations and may be identified in several different ways, depending on the context. For current purposes, the context is assumed to be the commercial ownership of real estate. To further clarify, this refers specifically to those organisations whose business relates to owning, trading, managing and tenanting real estate on a professional basis, whether in the residential or commercial sector. The question therefore is what BV means to participants in that market.

Perhaps expectedly, BV is best understood in a broad sense, encompassing both financial and non-financial considerations.

At a financial level, BV is about enhancing internal operational efficiencies (Deloitte Center for Financial Services, 2015), partially through increased levels of automation and precision. Beyond cost reduction and increased revenues, it also entails improved risk assessment and management, leading to better business insights which in turn produce better decisions (Deloitte University Press, 2015). In this sense, BV in a financial sense refers to the optimisation of net operating income.

In a non-financial sense, BV is about improved tenant, customer and employee service, retention and engagement (Deloitte Center for Financial Services, 2015). These considerations have an indirect financial impact and are likely to include notions of attracting and retaining quality tenants, having consistently strong rental escalations, as well as striking an appropriate balance between aesthetics and rental charged. Arguably, BV in this context relates to real estate companies establishing and maintaining a sustainable competitive advantage in the market in which they operate (Heywood & Kenley, 2008).

Importantly, the extent to which one achieves BV exists on a continuum, **to a greater or lesser degree. Of course, companies that don't use any** form of technology will not be achieving any degree of BV in the sense described above. In reality, it is likely that real estate companies will be achieving greater or lesser levels of BV. On that basis, assessments of BV are about identifying where an organisation exists on the spectrum and then, taking into account the context in which it operates, determine the extent to which enhanced levels of BV are achievable.

1.4 Research Problem

There is no cohesive, comprehensive and contemporary account addressing the nature and extent of technology adoption within the real estate industry, the inhibiting and enabling factors impacting technology

adoption and finally, the benefits of leveraging technology to achieve best value.

1.4.1 Research Question

For the purposes of this study, there is a primary question, as well as three secondary questions.

The primary question is:

“Do real estate companies leverage technology to achieve best value?”

The secondary questions that follow are:

- (1) **“What are the key benefits of technology experienced by real estate companies?”**
- (2) **“What are the key inhibiting factors behind technology adoption in the real estate industry?”**
- (3) **“What are the key enabling factors behind technology adoption in the real estate industry?”**

1.4.2 Research Aim

The purpose or aim of this research is:

- (1) To determine the nature and extent of current and imminent real estate technology solutions employed in the market;
- (2) To understand and analyse the benefits of technology solutions in the real estate market; and
- (3) To establish the key enabling and inhibiting factors impacting technology adoption within the real estate sector.

1.4.3 Research Objectives

The research objectives are:

- (1) To establish a comprehensive descriptive account of all major current or imminent technologies employed or being tracked by leaders within the global real estate market;

- (2) To establish the nature and extent of technology use within industry leaders in the real estate market;
- (3) To establish the key benefits of leveraging technology in the real estate industry;
- (4) To establish which factors inhibit technology adoption and which promote adoption; and
- (5) To distribute the key findings of this research to large, medium and small real estate organisations to promote awareness of the potential benefits of technology.

1.5 Assumptions

It is assumed that the reader is a reasonably informed individual who utilises technology on a daily basis in the form of a mobile device, tablet or desktop computer, but who is not necessarily an IT specialist.

It is also assumed that in the real estate market, public companies are the leaders in innovation and technology. In the US, both public and private companies appear well-positioned to leverage technology to achieve best value. In either case, it is assumed that that any South African participants interviewed are market leaders. It is also assumed that the nature and extent of technology implementation in these participants is a fair representation of comparable organisations' efforts. In this research, it is assumed that US real estate markets are the most advanced and developed in the world (Pirolo, 2015).

This research also presumes that the ultimate beneficiaries of real estate innovation (such as staff, tenants or shoppers) are informed and familiar with technology to a lesser or greater extent. For example, those persons who have yet to embrace email or have a smartphone are unlikely to derive many material benefits from innovation in the real estate sector.

Finally, it is assumed that organisations are rational, in the sense that they seek to maximise the productivity and efficiency of employed capital. As such, a rational company would seek to employ technological

innovation if the benefits outweigh the costs in the selected time horizon. In this instance, costs and benefits ought not to be construed in a narrow, financial sense. Instead, they are viewed in a holistic fashion where intangible or non-financial considerations that may have an indirect impact on profitability (such as customer experience or employee well-being) are worthy of equal consideration.

1.6 Research Methodology

As outlined earlier, the theoretical underpinnings of FM are grounded in academic literature, consisting largely of textbook and online academic resources. Insofar as possible, the most recent literature has been consulted. Importantly however, this research has afforded a strong preference towards the works of those authors who are most frequently cited and regarded as specialists in their field, irrespective of the date of publication. Naturally, this assumes that such older work remains as relevant as when it was published. To the extent that this is not the case, more recent sources were preferred.

With regards to discussing technology, the most current and relevant sources of content are online. In the past, most online research would have focused largely on using search engines such as Google, and then experimented with different key words. While that is most certainly an effective way of finding relevant material, social media platforms such as Twitter and LinkedIn, have become even more effective at providing targeted content. This enables a researcher to find useful material online that may not have been search engine optimised. Twitter and LinkedIn have the advantage (and perhaps disadvantage) of being non-discriminate, offering a platform for smaller enterprise content to be found, outside of large commercialised websites.

Once an account of the technologies is explored, the data collection of Chapter 3 and data analysis of Chapter 4 is outlined. A single case study methodology was employed, coupled with semi-structured interviews of

five of **the case's clients**. The results of the interviews were transcribed and then collated and analysed using NVivo software, the industry standard for the analysis of qualitative data. These findings are then measured against the technologies identified in Chapter 2 and various explanations are offered. Based on these findings, Chapter 5 outlines some conclusions and potential areas warranting future research.

1.7 Delimitations

In the context of this research, there are a number of key delimitations:

- (1) **The notion of "technology" specifically excludes so-called "green technologies"**, generally understood to be technologies used to optimise energy efficiency. This includes both infrastructure (such as specific construction materials), hardware (such as sensors) and software used to analyse and interpret the data. On that basis, any findings from the research cannot reasonably be **extrapolated to include all notions of "technology"**.
- (2) With regards to technology, no attempt is made to discuss the mechanics of how the technology works. Instead, a descriptive account is favoured where the mechanics are only discussed to the extent it is required to facilitate an understanding of the technology concerned.
- (3) While broad technology themes are discussed, focus is on real estate specific technology only, and not technology relevant to other industries.
- (4) A quantitative approach was excluded for two key reasons. Firstly, the nature of the research questions is such that context and depth of data was critical. The quality and depth of data was regarded as far more valuable than the number of participants. Secondly, the criteria used **to assess the participants' responses** are difficult to objectively measure – a degree of value judgement is inherently required.

- (5) The research data is limited to listed real estate firms based on the following generalisations:
- a. Listed entities are more transparent about their operations than private companies;
 - b. Real estate markets are fragmented, however listed real estate markets are fairly consolidated, allowing one to sample a small number of entities covering a large number of properties; and
 - c. Listed entities have the scale and resources to employ technological innovations relatively affordably.

1.8 Dissertation Outline

In Chapter 2, the foundation and context is laid by exploring the notion of FM, since the use of technology in real estate falls squarely within its domain. Specifically, questions concerning what FM was, what it is now and what it is likely to be in the future are instructive. In addition, it will also be necessary to briefly underline the divergent views of human resources, motivation and productivity-maximising management beliefs **that inform one's understanding of the role of FM. This component of the research is based primarily on published literature, textbooks and online academic resources.**

Having outlined the broader context of technology and its role within FM, the next section explores some broad technologies that lead to the adoption of specific technologies, either currently employed or imminently so. The vast majority of this content is sourced online as those tend to be most current and relevant. In the interests of concentrating on the business value offered by innovation, the mechanics of how exactly the technology achieves this is only discussed in a cursory fashion where necessary. Having discussed a specific technology, an attempt is then made to offer examples of its practical use.

Subsequently in Chapter 3, the case study is outlined, specifically, the characteristics of the case itself. Thereafter, the findings of semi-structured interviews with key IT and information systems (IS) personnel of **the case's clients (namely real estate firms)** are presented.

Fundamentally, the interviews sought to establish the extent to which real estate innovations are actively or imminently employed, in both global and local real estate markets. To the extent that an organisation or **industry's adoption is low, questions are posed as to potential underlying causes**. The manner and form of this data collection is fully expounded in Chapter 3.

Chapter 4 sets out the findings of the data and offers analysis as to its significance. This enables conclusions to be drawn as to the extent to which real estate companies are leveraging technology and further, the factors contributing to their position.

Finally, Chapter 5 serves not only to reinforce the conclusions drawn in Chapter 4, but perhaps more importantly, attempts to shed light on both future innovation and areas of research warranting further investigation.

1.9 Concluding Remarks

This chapter sought to provide the overarching context of the research, including the research problem, questions, aims and objectives. It also briefly highlighted the prevailing literature and key assumptions and delimitations within this research. Chapter 2 below provides the relevant theoretical basis and prevailing themes that are evident in the literature.

Chapter 2: Literature Review

2.1 Theoretical Underpinning of the Research Question

2.1.1 Context

The research question at hand relates specifically to the extent that modern real estate companies leverage technology to achieve best value. Before considering the use of specific technologies and their application, it is necessary to provide a theoretical foundation, which in this case falls squarely within the domain of FM.

Importantly, this is not necessary strictly from an academic perspective. Aside from its academic value, it is submitted that there is significant practical value in having a solid understanding of FM.

Since FM has attracted such a wide and diverse range of views as to what it entails, it is best discussed in a fluid and less structured manner. The categorisation of the different elements and opinions on the matter is less important than understanding the broader FM context. For current purposes, it is helpful to consider a host of opinions on the matter, as no single view is necessarily definitive. Through a generalised and broad understanding of FM and its context, one should be capable of forming a reasonable level of understanding on the subject and its relevance to the research questions.

At the heart of FM, is the interaction between people, space and technology. The discussion below aims to outline the fundamental principles of FM, its evolution and what its practical implications are in a modern context.

2.1.2 FM & the Inherent Lack of Consensus

FM has been described differently by a diverse group of individuals over a significant period of time. A brief overview of the literature reveals that there is no harmonious and uncontroversial definition of FM (Tay & Ooi, 2001: 357). Across the globe, national facilities management associations

have defined FM differently, from Australia to England to the US and Middle East. Between 1990 and 2000, the issue was rigorously debated in academic circles and a range of divergent views emerged.

The heart of the debate centres fundamentally around the essential role of FM within an organisation. While some maintain that FM is strictly operational, others believe that equally, it has a strategic dimension (Tay & Ooi, 2001). While some commentators may agree that FM entails both elements, the weight afforded to each may differ to a significant extent. In contextualising the matter, it is useful to consider the disparate views as existing along a spectrum.

On the one end, some have espoused a narrow construct of FM, in terms of which it relates strictly to the management of hardware within an organisation. By hardware, one is speaking of the physical components of an organisation - its buildings, infrastructure and equipment. Shifting along the spectrum is a broader view that regards FM to include both hardware and software. Software in this context refers specifically to **organisation's intangibles such as business processes, employee well-being and safety**, as well as the impact of an environment on employee productivity. On the other end of the spectrum is the broadest possible conception of FM, holding that in addition to hardware and software, it also includes the property lifecycle of designing, building, financing and operating a physical property (Tay & Ooi, 2001).

It is submitted that the lack of consensus evident in the literature does not necessarily preclude one from establishing a reasonably informed view of FM. It is evident that some of the earlier views expressed appear to have much less support today than when they were originally articulated (Tay & Ooi, 2001). Furthermore, since FM does not operate **solely in an academic paradigm, it makes sense that one's view** of FM is influenced more by practice and less by a theoretical framework.

2.1.3 FM's Evolution

While some argue that FM can be traced to the era of scientific management and the exponential growth of office administration, others **point towards a 1960's** practice evident in the US where banks began outsourcing the processing of their credit transactions on a wholesale basis (Amarutunga, 2000). Quah (1999: A20) **suggests that "FM has evolved since the 70's, from a largely operational focus on the physical environment to a strategic emphasis on both physical and social environments"**. It is evident that in recent years, FM has gained increased recognition in both the public and private sectors (Alexander, 2003).

Alexander (2003) suggests that this can be attributed to a host of factors, including market policies, increased competitiveness, deregulation and privatisation. It is also evident that greater accountability for use of public resources has heightened demands of improved efficiency and value for money in the public sector. In the corporate world, cost reduction pressure and demands of improved flexibility has led practitioners to establish and implement more innovative ways of managing facilities to better support business (Alexander, 2003). Grimshaw & Cairns (2000) would probably argue that this change is at least partly attributable to **FM's innate ability to respond** to organisational change.

Generally speaking, FM is a relatively new discipline that is said to have grown from a caretaker /superintendent role into one of greater importance and influence (Langston *et al.*, 2002). Today, many regard it as a growing field and scientific discipline that is steadily anchoring its role in business processes around the world (Mudrak, van Wagenberg & Wubben, 2005). Alexander (1996), notes that FM has evolved from a highly technical base into one that is more of a management discipline. Nutt (2004) reflects this sentiment, suggesting that there is growing evidence that FM is increasingly becoming aligned with business.

Part of these trends are underlined by the notion that the traditional divide between so-called “non-core” (support) and “core” (business operations) is losing favour in the market. Modern FM encompasses a broad range of activities and services, far more than building operations and maintenance.

Today, “FM encompasses workplace, facility, support services, property, corporate real estate and infrastructure” (Chotipanich, 2004:365). FM is about ensuring that infrastructure supports core business tasks and adds value to relevant stakeholders, which include both the users of facilities and the service providers (Mudrak, van Wagenberg & Wubben, 2004). When speaking of infrastructure, this is not simply a reference to the buildings but includes notions of technology, workspace design, ergonomics, auxiliary services, security and ongoing environmental impact assessments. More commonly these days, there is a strong argument to be made that FM should not be seen simply as an overhead, but rather as an integral part of an ecosystem necessary to enable people to perform optimally. Although traditional pressure has been to reduce costs, the evidence suggests that today, more decisions are being made with a view to maximising value and competitive advantage (Langston *et al.*, 2002).

2.1.4 Modern FM Described

Quah (1999) argues that FM in the future will appear very differently to the way it is today – as modern technology advances, it provides for the divergence of the relationship between time and space. This will necessarily result in the establishment of a new FM manager – one who is **a “flexible, skilled, visionary leader who accepts change as everyday part of life, proactively anticipating change, designing organisation and services in conjunction with, rather than in reaction to, changing business requirements”** (Quah, 1999: A22). While it is clear that technical and analytical skills will always be required, it is the intuitive and managerial abilities of the modern FM manager that will enable them to think in a

holistic, creative and flexible manner in a constantly evolving environment (Quah, 1999).

Notwithstanding divergent views on the nature of FM, most tend to agree that three principals are prevalent in all modern FM circumstances:

- (1) It is a supporting management function to the core business of an organisation;
- (2) It concentrates on the area of interface between physical workplace and people; and
- (3) It requires a multi-skill approach (Amarutunga, 2000: 259).

In addition to those qualities, a critical evaluation of the literature reveals that there are a number of key elements to which most academics and practitioners would be likely to subscribe. The discussion below aims to outline these four elements in offering a generalised conception of modern FM.

2.1.4.1 FM: It has a Material Impact on Organisational Success

Generally, it is accepted that FM entails a range of facility services and that the management of these facilities is regarded as having a material impact on the success or failure of an organisation. FM is therefore an important function that serves to facilitate the realisation of an **organisation's short and long-term goals** (Chotipanich, 2004).

2.1.4.2 FM: It is Context Dependent

FM, its appearance and priorities are a function of the core business (Chotipanich, 2004). Companies rely on FM in different ways dependent on the environment and context. FM is ultimately an organisation-specific function that is dependent on the underlying needs of the business.

Specifically, the role of FM "should be defined by the relationship of facilities to the core business of an organisation in which success is measured by the degree and quality of support they provide to achieving key business objectives" (Chotipanich, 2004:365). The specific nature of

the facilities services themselves is determined by a range of factors including business function, industry, location and time (Langston *et al.*, 2002). This neatly encapsulates the assertion that the manner, form and scope of FM is primarily a product of the context, needs and goals of the business. Going even further, one could argue that the extent to which FM is prioritised (or at all) in an organisation, is similarly dependent on the **organisation's business**, goals and corporate culture.

2.1.4.3 FM: It has an Operational & Strategic Dimension

Nutt (2004) described FM as operating across two main levels: operational and strategic.

Operational FM, often seen as the primary and most visible function of FM, emphasises short-term results, covers day-to-day issues and concentrates on providing a safe and efficient workplace. This is FM as it has traditionally been conceived and understood (Chotipanich, 2004).

By contrast, strategic FM includes a far wider field including asset management, strategic property decisions, facility planning and development, the nature and extent of which are governed by the overarching strategy and goals of the organisation (Chotipanich, 2004).

Strategic FM is about longer-term issues, ensuring effective business planning of facilities services, leadership of a dedicated FM team and constantly developing new and innovative ways to enhance business value. **"Strategic" implies a purpose for which a direction is set over the long term**, requires leadership and a generalised understanding of the business context (Jack, 1994: 40). A strategic approach also tends to focus on the management of uncertainty, since it is well-established that property and facilities can have either a negative or positive impact. Property and facilities can inhibit the goals and work of companies and their employees, but it can also contribute to productivity and effectiveness.

In summary, at a national level, the strategic objective of FM is to provide better infrastructure and logistic support to business. By contrast, at a local or operational level, it is effective management of facilities and services (Nutt, 2000: 124).

2.1.4.4 FM: Definitions Tend to Concentrate on Specific Elements

Some definitions have centred on FM's role in supporting an organisation's core objectives. This has prompted some commentators to suggest that it **is accepted that the primary function of FM is to "handle and manage support services to meet the needs of the organisation, its core operations and employees"** (Chotipanich, 2004: 365). Other definitions have added that in addition to supporting the core business activities, FM is about constantly seeking new and innovative ways to add value to all stakeholders (Mudrak *et al.*, 2004).

Some authors have focused their understanding of FM on the notion of co-ordination. For them, FM represents the support function responsible for co-ordinating physical resources and support services in the workplace (Chotipanich, 2004: 365). Douglas (1996: 27), similarly emphasises the co-ordination element when he describes FM as being **"the co-ordinating management function that concentrates on the interface between the physical workplace or physical "useplace" and people."** The US Library of Congress appears to favour the notion of co-ordination too when it **describes FM as "the practice of co-ordinating the physical workplace with people and work of the organization as it integrates the principles of business administration, architecture and the behavioural and engineering sciences"** (Amarutunga, 2000: 259).

For others, FM tends to be framed in either abstract or practical terms. For example, Alexander (2003: 270) suggests that: **"FM can be summarised as a belief in the potential to improve processes by which workplaces can be managed to inspire people to give of their best, to support their effectiveness and ultimately, to make a positive contribution**

to the company's success". Robertson (2000: 376) by contrast, highlights the more practical elements of FM, suggesting that in in most companies, **"FM is the supplier of real estate space, co-ordinator for space planning, operator of facilities and generally responsible for accommodating office moves and changes".**

2.2.1 Changes in the Modern Workplace: It's Impact on FM

Before offering a definition of FM for current purposes, it is worth briefly considering the key drivers contributing to **the profession's evolution and** role within modern organisations.

Across a diverse range of industries around the world, significant changes have taken place on a global scale that have fundamentally altered the relationship between organisations and their infrastructure (Grimshaw & Cairns, 2000). Nutt (2004) notes some of the more significant changes that have altered the role of FM in modern organisations:

- (1) For many ecommerce companies, the location and appearance of warehouses is less important than the company website;
- (2) Teleworking arrangements in terms of which employees are mobile, reducing the need for physical space but increasing the need for a more robust ICT infrastructure;
- (3) Shift from workstations to diverse working venues;
- (4) Shift in management from an ethos of discipline and control to one of innovation and trust;
- (5) Increased demand for environmental responsibility;
- (6) Strong emphasis placed on well-being and providing a quality workplace;
- (7) Flatter, decentralised management hierarchies;
- (8) Increasingly technologically savvy and demanding users and consumers;
- (9) Work environments characterised by constant change;

- (10) Increased demand for technology facilitating employee collaboration and engagement;
- (11) Increased emphasis on **employees' quality of life and work-life** balance (attracting and retaining employees);
- (12) Greater demands for efficient use of space; and
- (13) Increased demand for energy reduction in real estate and its users.

It is evident that organisations have evolved significantly over the past decade and that this trend is likely to accelerate into the future. The challenge for FM is to maintain its relevance by ensuring that it continues to add business value. The point to stress from this discussion is that demands placed on FM have evolved and will continue to do so at a rapid pace.

2.2.2 FM: A Suggested Definition

It is relatively uncontroversial to remark that the central issues of FM consist of place or facility, people or user of the building, and process or activities in the facility (Chotipanich, 2004). It is also evident from the literature, all organisations have three key components:

- (1) People;
- (2) Space; and
- (3) Technology.

In the past, each of these components was managed in isolation by human resources (people), FM (space) and IT (technology). There is a strong argument that suggests that in isolation, these individual components struggle to offer long-term business value. Instead, the argument suggests that it is best that these components are integrated and aligned with the business to maximise business value (Robertson, 2000).

It is submitted that this is the preferred approach for modern organisations – a broad, all-encompassing role for FM that is flexible,

adaptable and constantly striving to add business value and meet the ever-changing needs of modern organisations.

In the context of this paper and the research question, FM is best understood as: **"The integrated management of the workplace to enhance the performance of the organisation"** (Tay & Ooi, 2001: 359).

2.2.3 How does Technology Impact FM?

Having outlined the nature of FM, it is useful to consider how, technology fits within the academic discussion and research problem. If one accepts the tenets of modern FM as being a diverse practice area that plays a critical role in supporting the operational and strategic goals of the business (and fundamentally relates to the interaction between people, space and technology), the link becomes clearer.

Technology does not and will never replace the role of an operationally and strategically sound FM manager. Instead, technology ought to be seen as an enabler, a tool that allows the FM manager to be more **effective, efficient and productive in achieving the business' core objectives**. Quah (1999: 33) notes that: **"Technology is an enabler that allows businesses to do things different, but it's not the driver. Staff need to be empowered and willing to use the tools and consequently, the advantages of time and place that technology makes available"**.

By automating and simplifying many of the routine and menial tasks of FM, technology enables FM manager to focus less on operations and more on strategy. **Technology-inspired FM is largely dependent on the business' goals and operational strategy**. A business that is resistant to **technological advancement will result in the FM manager's role remaining "stubbornly operational in nature"** (Grimshaw and Cairns, 2000: 393). **By contrast, a FM manager's role within an organisation that embraces technology and strives to remain up to date with advances, will inherently be more strategic in nature.**

Technology has the potential to play a material role in **companies'** ability to meet their strategic and operational objectives. Technology can reduce costs, increase revenue and highlight inefficiencies. It can also automate, simplify and streamline processes. Perhaps most excitingly, it can add **value by enhancing users' experiences and their interactions with real estate companies** (Case, 2015).

Consider below, various technology-driven initiatives that ultimately fall within the domain of strategic FM, managing the interaction between people, space and technology:

- (1) Tenants and visitors in a commercial building enjoy free WiFi, **enhancing the property's appeal to both;**
- (2) Properties utilise Wi-Fi-enabled sensory hardware to send **emergency notifications to tenants'** mobile devices and cell phones;
- (3) Properties have motion-detecting sensors to ensure that electricity and HVAC systems are only switched on when people are present in a given area;
- (4) Commercial leasing staff have mobile devices with vacancies and desired rentals displayed diagrammatically so they can show prospective tenants their options, as well as send them relevant floorplans, leases and marketing material on the go;
- (5) Prospective tenants for a high density residential development log into a portal which processes the application and makes for a relatively seamless and streamlined experience;
- (6) Property managers use a mobile application to take photos and **make notes of a property's condition prior to tenant** occupation, the tenant confirming such condition by signing using a stylus pen;
- (7) Tenants log into the tenant portal where they can query invoices, utility bills and lodge maintenance requests without picking up the phone; and

- (8) The FM manager wearing a pair of Oculus Rift glasses, shares his view with a technical expert who is remote and directs the FM manager how to solve a particular maintenance problem quickly and cost-effectively (Case, 2015).

These are simply a sample of some of the practical ways in which technology and FM intersect.

2.2 Broad Technologies Impacting Real Estate

2.2.1 Introduction

When considering technologies that have an impact on real estate, some are inherently broader than others. Furthermore, if one examines the specifics, it is evident that almost all employ multiple technologies in delivering the solution. On that basis, the discussion below focuses initially on the broadest technologies, followed thereafter by a discussion of the specifics. As noted elsewhere, this discussion ought not to be viewed as exhaustive, but rather an attempt to outline the most prominent and influential technologies in the market.

2.2.2 The Cloud

Most modern discussions of technology will invariably make reference to the impact of cloud computing. **Traditionally, a company's entire IT** infrastructure was situated locally, meaning that all servers, data centres and storage was situated on-site in a designated room with cooling and power. Furthermore, a team of IT experts was required to configure, install, maintain and upgrade an entire software and hardware stack. The individual software application itself would need to be installed on each **user's** personal computer (PC), meaning that upgrades would similarly require the specialist to install the update on each PC one by one. Often, the upgrade of a single software application would result in a failure of the overall software stack, so IT specialists tended to treat upgrades with caution. In addition to the above, they would also be responsible for any development, testing, staging, production and data recovery. These

practices tended to be prohibitively expensive for smaller businesses (Salesforce, 2016).

Cloud computing, simply put, is about allowing users within an organisation to access software applications and data storage through the internet, rather than their hard drive.

Importantly, cloud computing supports the desire to work anywhere, anytime. Of the younger generation of employees, most already use cloud-based email and project management software. In a recent survey in the US, almost half of the respondents indicated that they will invest or increase investments in cloud computing over the next year (Schwartz, 2015b).

Notably, the reality is that these applications and data need to exist in a physical server somewhere, it simply means that they are not on-site and they are accessible over the internet across multiple devices, rather than a single desktop PC. This necessarily shifts the focus from hardware towards high speed internet. Cloud computing offers numerous benefits to the company including flexibility, remote user across multiple devices, lower capital costs, minimal maintenance and seamless upgrades (Davison, 2011). Aside from the benefits, it is evident that more companies are embracing cloud computing, including the real estate industry. By some estimates, the global cloud computing market is expected to grow by 30% each year from 2015-2020, eventually reaching a value of \$270bn (Mandell, 2014).

Cloud computing is particularly useful for real estate companies, allowing users to operate from wherever they like– through mobile and handheld computers (Morley, 2014). Real estate professionals tend to be mobile and the cloud allows them increased flexibility to access key information from wherever they may be. Brokers leveraging cloud computing, for example, are better positioned for enhanced deal-closing velocity and professionalism (Beverly & Shipley, 2013).

In summary, the cloud represents an opportunity for real estate professionals to be increasingly mobile, have access to relevant information across multiple devices and ultimately, offers a higher degree of professionalism, responsiveness and efficiency.

2.2.3 Software as a Service ("SaaS")

In simple terms, SaaS is a delivery method providing access to software and functionality remotely as a web-based service (Beal, 2016a). Rather than existing locally on a user's PC, the software is capable of being accessed via the internet, meaning users can access it remotely and across multiple devices. Typically, SaaS tends to have a cost advantage over local installations (monthly fees rather than large upfront capital investment), is easier scale, upgrade and maintain, and generally requires less hardware (Beal, 2016a). A web-based mail service such as Gmail is probably the most commonly used SaaS application by private users, while a service such as Office 365 is increasingly popular in the corporate context. It is estimated that by 2018, almost 28% of the enterprise application market will be SaaS-based, generating over \$50 billion in revenue (Columbus, 2014).

Real estate companies have similarly embraced the migration towards SaaS solutions and presently have hundreds of different offerings across the entire real estate spectrum. SaaS offerings have arisen across the board and provide solutions to manage some of the key areas fundamental to real estate, including:

- (1) Construction;
- (2) Finance;
- (3) Client relationships;
- (4) Maintenance;
- (5) Billing;
- (6) Lease administration; and
- (7) Marketing.

Many real estate professionals, such as brokers and property managers, typically spend most of their time out of the office. SaaS empowers them to remotely access and act on key data, enhancing their efficiency and providing a better overall service to their clients. Perhaps more important than the benefits to the organisation or professional concerned, is the fact that clients expect their contacts to be accessible and responsive at all times.

In summary, SaaS real estate solutions offer real estate professionals an opportunity to be more responsive, more efficient and ultimately, provide a higher degree of service that has come to be expected in the modern era.

2.2.4 Big Data & Big Data Analytics

“Big data” is a term that gets a lot of coverage in technology circles and is widely recognised as having an increasing influence in the future of real estate technology. In simple terms, it refers to massive volumes of data that are difficult to process using traditional software techniques (Beal, 2016b). Others see it as being a collection of data from traditional and digital sources from both within and outside of a company that represent an opportunity for ongoing analysis and discovery (Arthur, 2014). Perhaps the best explanation of big data is that it is characterised by three main elements:

- (1) The sheer volume of data;
- (2) The wide variety of data; and
- (3) The velocity at which data can be processed (Rouse, 2014).

Naturally, in response to the growing role of big data in modern organisations, the techniques used to analyse and interpret such data **have similarly had to evolve into what is known as “big data analytics”**. These complex tools, most often cloud-based, have the ability to analyse big data and provide insights to companies in real-time (Tech Target, 2016). New technologies are empowering real estate companies to make

real-time decisions based on business intelligence and analytics — from market comparisons, census data and demographic information to understanding tenants, energy consumption and operating cost efficiencies.

From a real estate perspective, big data and big data cloud analytics enable real estate companies and professionals to spend more time on their core role and less time analysing and interpreting the wide range of data sets that exist in the industry. This gives them the requisite analysis and business intelligence to make better data-driven decisions. In **summary, “data-centricity”, namely “placing better, deeper, more accessible and more relevant data at the heart of decision-making”** (Hughes, 2015), is the critical element to boosting productivity. Today, one is able to integrate disparate real estate data with financial, sales, leads as well as various other sources to get a more holistic, evidence-based view of business performance. This capability, in turn, helps to align real estate strategy with the organisations overall goals (Hughes, 2015).

In summary, the practical benefits of big data and big data analytics include:

- (1) Real estate agents can save time by spending less looking at listings and more on time finding clients;
- (2) Retail real estate companies have better insight and knowledge of their consumers, their shopping habits and even how they make real estate decisions – this in turn promotes better targeted marketing;
- (3) The democratisation of real estate data (such as sales price, rental, mortgage bonds etc.) has helped close the knowledge gap that once existed in the industry and enables consumers to make better decisions (Hughes, 2015). One prominent example of where big data has changed the landscape of real estate is within the residential sales market in the US. Through its website,

Zillow provides insight into key data that traditionally residential buyers were not able to easily access. Algorithms crunch huge volumes of real estate data (relating to address, age of property, value, rental, size etc.) and present it in a centralised market place so that prospective buyers are easily able to compare the asking price with existing data of the surrounding area; and

- (4) Through big data analytics, real estate owners are empowered to better understand trends, patterns and inefficiencies across and make decisions accordingly (Hughes, 2015).

If in the near future, the Internet of Things (IoT) (discussed in 2.6.2 below) connected devices number in the hundreds of billions as predicted, it is self-evident that the volume of data requiring analysis will necessarily **increase**. From retail owners wanting to better understand their shoppers' habits to office owners wanting to optimise energy efficiencies, looking forward into the future, big data is likely to play an increasingly influential role within the real estate landscape.

2.2.5 Mobile

2.2.5.1 Defined

Mobile refers to all technologies that enable voice and data service via cellular connectivity (Bezerra, Bock, Candelon, Chai, Choi, Corwin, DiGrande, Gulshan, Michael & Varas, 2015). In addition, mobile is also defined in terms of the vehicle through which connectivity is achieved – namely, portable handheld computers such as tablets, e-readers and smartphones that have similar or improved power and functionality of traditional desktop or laptop computers. As the name itself suggests, the primary advantage of mobile devices is the convenience offered by being portable – allowing users to access functionality independent of a single location (GCF Learn Free, 2016). The release of the iPhone in 2007 is credited as creating a new category known as smart devices - those handsets or tablets that have the characteristics of a PC, have advanced

multimedia capabilities and the ability to install third-party software on it (Internet Society, 2015: 25). In some cases, smart devices have **additional functionalities beyond traditional laptops or PC's, including a** thermometer, photometer, barometer, accelerometer, gyroscope, global positioning systems (GPS) and proximity technologies (Internet Society, 2015). These additional functionalities are often leveraged by real estate companies throughout their operations.

2.2.5.2 Mobile Revolution

Global mobile data traffic grew 69% in 2014, and in absolute terms, was 30 times the size of the entire global internet in 2000 (Cisco Visual Networking Index, 2015). In 2015, mobile devices made up 38% of internet traffic. In 2015, mobile phone traffic increased 39% from 2014, while tablet traffic also increased significantly at 17% (Kemp, 2015). Global mobile devices and connections in 2014 grew to 7.4 billion, up from 6.9 billion in 2013 (Cisco Visual Networking Index, 2015). From a penetration perspective, mobile internet was around 28% in 2013 and is forecast to be 71% by 2019 (Internet Society, 2015: 44). Of the mobile devices, smartphones are certainly the most pervasive and influential, constituting 81% of all global mobile traffic in 2015 (Kemp, 2015).

Internet access across the globe has increased from 400m users in 2000 to around two billion in 2015, largely attributable to the widespread adoption of mobile devices (Nair, 2015). In 2015, 64% of Americans owned a smartphone (up from 54% in 2014) (Smith, 2015a), compared to 90% of Britons (Banks, 2015a) and 81% of Australians (Thornhill, 2014).

In September 2014, worldwide penetration of mobile phones passed 50% (Banks, 2015b). European and American regions have the highest mobile penetration figures at 78% while Africa remains the lowest at 17% (Nair, 2015). Around the world, mobile internet traffic has grown significantly, particularly in developing countries. At 76%, Nigeria has the highest

percentage of mobile traffic, compared to the average of approximately 33%. Interestingly, SA ranks third with 61% of internet traffic attributable to mobile devices. Global traffic figures **suggest that web traffic in PC's or desktop computers** decreased by 13% to 62% while mobile phones saw an increase of 39% to 31% (Banks, 2015b).

In a little under 15 years, mobile technologies have exceeded 3 billion users, making it the fastest adopted technology of all time (Bezerra *et al.*, 2015). From around 738 million mobile cellular subscriptions in 2000, it is estimated that in 2015, this figure increased to 7 billion (Nair, 2015). As technology has evolved from 2G to 4G, users have experienced tangible improvements in user experience at a lower cost – resulting in increased rates of adoption (Bezerra *et al.*, 2015). To give one a sense of the progress in mobile connectivity, consider these recent statistics:

- (1) 4G technologies enables a 12,000 time improvement in capacity relative to 2G, with maximum download speeds of 250 megabits per second (Mbps), as opposed to 20 kilobits per second (Kbps) for 2G;
- (2) The cost of network infrastructure per megabyte fell 95% from 2G to 3G, and 67% from 3G to 4G.;
- (3) The global average cost of mobile subscriptions relative to maximum data speed has decreased 99% or about 40% annually between 2005 and 2013; and
- (4) Smartphones have become much more affordable, with approximately 30% of all units sold cost less than \$100, and some sell for as little as \$40. These ever-decreasing costs and the growth in bandwidth has broadened the market to include a far greater pool of ordinary consumers, rather than being limited to the wealthy (Bezerra *et al.*, 2015).

These figures offer support to the argument that we are entering the age of **"supermobility"** – a time where mobile devices provide the technology for employees to be productive while out of office, whether it relates to

emails, documents or enterprise applications (Banks, 2015a). Mobile has fundamentally shifted the way we live, work, play, communicate, collaborate and experience.

2.2.5.3 Impact on Real Estate

Organisations, including real estate companies, are increasingly leveraging mobile technology and the associated applications to ensure that their employees are able to work remotely and remain productive. Simultaneously, these companies are enjoying enhanced internal efficiencies and improved tenant, customer and employee engagement and loyalty (Deloitte Center for Financial Services, 2015). In fact, mobile has been heralded **as “the indisputable focal point of real estate technology” (Caldwell, 2014).**

Real estate professionals have always been, and will continue to be, inherently mobile. This suggests that perhaps more than others, they have a more acute need to access relevant information at all times, independent of location. Furthermore, as millennials join the industry, as both consumers and professionals, their inherent demand to access information on command demands mobile adoption (Mandell, 2014).

Mobile technology appears to represent the foundation of supporting the future millennial workforce. A recent study found that 78% of IT **leaders saw an increase in their company’s remote workforce, explaining** why 70% of those surveyed rated it as the technology most likely to support the millennial shift (Schwartz, 2015a). Part of this trend is **attributable to the trend of “bring your own device to work”, enabling** employees to be more flexible and have relevant data at their fingertips when they need it (Banks, 2015a). On the back of this, 60% of IT leaders have indicated an intention to increase their investments in mobile within the next year (Schwartz, 2015a).

In a recent survey across North American companies, it was established that more than 60% of professionals surveyed use multiple devices in the

office at least half the time, with nearly 60% sending files back and forth between a mobile device and computer at least three times per week. 74% of employees have two devices that they use for work, and just over half of users juggle three devices. Schwartz (2015a) notes that the top five business tasks on a smartphone were:

- (1) Emails (91%);
- (2) Phone calls (92%);
- (3) Texts (87%);
- (4) Maps (69%); and
- (5) Photos (62%).

Today, mobile video comprises 53% of global internet traffic. As one of the most flexible technologies today, mobile video saves prospective owners, tenants and real estate agents both time and effort in searching for prospects and the right property (Miguel-Descalzo, 2014).

Fifteen years ago, most real estate companies were paper-based (McGuire, 2012) and got results by placing adverts in local newspapers **and having a fairly static website. Today, given that Google's** search algorithm favours mobile-optimised websites, real estate companies must embrace mobile in order to remain competitive (Property24.com, 2015). A joint study by the National Association of Realtors and Google showed that 89% of new home shoppers use a mobile search engine. Furthermore, approximately 45% of homebuyers use their mobile devices to ask for more information about listings (Title Source, 2015). Property buying searches on Google have increased by 253% over the past four years and 52% of actions on real estate websites come directly from the search engine (Fin24.com, 2015). Other studies have shown that as much as 70% of prospective clients want a virtual tour before they even set foot in the premises (Maximum Resites, 2015). Mobile appears to be the future and is already the platform of **choice for today's homebuyers** (Title Source, 2015). From a real estate services and marketing perspective, mobile technologies enable real estate professionals to provide quicker

response times, which is increasingly becoming a requirement for success in modern business (Maximum Resites, 2015).

Turning specifically to the retail real estate sector, mobile has similarly had a significant impact. A 2014 study by US group, Ninth Decimal, found that 81% of mobile users researched online before heading off to the malls and nearly 20% consulted their mobile in-store (Thornhill, 2014). Other studies have shown that 93% of consumers use their mobile devices for research to complete a purchase, while 82% leverage their device in-store to influence their purchase decision. These figures suggest that mobile technologies are immensely powerful and require real estate owners, retailers and brands to get on board (Samuely, 2015).

Today, in addition to leveraging mobile device hardware such as the camera, video or GPS functionalities (Lurchenko, 2014), there are a proliferation of mobile applications serving real estate professionals across the board. These include LoopNet, Evernote, Dropbox, LinkedIn, Twitter, Adobe Reader, Flashlight, Documents, Around Me and Voice Memos. Mobility represents an optimised platform for property owners, tenants, agents and marketers. Today, a property manager can reset a thermostat via smartphone while an architect can send plans via Dropbox. LoopNet for example, allows brokers to research a database for listings, including searching and securing comparables from their mobile devices. (Beverly & Shipley, 2015). On the consumer side, mobile technologies allow individuals to interact with real estate companies in a multitude of ways, from making application to rent and then paying via their mobile phone (Chan, 2014) to searching for properties.

Across all aspects of the industry – from viewings, signature of leases and inspections to ad hoc maintenance, compliance and enhanced retail experiences – mobile technology has revolutionised what real estate companies do and the way they do it. While it is probably the case that a plethora of factors have resulted in higher rates of adoption of mobile

technology in the real estate industry, the following broad factors are instructive in current circumstances:

- (1) The consumerisation of technology and the mainstream adoption of mobile technology;
- (2) A culture where clients expect companies to engage with them through their mobile device, including social media channels;
- (3) Enhanced client expectations of response times, as well as value and experiences; and
- (4) The incessant drive to automate process-driven daily and ad-hoc tasks, as well as streamlining and enhancing operational efficiencies.

(Deloitte Center for Financial Services, 2015).

2.3 Specific Technologies Considered

2.3.1 Omni-Channel Retailing

2.3.1.1 An Overview

Omni-channel retailing is a term that is becoming increasingly ubiquitous across the retail real estate landscape. Particularly in the US, retail-focused real estate investment trusts (**REIT's**) have recognised that omni-channel retailing has evolved into more of a requirement, rather than an amenity. Increasingly, owner operators are looking for new and innovative ways to make malls more exciting, interesting and engaging. Omni-channel retailing is one of the tools that retail real estate owners are employing to improve the overall shopper and tenant experience (Real Comm Conference Group LLC, 2015: 15-16).

Widespread adoption of smartphones has resulted in modern consumers being able to engage with companies across both physical (in-store) and digital platforms (online store or social media). Increasingly, consumers are demanding a seamless and consistent experience irrespective of the channel or device (Newman, 2014). This is the essence of omni-channel

retailing – ensuring that consumers are delivered a consistent brand message across all channels and that inter-channel retail experiences are uninterrupted and connected. The consumer shopping experience must be continuous, as users want to be able to switch between channels and devices, picking up where they left off in the purchasing process. Omni-channel interactions are fundamentally integrated, offering the consumer a richer, seamless and context driven experience throughout the entire shopping journey (Wakelin, 2015).

2.3.1.2 Driven by a Shift in Marketing

One of the major drivers behind the push for omni-channel retailing is a fundamental shift in the way companies market themselves. This shift has arisen through the emergence of digitally connected consumers which has radically altered the dynamic between relationships and transactions. Importantly, a recent report argued that:

“Marketing has evolved significantly in the last five years, driven by the rapid convergence of customer, digital, and marketing technologies. Marketers have access to an unprecedented amount of data to inform targeted marketing campaigns. Channel access is ubiquitous, as are touchpoints of all kinds—offline and on. Consumer messaging has morphed into social engagement, allowing companies to view their brands from the outside in. The result is a magnification of customer expectations in terms of relevancy, intimacy, delight, privacy, and personal connections. Increasingly, organizations no longer market to masses. They are marketing to individuals and their social networks. Indeed, marketing itself has shifted from the broadcast of messages to engagement in conversations, and now to the ability to predict and rapidly respond to individual requests. Organizations are increasingly able to engage audiences on their terms and through their interests, wherever and whatever they are. And customers are learning to expect nothing

less, from both B2C and B2B enterprises” (Deloitte University Press, 2015:51).

Beyond the “four P’s” of marketing (product, price, place, promotion), **“dimensional marketing”** also includes four additional inter-related elements, namely:

- (1) Engagement;
- (2) Connectivity;
- (3) Data; and
- (4) Technology.

Modern consumers are able to shop irrespective of geography or time, they expect their experiences to be in real-time and personally relevant. Increasingly, user experience and quality design are regarded as the foundation for any solution. Given the volumes of data that retailers have on the consumers, to the granular detail, the integration of this data into the customer relationship management (CRM) software and marketing campaigns becomes vital in ensuring that communications are personalised (Deloitte University Press, 2015: 52). Increasingly, integration is becoming easier with various off the shelf, and in some cases, free products (Clark, 2015).

Furthermore, beyond the one-way nature of communication between brands and consumers, marketers necessarily need to engage in a dialogue if their communication is to have any meaning. This requires them to develop an in depth understanding of the consumer leading to effective relationships that foster a greater sense of loyalty and cultivate influencers within communities (Deloitte University Press, 2015).

2.3.1.3 Driven by Shopping Habits

A recent study commissioned by eBay found that being broadly present across channels, and enabling each channel to serve the customer at any point through the purchase journey, raised brand awareness and drove loyalty. The study also found that leading retailers with a presence across

store and non-store channels succeeded in capturing additional sales from non-store channels due to increased awareness of their products, expanded market share and/or a greater share of sales captured from competitors (Deloitte University Press, 2015). Other studies have shown that companies with well-defined omni-channel strategies are able to increase customer retention by 91%, while the lifetime value increases by 3,4%, compared to 0,7% decrease in companies without an omni-channel strategy (Wakelin, 2015). By the end of 2015, 64 cents for every dollar spent in retail stores was influenced by digital interactions –\$2.2 trillion in total. This represents a four and a half times increase from 2012 where it was found that approximately 14 cents per dollar spent was influenced by digital interactions (Deloitte Digital, 2015: 6).

Over the years it became common for commentators to argue that the growth in e-tailing signalled the end for brick and mortar retail. The evidence however suggests that this is not the case, although the trend will no doubt alter the economics of the sector (PWC, 2015). Within the US alone, 90% of retail sales take place in-store, 9% online and 1% is attributed to catalogue sales (Real Comm Conference Group LLC, 2015: 31). It is predicted that in fast growing economies such as China, online sales will rise to 30% by 2025 (Yu, 2015). Furthermore, two-thirds of all online sales have at some point in the shopper experience touched brick and mortar – whether trying it on or returning the product (Real Comm Conference Group LLC, 2015). While it is true that millennials love digital to discover and communicate, much like seniors, they still like to shop in-store to test, try and buy (Real Comm Conference Group LLC, 2015: 16). Rather than signalling the end of brick and mortar stores, it has led to a phenomenon known as the multiplier effect, which has the opposite effect (Real Comm Conference Group LLC, 2015: 31).

General Growth Properties, a Standard and Poor (S&P) 500 company, has recognised this effect and highlighted the fact that the physical store is now more important than ever, particularly if one understands how the

physical space interacts with the digital space. In short, the multiplier effect provides that when companies open online stores, their in-store sales increase, while the opposite is true when they close brick and mortar stores. So rather than representing a threat to traditional brick and mortar retail, those who understand how the physical and digital spaces interact view e-commerce as an opportunity to enhance the consumer experience. The multiplier effect has provided a strong incentive to traditional retailers to embrace the omni-channel experience (Real Comm Conference Group LLC, 2015).

2.3.1.4 Practical Implementations

It is clear that mall owners are driven by retail productivity, meaning they are constantly looking to attract the right kind of consumers, both repeat and first-time. In addition, they are also trying to find the right mix of marketing, consumer experience and technology to better understand the consumer and the path to purchase (Real Comm Conference Group LLC, 2015). Below is an outline of some of the key technologies and implementations of the omni-channel experience. As a starting point, all the technologies described hereunder assume high speed internet access. Increasingly, free WiFi in retail malls is becoming less of a luxury and more a necessity, as retail owners leverage the benefits of scale to roll-out connectivity across their portfolios (Real Comm Conference Group LLC, 2015).

It has been suggested that consumers have a pervasive belief (that is growing) that anything they want is two clicks away and can be on their doorstep the following day. This trend further serves to blur the lines between the **physical and the digital realm. In this regard, “click and collect” and the “endless aisle” are likely to become increasingly prevalent** (GWL Realty Advisors, 2015). **“Click and collect” gives consumer the** convenience of ordering and paying for their goods online (whether through a mobile or web application) and then going into the store to collect. In a 2014 study it was found that nearly half of all Britons have

paid for goods online and collected in store – this trend is expected to rise by 82% within the next five years (Butler, 2014). **While “click and collect” has gained the most attention, the notion of the “endless aisle” is** regarded as being a potentially more significant innovation. Traditionally, retailers with an extensive range of products routinely faced the difficulty of being out of stock. Not only did this inhibit revenue growth, it is **resulted in a disappointed consumer. The “endless aisle” is about being** able to fulfil products that are out of stock by allowing the consumer to order out of stock goods, pay in-store and have it delivered for free. This boosts revenue, allows retailers to increase their product offering without the risk of unsold inventory and ultimately, results in an overall better consumer experience (Silverman, 2015). In time, it is predicted that physical stores will be a hybrid between showrooms and distribution centres, as the lines between the physical and digital become increasingly blurred (PWC/Kantar Retail, 2012).

Already online stores are considering expanding into the brick and mortar space. In an attempt to gain a physical presence, Amazon recently filed a patent that would allow consumers to remove the check-out element of retail by simply picking up an item and walking out of the store. In an attempt to streamline and enhance the user experience, the stores in question would use a combination of cameras, sensors or radio frequency identification readers (RFID's) to identify both the shopper and the items chosen. One of the obvious upsides is the lower operating costs by not having cashiers. Similarly, the store could also function as a collection point for online orders (Del Rey, 2015).

One of the other major technologies recognised in the retail space and omni-channel retailing is iBeacons (Real Comm Conference Group LLC, 2015: 31). If omni-channel retailing is partly about pushing the right content to the right consumer at the right time, iBeacons represents the catalyst for these push notifications, as well as data collection. iBeacons are Bluetooth-enabled devices that that are able to detect and

communicate with consumers' smartphones that can either be used to send media content such as adverts or limited time offers, or otherwise track **consumers' movements and patterns within a retail mall** (McDermott, 2014). On a practical level, retail owners would only be able to leverage the benefits of iBeacons if consumers were willing to download the relevant mobile application (Sjölund, 2015). This in itself may prove challenging, as aside from data privacy (Gilpin, 2014) and security concerns (Goldner Martinez, 2014), some consumers may not be willing to download an application unless it provided some sort of material benefit.

In any event, while many large retailers in the US such as Kenneth Cole, **Macy's and Timberland** currently utilise iBeacons, it is estimated that in 2016 the number of iBeacons will increase from 30,000 in 2014 to 3.5 million. Furthermore, it is also estimated that in 2016, over 85% of all major retailers will use iBeacons. Probably the most important statistic for retail owners is that iBeacons have been shown to increase purchase intent by up to 20% (aKontakt.io & Howler, 2015). iBeacons have also been utilised in other ways within the retail context.

Again, through a mobile application and using iBeacons, many retail owners offer digital way-finding for consumers, allowing them to easily navigate themselves to stores that may interest them (22 Miles, 2015). **It's also conceivable that these solutions provide voice-**navigation much like traditional satellite navigation systems. Some, quite conceivably, have over-engineered the solution in the form of digital way-finding robots which are unlikely to justify their extensive capital outlay in the long-run (Lloyd, 2015).

Other retailers, once again through iBeacons and the associated mobile application, have made attempts to gamify the retail consumer experience. This may incorporate some or all of:

- (1) Award prizes and awards for social sharing – i.e. by sharing the application or a post on social media, users get a discount or benefit;
- (2) Utilising a count-down to create a timing urgency – i.e. one- time offers get pushed to consumers, creating a limited period in which to take advantage of an offer; and
- (3) Competitive leader boards – based on selected criteria (such as money spent, social media posts shared or number of reviews); users' identities are displayed on a public forum and award certain privileges which may or may not have a monetary benefit (Nix, 2015).

Beyond loyalty programmes, gamification offers consumers a fun and interactive experience while simultaneously creating awareness, customer loyalty and ultimately, greater profits (Nix, 2015).

Aside from the value offered to consumers, the over-arching benefit of iBeacons to retail owners is the ability to collect and track enormous **volumes of data, giving more insight into shoppers' habits than ever** before (Gilpin, 2014). Many retail applications also have built-in loyalty programmes, providing additional insight into consumer preferences and habits (Real Comm Conference Group LLC, 2015). Assuming real estate companies employ best practices from a consent and privacy perspective, iBeacons have the potential to provide valuable insight helping them push the right content at the right time to the right person.

In an attempt to further enhance the consumer experience, a number of major retailers across the globe have rolled out virtual mirrors across strategic assets in their portfolio. There are a number of different offerings in the market, however they typically rely on gesture or touch-**based interfaces that overlay virtual garments over a consumer's** reflection, allowing them to **"try on" different items of clothing** (Fretwell, 2011). While some have used virtual mirrors to identify flaws in physical appearance and then suggest products to remedy the defect (Prigg,

2015), others have used it as an opportunity to offer real-time expert fashion advice, resulting in greater customer loyalty and higher sales (DigitalDM Digital Solutions, 2015). The significant investment by large listed multi-nationals such as Cisco Systems and Samsung suggest that whatever its purpose or specific functionality, virtual mirrors at worst offer consumers a unique, interactive experience and at best, increase revenues and brand loyalty by revolutionising the way consumers engage with products.

Beyond virtual mirrors, others have experimented with digital dressing rooms, storefronts and shopping experiences where friends sitting **remotely can “shop” together in an immersive and social digital realm** (PTMNTS.com, 2015). In assessing the role of a virtual shopping **experience in the modern context, it’s been suggested that people** innately still want an in-store experience. Rather, it is argued, virtual reality could be positioned as more of a planning tool, rather than a purchasing tool (Sinha-Royand and Richwine, 2015).

It is evident that the technologies employed within the retail real estate environment are becoming increasingly valuable and having a positive impact on consumers, tenants and the operations of the organisation concerned.

2.3.1.5 Challenges to Omni-channel Retailing

Undoubtedly, the biggest challenge is consumer resistance to embrace the technology (i.e. download a retail mobile application) on the back of security and privacy concerns (Goldner Martinez, 2014). The risk of outlaying capital to develop an application that is never used is reasonably high (Lloyd, 2015). With regards to the privacy issue, a recent poll showed that 64% of US smartphone users were concerned about privacy and security. It has been suggested that mobility has created a fundamental paradigm shift, namely the ability to collect and use data about individuals in the physical world. The major objection to this is that

such data is typically more sensitive, personal and contextual than traditional forms of consumer data (Wharton University of Pennsylvania, 2015).

In order for consumers to embrace, it is submitted that there must be a clear benefit or advantage to doing so – whether this amounts to discounts or some other incentives. When downloading the application, it is preferable for consumers to specifically opt-in to receive communications, as well as being able to give consent to use data from other social platforms. Furthermore, it is critical for retail owners to maintain the trust and confidence of consumers by ensuring that only relevant content is pushed to them. In a data saturated world, consumers have little tolerance for irrelevant content and will quickly uninstall any application that no longer serves their interest.

Looking into the future, technology and analytics appear well-placed to deliver a seamless, contextual, and hyper-targeted customer and prospect experience. Simultaneously, this will empower marketing departments to drive internal capabilities for automation, precision and efficiency (Deloitte University Press, 2015).

2.3.2 Internet of Things (IoT)

The concept of the IoT is becoming an increasingly talked about concept impacting both our professional and personal lives. It was first mentioned in 1999 by a digital innovation expert named Kevin Ashton. At the time, he imagined a world where computers were all around us and they knew everything there was to know about things. This data, he suggested, could be used to track and measure everything, greatly reducing waste, loss and cost. He imagined a day where things could identify themselves as needing replacement, repair or otherwise whether they were fresh or past their best (Technopedia, 2016). This embodies the essence of the IoT.

In short, it refers to network of physical devices that feature an internet protocol (IP) address (i.e. have internet connectivity) (Stroud, 2016) and are able to sense aspects of the physical world such as temperature, lights, presence or no presence, humidity, oxygen levels and the like (Duncan, 2014). Through their internet connectivity, these devices are able to identify other connected devices and can report or act on the data being collected. In this sense, the IoT represents a self-configuring network of interconnected sensors creating a global data field that resembles a type of internet nervous system (Diamandis and Kotler, 2014: 63).

As noted in the 2015 Deloitte Tech Trends report, the critical part is **deciding what “things” warrant being connected to the internet as the** focus shifts from the novelty of connected and intelligent objects to those devices that automate business process, offer model transformation and ultimately, business value (Deloitte University Press, 2015: 36). The report suggested that the underlying purpose of the thing is to collect and report on relevant data, leading them to conclude that the IoT is fundamentally about data analytics - how business can turn data into signals and such signals into useful insights (Deloitte University Press, 2015).

From a practical perspective, modern advances in sensors and connectivity suggest that one can embed intelligence into almost anything around us with relatively few technical limitations. Current technologies within this space include sensing, monitoring and reporting on:

- (1) Broadcasts of health - diagnostics and status reporting (i.e. how strong is our internet connection);
- (2) Location – communication of physical location using GPS, GSM (Global System for Mobile communication), triangulation techniques;

- (3) Physical attributes – monitoring the world around the device, including altitude, orientation, temperature, humidity, air quality and noise;
- (4) Function attributes – **higher level intelligence rooted in device's** ability to describe business process; and
- (5) Actuation services – ability to trigger, change or stop the physical properties or actions on the device (Deloitte University Press, 2015: 36).

Importantly, these sensors don't only serve to find quicker and automated ways to collect real-world data, but more importantly, they have the ability to turn historical and social data into patterns which can be used to predict behaviour and make improvements where required (Deloitte University Press, 2015). In general, the 2015 Deloitte Tech Trends report highlighted a number of potential benefits including improved efficiencies, cost reduction, enhanced monitoring and fine-tuning, more comprehensive risk and performance management, revenue growth, improved business insights, better decision-making, more meaningful customer engagement and fundamentally, a shift from transactions to relationships and from goods to outcomes (Deloitte University Press, 2015: 37). This represents probably the biggest opportunity offered by the IoT, the ability to for vast volumes of data to flow seamlessly into a workplace management, enterprise resource planning (ERP) or business intelligence system to create actionable insight (Brucella, 2015).

It is estimated that by the year 2020, IoT will be worth \$7 trillion (Pieper, 2014b). By one estimate, there will be approximately 50 billion connected devices by 2020 (Cisco, 2015). Others suggest that by 2021, there will be up to 200 billion such devices (Duncan, 2014). **It's been suggested that it won't be long before the IoT is a crucial element of business, including the** real estate industry. While there are certainly concerns around data integrity and privacy (Miguel-Descalzo, 2014), real estate companies have realised that the IoT represents an exciting opportunity to convert

building data into a decision-making platform that will change the way companies do business (Schwartz, 2015a).

From a practical perspective, the IoT conceivably has endless applications across the real estate paradigm. From tracking foot traffic and dwell time in a retail mall to optimising air flow and light in an office complex, it is evident that in time, it will no longer be a “nice to have” as much as a business critical tool.

2.3.3 Additive Manufacturing / 3D Printing

Additive manufacturing (more commonly known as 3D printing), is increasingly being recognised as a technology with enormous potential to influence the real estate sector. Originating in the 19th century, 3D printing has the potential to eliminate the long-standing trade-off between cheap and good. The concept is best understood as a process in which whole objects (and related parts) are manufactured layer by layer, drastically reducing the cost of production as only precise quantities of materials are used. Given its ability to handle a wide range of geometric shapes and complexities, it is also thought that the technology has the potential to radically shift the way objects (including entire buildings) are designed (Deloitte University Press, 2015).

While its application was originally thought to be limited to consumer technology (such as toys and trinkets), it is evident that large-scale industry is gradually being able to see the benefits and that this trend is **likely to gain momentum into the future (D’Aveni, 2015)**. While the technology is unlikely to have widespread application in the short-term, progress has been rapid. Most recently, a Chinese firm successfully printed a five-story building and a luxury villa, complete with all fixtures and fittings (Title Source, 2015). 3D printing has also attracted the interests of the US listed property sector where prominent industry leaders suggested that 3D printing has the potential to be a “game

changer” as the costs reduce further (Real Comm Conference Group LLC, 2015: 15).

2.3.4 Drones

Also known as unmanned aerial vehicles, drones come in a wide range of shapes and sizes that are fundamentally controlled by remote or control systems on the ground (Pravas, 2016). They are characterised as being unmanned and highly accurate. Traditionally thought of as being useful in combat where a manned flight is too risky, its application has recently expanded and evolved to serve a much broader market including farming, news reporting, nature conservation, search and rescue missions, crime prevention, food delivery and most relevant in this context, real estate (Atmel Technology, 2016).

Increasingly, drones armed with high-end camera equipment, are being used to reinvent the way real estate is being marketed. Directed by a controller, tablet or smartphone – drones are capable of flying up to 50 metres above ground and are able to capture high quality images and video of properties (Tracy, 2014). Without incurring the expense of helicopters or planes, drones provide an inexpensive way to get elevated images, allowing prospective buyers or tenants an opportunity to see the entire property and the surrounding neighbourhood (Title Source, 2015).

Some drones are also able to climb walls and move across ceilings (Tracy, 2014), creating quality content that can be used to create virtual and 3D tours of a property, eliminating the need to physically see the property (Perry, 2014).

While there are concerns relating to privacy as well as its legality (set to be clarified in the US during 2016 by the Federal Aviation Administration), it is evident that the technology has the potential to alter the real estate marketing landscape forever as the marketing costs of properties gradually decrease (Tracy, 2014). While some real estate agents adopted the technology as early as 2012 (Miguel-Descalzo, 2014), it continues to

gain momentum and interest amongst real estate professionals. In addition to acknowledging the increased relevance of drones in the leasing process, some listed real estate companies have also identified a use outside of marketing, namely: the performance of inspections in hard to reach areas of a property (Real Comm Conference Group LLC, 2015: 15).

As drones becoming increasingly smaller, lighter and more affordable (Belton, 2015), it is likely that they will continue to impact our lives and indeed the real estate sector in ways we have yet to conceive.

2.3.5 Wearable Technology

Wearable technology, wearables or wearable devices all refer to the same thing - electronic technologies that can be incorporated into your clothing and accessories. Most have sensory, scanning, internet-connectivity or communication features that allow the wearer to track and access data in real-time. The technology may include devices such as watches, glasses, rings, bracelets, hats or any removable or imbedded accessory (Tehrani and Andrew, 2014). At present, the application of wearables in the real estate space is fairly limited, however experts suggest that as adoption increases, so will the impact on the industry (Real Estate Tech News, 2015).

In the context of real estate, much of the focus has been on augmented reality smart glasses. The range of potential uses is varied and may include:

- (1) Maintenance personnel sharing their point of view with others;
- (2) Maintenance personnel seeing visual alerts from building sensors of a part requiring repair or attention; and
- (3) Buyers walking around a neighbourhood and relevant publically accessible property data is displayed (i.e. size of site and dwelling, purchase price) (Pieper, 2014a).

Others have suggested that smart watches could similarly play an important role into the future. Interested buyers could subscribe to a set of criteria and then using location awareness, information on a property will be sent straight to the phone when passing (REA Group, 2015). Smart watches could also serve as a virtual phone system in terms of which agents can have all phone calls directed to email or transcribed and then responded to by text, all using their smart watch (Stanley, 2014). In general, it is fair to say that at this stage, wearables have had a limited impact on the industry. It is however submitted that in time, it will become increasingly prevalent as the technology evolves beyond the benefits of working remotely and hands-free.

2.3.6 Virtual Reality (VR) & Augmented Reality (AR)

2.3.6.1 Overview

The terms VR and AR are often conflated, despite being fundamentally different.

AR is about augmenting or adding to reality, creating a blend between a digital reality and real life. AR applications use real world objects to trigger digital images, videos or interactive graphics that users can engage with (Virtual Reality, 2016). In this sense, users can distinguish what is virtual from that which is real. By contrast, VR is about creating a completely virtual world without any reference to the real world. VR is in essence an entirely digital experience, although the better applications make it difficult to distinguish the virtual from the real (McKalin, 2013).

AR and VR systems are typically implemented in one of three ways:

- (1) Head-mounted displays – **these are attached to the user's head** and track orientation and position of the head;
- (2) World-fixed displays – these are static displays and are most often utilised in augmented reality; and

- (3) Handheld devices – these are the most prevalent since the advent of the smartphone and tablet (NextGen Interactions Consulting and Contracting Services, 2016).

2.3.6.2 Virtual Reality (VR)

Virtual reality was traditionally associated with gaming (Carson, 2015), but thanks to significant investment from key technology companies such as Facebook, Google and Microsoft, the technology has reached a tipping point in terms of mainstream consumption. A number of key players across the real estate paradigm stand to benefit from this increasingly accessible technology.

Architecture firms can leverage VR as a pre-visualisation tool for walk-throughs of spaces to ensure that layouts are suitable, scaling is **proportionate and that there aren't any material inconsistencies in design**. One could also envision VR simulation providing insight into how a development interacts with the surrounding area and assisting in **understanding key issues such as lighting from a user's perspective** (LNG Studios, 2016).

Developers could potentially utilise VR in the pre-sales phase to create virtual showrooms of a development, rather than having to undergo significant costs in physically building a replica apartment or property. This will also serve to broaden the market beyond those in the immediate vicinity as potential buyers could enjoy a 3D walk through of the space using a custom application (LNG Studios, 2016).

Through VR technologies employed in building information modelling, real estate professionals across the board (developers, architects, engineers, construction, agents, users) are able to collaborate throughout the entire design and construction process in a development (LNG Studios, 2016).

Residential and commercial real estate brokers may similarly benefit from having potential tenants being able to do an immersive walk through of a 3D render of the space, all done from a remote location utilising a custom

application (REMax of Boulder, 2015,). This footage may be captured using a drone or other technologies which can prompt users to take photos and stitch them together in order to create an interactive 3D experience (LNG Studios, 2016). This kind of innovation serves not only to save brokers time, it also allows prospective tenants the opportunity to browse dozens of properties, reducing the inconvenience and burden inherent in searching for a property.

Finally, from a user's perspective, VR has potential to streamline the entire design process while simultaneously reducing both risk and costs. Retailers can now create models of a planned store and interior designers can similarly utilise VR to plan the design and layout of a property (LNG Studios, 2016).

2.3.6.3 Augmented Reality (AR)

While the notion of AR existed as early as **1957, it wasn't until 1990 that** term was coined (Newton, 2015). Subsequent to the mobile revolution **starting in the 2000's, AR has increasingly found its way** into the consumer market. Across, industries, the most significant impact has been on the manner in which goods and services are marketed across a diverse range of industries (Mangiaforte, 2014), including real estate.

As a technology, AR has the ability to turn static images on a marketing brochure, advertising board or business card into interactive user experiences. By bringing static 2D images to life, users enjoy an immersive, interactive and exciting experience.

Within real estate specifically - agents, developers and designers have all leveraged AR to revolutionise their marketing efforts. An agent may seek to impress prospective clients through a custom application. For example, **when scanning an agent's business card, users could have a video of the** agent pop up, introducing the company and unique selling points while simultaneously pointing to a link of available properties. Developers may use AR to assist with pre-sales as a virtual interactive 3D image of a

planned development may appear when a prospective purchaser scans a marketing brochure. Designers, could use their application to drag and drop layouts and furniture in an existing space (Augmented Marketing, 2015). Already, big retailers such as Ikea have developed custom applications that allow consumer to design their own home by placing and removing virtual images of furniture over their physical space (Ridden, 2013).

In summary, across the developed world, the immersive and interactive experience offered by AR and VR has already had a material impact on the real estate industry and the manner in which people interact with real estate professionals. It is reasonable to conclude that looking forward, this trend is likely to gain further momentum and become the *modus operandi* of real estate companies.

2.3.7 Driverless Cars

Driverless cars, an almost fanciful notion less than ten years ago, is fast becoming a reality and could serve to have a significant disruptive effect on the real estate industry or otherwise shift economies (Long, 2015). Rather than have people behind the wheel, driverless cars use sensors to connect and communicate with each other, helping negotiate the traffic system in a manner that will optimise routes, safety and capacity efficiencies (Sheth, 2015). While there are certainly regulatory (Derhake, 2016), legal and insurance-related (Sheth, 2015) hurdles to overcome, driverless cars are gradually moving towards commercialisation. Already, major manufacturers such as GM, Audi, BMW, Nissan and Tesla are exploring the notion of autonomous cars and expect to have vehicles on the road by 2020 (Sheth, 2015). It has also been widely reported that Google, who have been experimenting with the concept for over seven years, aim to have a product commercially available by 2020 (Bridges, 2015:2).

Proponents of driverless cars also claim that they are safer and far less prone to accidents (Sheth, 2015), especially fatal ones (Hoffman, 2015). Studies have shown that there are around 189 accidents involving injury or property for every 100 million miles travelled, with just over 1% of collisions being fatal. This would suggest that driving is not as dangerous as most think, however the sheer volume of driving around the world results in 1.2 million annual traffic deaths. By one estimate, a 90% market penetration rate of autonomous vehicles would save 21,700 lives a year in the US alone. Many of the common problems typically associated with driving (such as texting, phoning, alcohol consumption, tiredness or road rage) disappear with the driverless car (Hoffman, 2015).

Furthermore, autonomous vehicles are regarded as being capable of increasing the capacity of current infrastructure by a factor of five, since they are able to travel much closer together (Ferren *et al.*, 2015). Most city bowl districts (**CBD's**) around the world experience a greater or lesser degree of congestion, pollution and commuter stress and frustration (Bridge, 2015:5). This is influenced significantly by the extent of prime real estate dedicated to parking and other uses outside of highest and best use. In addition, it is estimated that at any time, up to 30% of the **vehicles driving around in CBD's are looking for parking (Rossenfield, 2015). It's been suggested that the average commuter drives** two and a half days per year and the average car spends 22 hours parked empty per day (Kanne & Malek-Madani, 2016:4). Driverless cars could be positioned to remedy some of these inefficiencies, risks and adverse lifestyle impacts that presently exist.

On the negative side, networked autonomous vehicles will however introduce cybersecurity challenges as has been demonstrated through the recent hacking of several high profile vehicle brands (Gelles, Tabuchi & Dolan, 2015). In addition, privacy will also be a concern as on-board computers will be capable **of collecting data about one's driving patterns,** destination and the like (Hoffman, 2015).

While some have argued that this innovation could disrupt the entire ecosystem of the real estate industry (Sheth, 2015), others go so far as to say that it has the potential to change the industry as much as the internet (Derhake, 2016). The question is, on practical level, how much can driverless cars impact real estate?

The most notable impact is likely to be a significant shift in the real estate economics – fundamentally changing the highest and best use of certain prime urban locations (Derhake, 2016). At the 2015 RealComm conference, key note speaker and futurist, Bran Ferren, noted that half of Los Angeles is designed for parking (Ferren *et al.*, 2015). Others have **suggested that in most CBD's, 40% is comprised of parking areas** (Levitt and Dubner, 2014:175). Aside from parking, it is clear too that a significant portion of prime real estate accommodates businesses whose relevance is likely to be challenged in the future. Petrol stations, car washes, motor mechanics and the like are likely to have little to no use in urban centres as these services could all be moved into surrounding industrial or suburban areas (Sheth, 2015). **If one's car is able to drive** itself to refill with petrol or to a panel beater, it is difficult to understand what use these types of services would have in a CBD.

It is also argued that in some cases, driverless cars will serve to increase house prices around commuter belts as the reduced traffic, benefits of shared rides and enhanced experience mean that people are prepared to **live a little further outside of CBD's** (Goodwin, 2014). Others are not as optimistic, suggesting that driverless cars would have a negative impact **on values as "location, location, location" becomes less relevant** (Fundrise, 2015). Given that more people are likely to flock to outer lying suburban areas, it has been suggested that corporates will follow their employees and set up offices in these types of locations, enhancing local values (Cite Partners, 2015). Turning to the industrial real estate market, driverless trucks could allow for faster delivery of goods as they could be on the roads for longer periods. Furthermore, it is also conceivable that

ecommerce retailers, in an attempt to ensure same-day delivery, reduce their footprint by having more, smaller distribution centres closer to the consumer (Cite Partners, 2015). For the retirement or senior housing market, many people make the decision based on the availability or **proximity of housing, since many don't drive. Driverless cars would** provide them with greater autonomy in terms of choice of location (Dawda, Mann, Mulcachy and Sadler PLC, 2015).

Furthermore, driverless cars are likely to have an impact on construction economics and design. At a minimum, parking requirements will be reduced and within designated parking spaces, one could probably construct lower ceilings and smaller spaces (Ferren *et al.*, 2015). Less parking would mean less land is required, with the result that either developers get to enjoy the lower initial capital expenditure or otherwise use their capital more productively. Furthermore, trends in spatial development and town planning are similarly likely to change to accommodate the more productive use of prime real estate (Goodwin, 2014).

In terms of real estate professionals, almost all stand to gain from driverless cars, as most find themselves outside the office. The commute is often a time-consuming, unproductive and frustrating experience. Driverless cars could however enable mobile real estate professionals to optimise productivity by being able to work while commuting and travelling during the workday. Furthermore, besides the convenience, driverless cars could also represent an opportunity to impress prospective clients – for example, real estate agents could program vehicles to collect prospective clients and take them to various properties.

Driverless cars or autonomous mobility (Long, 2015) represents an opportunity to alter the highest and best use of prime real estate, reduce congestion and pollution, reduce accidents, and lead to an overall improvement in the client, real estate professional and commuter experience.

2.3.8 Best of Breed Software Solutions

Traditionally, organisations across all industries had to make a choice of whether to embrace either a fully integrated ERP or adopt individual “**best of breed**” solutions. **It is therefore not as much a decision about the** different brands of software as much as it is about the types.

A fully integrated ERP is a comprehensive suite of software with multiple elements that seamlessly links all elements of the organisation, from accounting to inventory management to client relationship management. As an alternative, organisations may instead choose to adopt best of breed solutions – these are typically best-in-category or leading software products focused only on a particular segment such as sales, inventory or client management. While a fully integrated ERP has the advantage of providing a single operating system for the business, its individual components are rarely best of breed. While best of breed solutions may **better address an organisations’ needs in specific areas, the major** disadvantage is the lack of a central operational dashboard (this can however be built, at a cost) (Reflex Enterprise Solutions Group Inc, 2016:2). The fundamental choice described (integrated ERP or best of breed), has also manifested itself in the real estate space.

By some estimates, there are some 2,000 real estate technology companies operating across the globe (Young *et al.*, 2015). As noted elsewhere, 2016 has witnessed an increase in investment, up to \$1.8bn for the first half of the year alone (CB Insights, 2016). Leveraging the increasing influence of the cloud, big data, SaaS and mobile, many of these companies have successfully developed highly sophisticated and specialised software to meet the acute business needs of real estate professionals across the board. Perhaps more than ever, real estate companies today have access to an increasingly broad range of sophisticated and well-designed products. Moreover, most of these best of breed products have recognised the need for integration amongst disparate platforms and services, and accordingly, have built application

programming interfaces (**API's**) for that specific purpose. In response, **some real estate ERP's such as** Management Reports International (MRI) **have created a SaaS model that supports specific API's of other vendors.** Despite such attempts from ERP vendors, many major real estate companies continue to lean towards individual best of breed products and away from single product **ERP's or customised solutions.**

Today there are a large number of SaaS offerings in the market, covering all aspects of the real estate industry. Table 3 below represents a short summary of the key areas and some of the major vendors in the space. It is in no way exhaustive and merely serves to illustrate the view that best of breed SaaS offerings are becoming increasingly prevalent and sophisticated, and accordingly, cost effective for real estate companies to implement.

Table 3: Case, 2014

Offering	Description	Vendors
Leasing	Real time platforms for tracking deal flow, manage space and collaboration between asset managers and brokers. Tracks entire leasing pipeline, identifies trends, provides rent rolls, lease rolls, tenant related encumbrances, lead generation, virtual video tours, multiple listing publication and associated analytics.	View This Space, High Tower
Supplier management	Real time insights tracking communication with suppliers, historical supplier data, tracking procurement, bid management, risk mitigation, supplier document management and supplier analysis and reporting.	Honest Buildings, eBid eXchange, Vendor INSIGHT
Client relationship management	Platform to manage interactions with current and future clients, contact details, record contact with clients, tracking opportunities, automate promotions and client messages, reporting and analysis of sales, client retention etc.	Salesforce, Microsoft Dynamics, Silverpop, SAP
Property Management	Find tenants, allocate payments, manage work orders, track vacancies, charging rental and taxes, income and expense reporting per building/tenant.	MRI, Yardi, JDE, Qube PM
Asset management	Investment management solution, includes fund management, debt management, valuations, asset management, analytics, budgeting and forecasting, scenario planning.	Cougar, Talience, Argus, PlanEASe, SAP Real Estate, Manhattan Software, Pereview
Facilities management	Manage facilities through a central platform that covers move management, project management, maintenance, space reservation, strategic planning.	FM Systems, Maintenance Connection, UpKeep, AssetSmart, Planon

Offering	Description	Vendors
Business intelligence and operational dashboards	Consolidating all data, external and internal, into a central dashboard or source of truth to streamline data-driven decision-making	Voyanta, Hipercept
Construction management	Streamlining project communication and documentation, collaboration platform, document management of all relevant documents, workflows and approval functionality, budgeting, bid management, purchase order management, daily logs, to do's, photo and document management, selections and change order management, scheduling and warranty administration.	Procore, ViewPoint
Energy management	Automate the process of pulling utility bills and smart meter readings into a SQL database, pulls data and sends commands to HVAC, lighting, security, optimise energy efficiency, minimise manual input, energy monitoring, analytics and reporting software.	Urjanet, Envizi, Lucid, Planon
Maintenance management	Create work orders in a centralised system and track progress, provide communication tools (for contractors and maintenance staff) and the ability to schedule multiple requests within limited time frames, include an online portal where tenants can directly submit new maintenance requests.	K2, SAP, Building Engines, Planon, Maintenance Connection
Business intelligence and operational dashboards	Consolidating all data, external and internal, into a central dashboard or source of truth to streamline data-driven decision-making	Voyanta, Hipercept
Construction management	Project communication and documentation, collaboration platform, document management, workflows and approvals, budgeting, bid management, purchase order management, daily logs.	Procore, ViewPoint

2.3.9 Artificial Intelligence (AI) & Robotics

AI and robotics are two fields of computer science that are often conflated (ResearchPedia, 2014), yet they remain distinctly defined. Although they are not inherently inter-related, they are often used together to create computers or machines that mimic human behaviour (Banerjee, Gini, Guy, Isler, Narain, Papanikolopoulos, Roumeliotis & Schrater, 2016)

AI refers to the use of a computer to model or replicate “intelligent behaviour”, using the development and analysis of algorithms that learn or perform human behaviour with minimal human intervention (Banerjee *et al.*, 2016). John McCarthy first used the term AI while at the Massachusetts Institute of Technology (MIT) in the mid-1950s, defining it as **“the science and engineering of making intelligent machines.”** Since then, AI has evolved into a multidisciplinary field that includes not only computers and robotics but computer science, mathematics, neuroscience, linguistics and psychology (Deloitte LLP, 2015: 15). Robots by contrast are machines used to execute one or more tasks repeatedly and with speed, most often requiring human control (Whatis, 2007). A robot is only as intelligent as the program used to direct it, but AI can be **used to create “more intelligent” robots (WiseGEEK, 2016).**

Robots started to change the industrialised world over fifty years ago and since, have transformed entire industries – from the way goods are manufactured, to replacing human employees to the fulfilment of warehouse orders (Deloitte LLP, 2015). Initially, robots were introduced into assembly lines, replacing the menial, routine human tasks (Deloitte LLP, 2015). Since then robots have begun performing increasingly complex tasks on the back of progress in AI, to a point where it is predicted that by 2020, the majority of knowledge worker career paths will be disrupted in both a positive and negative sense by smart machines (Deloitte University Press, 2015). Beyond unskilled labour, the indications are that professionals too will be impacted and that in the future, machines will also replace humans in terms of real-time data gathering

and analysis (Deloitte University Press, 2015). In fact, it is likely that almost every job will be impacted by machines at some point with many jobs becoming obsolete. Oxford researchers recently forecast that machines could perform up to half of all jobs in the US. Rather than something that happens overnight, it has been suggested that the **technology tends to exert a “slow but continual downward pressure on the value and availability of work” (Thompson, 2015).**

Outwardly, machines seemingly have the capacity to eradicate vast amounts of jobs, however the International Federation of Robotics estimates that these devices would also have created between 900,000 and 1.5 million new jobs between 2012 and 2016. Between 2017 and 2020, it is suggested that the use of robotics will generate as many as 2 million additional employment opportunities. For example, if robots do the **work, this substantially increases the company’s output and ability to** grow demand by reducing its prices. As a result, workers can now earn more by maintaining and supervising a growing number of robots. Critically, this sort of job growth can be attributed to the fact that the combination of humans and machines most often produce far better results than either on their own.

In summary, the challenge for organisations and broader society is to find creative ways to drive job creation as robotics makes many jobs redundant (Deloitte University Press, 2015). Throughout history, technological advances have produced as many new jobs as they displace, and there is no reason to believe that this long-standing trend will change now (Smith and Anderson, 2014).

A recent report indicates that capital investments into AI and robotics has grown by 70% each year since 2011 (Deloitte University Press, 2015). The overwhelming evidence suggests that the influence of AI and robotics is likely to grow in the coming years. By 2025, artificial intelligence is **predicted to be built into “the functions of business and communication,** increasing relevance, reducing noise, increasing efficiency, and reducing

risk across everything from finding information to making transactions”

(Smith and Anderson, 2014). Given its likely impact, organisations would do well to leverage these technologies to drive further value creation in their respective industries. Real estate is no different and these technologies look positioned to materially impact the future of the sector.

If one accepts the proposition that the demand for commercial real estate is derived demand, in the sense that it is derived from the demand for the underlying goods and services, then the potential impact of AI and robotics is clear. From a demand perspective, robotics and AI have the potential to change not only the amount of space required, but the type and the associated amenities too – this means less common areas, ablution facilities and considerations of employee well-being. If companies **follow Amazon’s lead and have fulfilment centres where robots pick and ship the products** (Deloitte University Press, 2015), one could also argue that the real estate economics will change as location becomes less of a consideration. Besides from the impact on commercial real estate, others suggest that AI and robotics could also impact on residential property values (Freakonomics, 2013)

Machines have the ability, to a lesser or greater extent, to automate many of the administrative operations inherent in real estate companies. Some of the more prominent possibilities (or in some cases, realities), recognised by industry leaders include:

- (1) Driverless cars that collect clients and take them on real estate viewings, opening up access and providing relevant information on demand;
- (2) Robots that are able to create 3D renderings of interior space;
- (3) Robots that act as security and control access (Berger, 2014);
- (4) Robots collecting refuse and facilitating recycling (Smith and Anderson, 2014);
- (5) Robots that measure space (Real Comm Conference Group LLC, 2015);

- (6) Robots that conduct routine inspections and maintenance (particularly in hard to reach areas), reporting any inefficiencies (Real Comm Conference Group LLC, 2015);
- (7) 3D Printing, operated by machines (Real Comm Conference Group LLC, 2015); and
- (8) Robots that clean, particularly hard to reach places like solar panels and windows (Berger, 2014).

As noted above, these are merely some of the possibilities and realities that exist today. **It wasn't long ago that voice**-command technologies were seen to be decades away. Today, there are technologies like Siri, suggesting that we have advanced quicker than anticipated. Although it is **difficult to predict the timing, nature and extent of AI and robotics'** impact, few would argue against their increasing influence in the coming years, across all sectors including real estate.

2.3.10 Practical examples of Real Estate Solutions

2.3.10.1 Overview

In the past, real estate companies often turned to customised solutions in order to meet their business needs. Today however, there are a plethora of pre-packaged technology solutions in the market, covering the entire spectrum of the real industry. As noted elsewhere in this paper, there are over 2,000 real estate technology companies across the globe (Young *et al.*, 2015). Of these, the vast majority are leveraging mobile and SaaS to provide relatively affordable and easily scalable solutions to meet the business needs of real estate companies. Aside from the operational efficiencies, real-time data and integration with ERP providers, many companies are also motivated to implement these technologies to meet the growing needs of the modern workforce. Below is an outline, in brief, of three solutions in the market, not mentioned elsewhere in this paper.

2.3.10.2 Inspections

Fisher (2015) notes that a common dominator evident throughout all real estate assets is the need to conduct scheduled or ad-hoc inspections of the property. This tends to be the case across all jurisdictions that permit private ownership of real estate. Being a physical asset prone to wear and tear requires that property or facility managers engage in a process in terms of which the condition of the property is properly documented at pre-determined stages of the lease.

Often, the most crucial period for this to take place is both pre and post tenant occupation. While the default or agreed terms of a contract may vary across international jurisdictions, the tenant is typically only liable for wear and tear beyond what is fair and reasonable. Without going into a debate as to what constitutes “**fair wear and tear**”, it is self-evident that a properly documented inspection minimises the likelihood of disputes between tenants and landlords. The timing of such inspections is critical – the longer the period between the tenant vacating and the inspection being conducted, the greater the scope for dispute.

In addition to inspections of lettable areas, it is also necessary for in-house maintenance personnel to conduct ad-hoc inspections of the common areas, as well as the infrastructure. Common areas need to be clean, properly maintained and neat in order to retain tenants and preserve rental levels. From an infrastructure point of view, common sense suggests that prudent building management requires that qualified personnel occasionally evaluate the condition of HVAC systems, elevators and other business-critical infrastructure.

Whether scheduled or ad-hoc, inspections have a tendency to be subjective and inefficient as different personnel engage with different tools, methodologies and systems. Across large portfolios and dozens of different personnel, the problem is compounded. A common way for maintenance inspectors to conduct inspections is to take pictures on a

smartphone and upload to a local hard drive later. Thereafter, the tenant is emailed a copy of the pictures and is asked to print, sign and scan back for filing. This is not only inefficient but without being prompted to note specific issues, it is likely that several defects could go overlooked.

A custom mobile inspection application solves these difficulties inherent in inspections. Using a pre-selected template (could be office, retail, industrial, or could even be A-grade office, B-grade office etc.), the user is prompted as to which fields to fill in prior to being able to move to the next item. The templates could even be customised for unique or unusual properties. Using the camera of the mobile device, the user takes pictures of various areas of the property, including defects and alongside, is a space for the tenant to acknowledge such condition. Using the stylus pen, tenant acknowledges the condition of the premises on the spot. On completion of the inspection, the report is automatically synced with the **property management company's CRM**. This process serves to standardise inspections, remove the subjectivity, as well as double data entry required of most current practices. Mobile inspection applications serve to provide real-time data and real-time inputs that can also be consolidated in a central platform so that managers can get insights into typical issues facing a building or portfolio (Fisher, 2015).

2.3.10.3 Tenant Portals

Fisher (2015) suggests that effective property management, in many ways, amounts to the effective administration of real estate. This entails co-ordinating numerous process-driven matters from rental collection and rental disputes to processing maintenance requests. To optimise efficiencies within the business, as well as provide a better experience for tenants, a self-service portal goes a long way to streamline and automate many property management tasks. A self-service tenant is a web application that tenants log into to self-manage many of the issues that would otherwise warrant a lengthy telephone or email exchange such as:

- (1) Make application to let premises and pay for any associated application fees;
- (2) Make payment of monthly rental;
- (3) Obtain statements of monies charged, paid and what remains outstanding;
- (4) Obtain insight into the utility costs and how they are calculated (often pro-rated amongst tenants in a given building);
- (5) Lodge maintenance or work-order requests and track their progress along a timeline;
- (6) Query invoices; and
- (7) Lodge and track complaints about management or other tenants.

While there are several pre-packaged tenant portals in the market that will offer some of the benefits above, it is unlikely that they will be able to meet all of **one's requirements. In addition to the advantages described** above, a custom portal would allow for various other functionality such as:

- (1) Create, dispatch, collate and analyse custom tenant satisfaction surveys which can be extremely useful for maintaining strong tenant relations;
- (2) Integration with accounting software so that when a billing error is rectified on the portal, it automatically updates the financial data in the accounting system;
- (3) A social platform that can be used for tenants to communicate with each other and management – as well as being a forum through which management can communicate relevant building **communications such as "Elevator A is out of service for the day" or "We are in the process of refurbishing the common area on the 6th floor, apologies for the inconvenience";** and
- (4) Maintenance or work-order requests are automatically redirected to approved vendors who can similarly have access to the platform and provide updates therein (Fisher, 2015).

In short, a tenant portal is a useful mechanism to reduce the administrative burden on property management companies, but equally, also serves to provide an overall improved tenant experience.

2.3.10.4 Certificate of Insurance (COI) Management

Although this trend is less prevalent in SA, it is clear that in the US, **COI's** represent a significant administrative burden on property managers that is particularly time-consuming. **Essentially, COI's are documents issued by insurance companies that confirm that a tenant's insurance policies are paid up as well as outlining the major insured events** (BusinessDictionary.com, 2016). From a legal perspective, as a condition of their insurance, landlords are typically required to ensure that those who occupy its premises do so with the requisite type and extent of insurance. Even though most leases would make it a condition of occupation that insurance is maintained, in practical terms, it is usually up to the property manager to ensure that all **tenants' insurance is up to date**.

Fisher (2015) notes that this process has been automated to a large extent through the use of web-based pre-packaged solutions. The software will identify those tenants who have not submitted their **COI's**, alert property managers to key COI expiration dates and otherwise provide an overall view on COI risks in the business. It is even conceivable that through some customisation work, the COI platform could integrate with a tenant portal such that notifications are automatically sent to the tenant alerting them of impending expiration dates, as well as giving them the ability to upload their own COI documentation online.

Pre-packaged COI solutions streamline and automate a real estate **company's** processes. However, they also can reduce the administrative burden on tenants and reduce the risk of default.

2.4 Concluding Remarks

The discussion above sought to contextualise the role of FM within the research problem. In that regard, the broad and specific technologies discussed above are best viewed as tools that can be leveraged by facilities managers in **achieving an organisation's underlying** objectives. Chapter 3 below highlights both the relevant literature relating to research methodologies, as well as the chosen approach in this research.

Chapter 3: Research Methodology

3.1 Introduction

This chapter represents an exploration of the literature that exists in the area of research method, methodology, approach, design and analysis. It also emphasises the underlying ethics and principles of validity and reliability, all of which are critical for meaningful research. It is only through a strong understanding of research theory that researchers are able to establish a framework through which to establish knowledge. Furthermore, it also serves to provide the researcher with tools to develop an understanding of the relationship between data collected and literature.

3.2 Research Paradigm, Theory & Knowledge

3.2.1 Research Paradigm

In this context, paradigm is defined as “the researcher’s perception of what one should be doing and how one should be **doing it**” (Gummesson, 2000: 18).

A research paradigm is best viewed as a framework that informs and guides the manner in which scientific research is conducted.

Fundamentally, it is based on human philosophies and assumptions, as well as the nature of knowledge itself (Guba & Lincoln, 1994). Others have argued that a research paradigm is a necessary process in the quest for knowledge, **highlighting an observer’s view of the world, also referred** to as ontology. This typically leads to questions about various types of social phenomena and the relationship dynamics at play, commonly known as epistemology. These considerations create an obligation on researchers to employ a suitable methodology to examine the subject (Denzin & Lincoln, 2005).

Importantly, it ought to be noted that since research paradigms are fundamentally constructed by humans requiring intervention by the

human mind, it is always subject to human error (Guba & Lincoln, 1994). The matter of how one approaches social science research is said to be largely dependent on basic assumptions in relation to epistemology, ontology and human nature (Morgan & Smircich, 1980).

3.2.2 Epistemology

Epistemology, originally derived from the Greek word "episteme" or "truthful knowledge", refers to a theory of knowledge and the manner in which knowledge is created (Hesse-Biber & Leavy, 2004:2). In the context of scientific research, "truthful" may be regarded as synonymous with "valid", in the sense that knowledge is proven and produces a theory (Babbie & Mouton, 2001). This serves to help researchers explain social phenomena (Morgan & Smircich, 1980). There are primarily two epistemological positions evident in research – positivism and interpretivism. While the former is typically associated with quantitative research, the latter by contrast relates to qualitative research (Bryman & Bell, 2007).

Positivism proposes that the social world and related phenomena are external to the researcher (Hesse-Biber & Leavy, 2004). The fundamental implication being that relationships are established and structured, and this forms the basis of our understanding (Morgan & Smircich, 1980). Through this approach, researchers seek to objectively test hypotheses and predict outcomes (Hesse-Biber & Leavy, 2004). This view has however been criticised as producing a narrow interpretation of the social world that does not reflect the reality of a complex social reality with many truths. Accordingly, positivism has little room for perception and interpretation (Lincoln & Guba, 1985).

In contrast, interpretivism suggests that knowledge may only be created and understood through **the researcher's** interaction with the subject, unlike positivism which assumes that the two exist in isolation (Hesse-Biber & Leavy, 2004). Commentators suggest that in the realm of

interpretivism, research focus is directed more on understanding, rather than prediction, of human behaviour (Babbie & Mouton, 2001). The interpretivist approach looks for culturally derived and historically situated interpretations of the social life-world (Crotty, 1998: 67). The major **criticism of this approach is that a researcher's findings are necessarily** impacted by his or her view of the social world (Morgan & Smircich, 1980).

3.2.3 Ontology

Ontology is regarded as the "the form and nature of reality" (Guba & Lincoln, 1994: 201), therefore excluding matters of moral significance and aesthetics and **focusing on "how things really are"** (Hesse-Biber & Leavy, 2004: 21).

Objectivist schools of thought emphasise the need for the researcher to remain objective and in doing so, become observers of the subject. The underlying assumption being that the researcher is external to the subject being studied, allowing for an objective analysis of reality (Hesse-Biber & Leavy, 2004).

Constructivism, by contrast, assumes a social reality is produced only as a result of social interaction and human behaviour, all of which is fluid and requires constant revision (Bryman & Bell, 2007). Put differently, **social reality is constructed from "projections of human nature" and is therefore** largely dependent on the subjective interpretation of the researcher, focusing on the way in which human beings interact (Morgan & Smircich, 1980: 492).

3.2.4 Human Nature

All research approaches rely on basic assumptions made regarding human nature. It has been argued that in the research paradigm, the researcher has one of two views of human nature. The first view is that humans are deterministic, in the sense that they shape the world in which they live through their relationships and interactions. Alternatively, they are seen

as voluntary or objective in the process, indicating that humans are separate from the social environment in which they live and simply react to their social constructs (Morgan & Smircich, 1980).

3.2.5 The Chosen Approach

Based on the above considerations, this research will follow interpretivist and constructivist ideologies, based on the assumption that human nature is deterministic.

3.3 Research Methodology

3.3.1 Overview of Main Research Methodologies

Research methodology refers to the approach used by a researcher in obtaining knowledge. The approach, for the most part, determines the selection of tools or methods used in order to obtain such knowledge (Leedy & Ormrod, 2010).

Quantitative research is a deductive approach incorporating practices and norms of the natural scientific model and views of social reality as an external, objective reality (Bryman & Bell, 2007). Others have argued quantitative research relates to the collection of numerical data that allows for mathematically or statistical based methods to isolate specific variables for analysis (Creswell, 1994).

Qualitative research, by contrast, is an inductive approach that rejects the scientific model. It suggests that the manner in which humans interpret the social world is a constantly shifting quality of the human mind (Bryman & Bell, 2007). Qualitative research fundamentally refers to non-statistical data collection and interpretations of social reality, based on the assumption that knowledge is obtained by focusing on the meaning of social interaction and human behaviour (Denzin & Lincoln, 2005).

It has been argued that qualitative research allows for a richer, more diverse analysis of data as a result of its assumptions about the nature of the relationship between the researcher and the subject (Hesse-Biber &

Leavy, 2004). While quantitative approaches exclude meaning and purpose of human actors, qualitative data can provide meaningful insight into human behaviour (Guba & Lincoln, 1994). Qualitative research, by its nature, has the advantage of increased flexibility, reduced reliance on pre-determined assumptions and tends to focus on the meaning of key issues for participants. The most obvious limitation to qualitative research is that it generally has a small dataset (Griffin, 2004). It has been suggested that if a concept needs to be understood and examined because it is a new field of research, a qualitative approach is likely to be suitable (Creswell, 1994). Further, qualitative research is also suitable if a researcher is not familiar with the variables to be tested (Noor, 2008) or if the social phenomenon under question is intricate and complex (Bryman, 1984).

3.3.2 Justifications for a Qualitative Approach

Due to the lack of coherent literature on real estate technology and the fact that many of the variables were relatively unknown, a qualitative approach was regarded as most appropriate in the circumstances.

3.4 Research Methods

3.4.1 Overview

Research methods have been described as the “techniques and tools that researchers use to collect and interpret data” (Biber & Leavy, 2004: 3). Importantly, the method selected ought to be determined by both the **underlying context of the research question and the researchers’** epistemological and ontological leanings (Hesse-Biber & Leavy, 2004). In short, the argument is that the chosen research method is driven by the problem and that no single technique is superior to another, but whose value is context-dependent (Bryman, 1984).

In the realm of social sciences, there are a number of potential methods, including:

- (1) Experiments;
- (2) Case studies;
- (3) Interviews;
- (4) Action research; and
- (5) Ethnography.

Importantly, it ought to be noted that one is capable of utilising more than one strategy for a particular research question. The strategies are not mutually exclusive and it is therefore conceivable that one can have interviews within a case study or vice versa (Yin, 1994:9).

As noted by May (2011:226), "while they do possess clear limitations, any research method involves necessary trade-offs; the inherent weaknesses of any one method, however, can potentially be offset by situating them within a broader, pluralistic mixed-method research strategy".

3.4.2 Case Studies

Yin (1994:13) defines a case study as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident".

Yin (1994:13) goes on further to suggest that "the case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis". In this sense, case studies ought to be considered not simply as an approach to data collection or data analysis, but rather, a comprehensive research strategy.

Critically, case studies are not simply exploratory, but could be either exploratory, descriptive or explanatory, depending on the context (Yin, 1994:4). In addition, they could further be categorised as either

qualitative or quantitative or as either single or multiple case studies (Yin, 1994: 14).

3.4.2.1 Suitability of Case Studies

Yin (2003), suggests that a case study may be most suitable in the following circumstances:

- (1) If **the focus of the study is to answer “how” and “why” questions;**
- (2) If the researcher cannot manipulate the behaviour of the participants;
- (3) If the researcher wishes to address contextual issues; or
- (4) If the boundaries between the phenomenon and context are not sufficiently clear.

Going further, case studies are **said to be “...particularly well suited to new research areas or research areas for which existing theory seems inadequate. This type of work is highly complementary to incremental theory building from normal science research. The former is useful in early stages of research on a topic or when a fresh perspective is needed, whilst the latter is useful in later stages of knowledge”** (Huberman & Miles, 2002: 32).

3.4.2.2 Advantages & Disadvantages of Case Studies

There are a number of key advantages to case studies:

- (1) Unlike other methods which occasionally suffer from a lack of context, case studies have the advantage that data is examined within a context (Zainal, 2007: 4). This facilitates richer and more holistic research.
- (2) Case studies are also said to be highly flexible and capable of adapting to the specific research problem. Case studies are equally adept at qualitative or quantitative research, the common misconception being that case studies are often equated with the former (Zainal, 2007: 4).

- (3) Unlike experimental or survey research, case studies have the ability to not only describe or explore data, but also explain the complexities of real-life situations. This is particularly so in circumstances where variables are inter-connected and causal relationships are complex and non-linear (Zainal, 2007: 4).

The literature also highlights a number of key disadvantages of case studies:

- (1) They often suffer from a lack of representativeness and lack of methodological rigour. Linked to this, is the subjectivity of the researcher which introduces a degree of bias (Hamel, 1993:23).
- (2) They inevitably face the difficulty of generalisability, particularly when there is only a single case. In short, the question is whether one can validly extrapolate the findings of the single case and attribute to a broader group. There are a host of arguments challenging this type of argument about generalisability. Evidently, to the extent that a case study is seeking to confirm or refute a particular issue, generalisability will remain a challenge and need to be addressed. Furthermore, it is also evident that the strategic selection of cases increases the generalisability of a single case study. Poor case selection will undermine the credibility and validity of the research in a significant manner (Willis, 2014).

3.4.3 Interviews

Interviews are regarded as one of the most frequently employed and important data collection methods for qualitative research (Punch, 2005).

By their nature, interviews tend to highlight a subject's interpretation of facts, events or circumstances, rather than a researcher's objective observation of a subject's thoughts or actions (Bryman, 1984). Barriball & White (1994) highlight a number of key advantages to utilising an interview as a data collection method:

- (1) It increases the rate of responses, relative to questionnaires;

- (2) **It highlights a subject's opinions, attitudes, values and beliefs;**
and
- (3) It can allow for comparisons to be made by ensuring that all subjects answer the same questions.

It is evident that interviews may be either specific or open-ended in their nature. While the latter tends to extract opinions and beliefs, the former tends to be more corroborative (Yin, 1994). The key challenge with interviews is that they do entail a degree of inherent bias, as well as the risk of the interviewer being unable to recall responses. One is able to overcome the latter challenge in a number of ways, including recording and then transcribing the interview (Yin, 1994).

Punch (2005) identifies three main categories of interviews, classified according to the extent of structure. These are:

- (1) Structured;
- (2) Unstructured; and
- (3) Semi-structured.

Whichever choice is made, it is imperative that the interview aligns with the purpose of the research in order to achieve the necessary objectives (Punch, 2005).

3.4.3.1 Structured Interviews

In this type of interview, each respondent is asked a pre-determined set of questions. The questions typically allow for a limited number of responses, making analysis a relatively simple task (Punch, 2005). By ensuring minimal deviation from the questions and instructing respondents to select from a list, researchers are able to analyse and compare large volumes of data (Qu & Dumay, 2011).

3.4.3.2 Unstructured Interviews

Unstructured interviews are open-ended and are designed to create conditions under which the respondents feel comfortable and more

inclined to share their perspective on the subject (Hannabuss, 1996). If carried out properly, they are regarded as powerful research tools that can produce a rich dataset (Punch, 2005). Critically, due to their nature, it is imperative that researchers have sufficient insight into the subject to formulate follow-up or clarification questions (Qu & Dumay, 2011).

3.4.3.3 Semi-Structured Interviews

A semi-structured interview is the most common type of interview in qualitative research (Alvesson & Deetz, 2000) and entails a limited number of prepared questions that relate to issues that the interviewer wishes to examine (Bryman & Bell, 2007). Through the use of broad questions, the interviewer can probe further with additional questions and steer the respondent in a direction likely to address the research question (Bryman & Bell, 2007).

Aide memoires or interview guides serve as a reference point and vary from being highly scripted to entirely open-ended, depending on the purpose of the interview. Interviewers ought to ensure that not only do the questions address the research question, but further, that the interviewer is sufficiently prepared to improvise based on particular responses (Wengraf, 2001). It is also advisable that researchers develop as much knowledge on the relevant topic to allow them to pose relevant and informed questions that can lead to a robust and rich dataset (Qu & Dumay, 2011).

In general, semi-structured interviews are regarded as most suitable for exploring complex and occasionally sensitive, perceptions and opinions. Furthermore, semi-structured interviews offer the advantage of giving researchers the ability to clarify areas of uncertainty (Barriball & While, 1994).

3.4.4 Justification for a Case Study Approach Combined with Semi-Structured Interviews

Based on the research questions, a case study approach combined with semi-structured interviews was deemed most appropriate. A single case was selected and semi-structured interviews were conducted with five of the **case's clients**, as well as the Chief Executive Officer (CEO) of the case.

A case study approach was favoured because:

- (1) The subject is diverse, complex and often, subjective;
- (2) The research question demanded a holistic, empirically-rich and context-driven approach; and
- (3) The research area is inadequately addressed in the literature. A case study was regarded as providing a platform upon which knowledge could be built.

It is submitted that challenges in relation to the generalisability of a single case are overcome for the following reasons:

- (1) The case was well-selected and highly suitable. As a South African organisation, the case has unrivalled experience and contacts in global real estate technology market. Few South African organisations have direct access to global real estate IT leaders. Furthermore, and most importantly, few companies can be said to have such high quality and long-lasting relationships with such individuals. The quality of these relationships cannot be understated – without them, the likelihood that board level IT leaders would engage with someone disconnected is extremely low. Finally, the US is the epicentre of real estate technology (Guttman, 2015) and the case has been working with recognised industry leaders in the US for well over a decade;
- (2) Reliability and trustworthiness was achieved by the fact that both **the case and the case's clients are leaders in their respective industries**. Despite anonymity and confidentiality concerns it is

worth noting that **numerous of the case's clients are recognised** thought leaders in the industry and hold advisory panel roles within real estate technology associations; and

- (3) Reliability, validity and rigour was further realised through triangulation and the achievement of data saturation.

Supplementary to the case study, semi-structured interviews were favoured because:

- (1) The **underlying goal was focused on a respondent's** subjective interpretation, rather than attempting to form an objective **assessment of the respondent's perceptions or beliefs.**
- (2) An interview with key industry leaders was regarded as most likely approach to produce new, unexpected, meaningful and relevant insight into the subject;
- (3) As senior executives in their respective organisations, **the case's** clients (respondents) would be unlikely to have the time or inclination to complete a lengthy written survey. Even if they did, the responses would be unlikely to contain sufficient detail for meaningful insights to be extracted. Given the limit time available with the respondents, an unstructured interview would be equally inappropriate. In the absence of an aide memoire or interview guide, the respondents would probably have unwittingly shared much irrelevant insight before their respective time limits were up. A semi-structured interview offered the best flexibility and direction required in order to obtain insight relevant to the research question;
- (4) It offered the flexibility to probe further and ask clarification or follow-up questions where information was unclear or incomplete; and
- (5) As industry leaders in their field, respondents were assumed to be more willing to share insight and information in a format more

closely resembling a conversation than either a written questionnaire or a verbal series of questions and answers.

3.5 Research Design

It is suggested that a good research design is one where the components work together in harmony, promoting successful and efficient function. By contrast, a poor one leads to poor operation or failure. In general, the purpose of a research design is to ensure that the evidence obtained enables researchers to answer the research questions in as clear a manner as possible (Maxwell, 2013).

In this research, the single case was selected for reasons highlighted above and in section 3.6 Population & Sampling below. Based on those discussions, it is submitted that the case is an organisation that has both the requisite knowledge and access to clients that would enable a researcher to obtain information that would successfully address the research questions. The semi-**structured interviews of the case's clients** and use of an aide memoire, justified in section 3.4.4 Justification for a Case Study Approach Combined with Semi-Structured Interviews, enabled the researcher to obtain specific information required to address the research questions. Simultaneously, the approach permitted a conversational style of interview, which served to provide interesting and unexpected insight and examples.

The case's leadership and clients were interviewed and the results formed the basis of data analysis. It is submitted that elements outlined in the research design above worked together in congruence to successfully address the research question.

3.6 Population & Sampling

3.6.1 Overview

Sample selection has the potential to have a major impact on the quality of the qualitative research (Coyne, 1997). If interviews are the main

method of data collection, it has been suggested that researchers define a set of criteria to identify the right profile or suitability of a participant to be interviewed. Furthermore, one should ensure the purpose behind sample selection is clear to ensure that answers and responses are properly interpreted (Wengraf, 2001).

There are a number of non-probability sampling strategies that can be employed, determined at least in part by the underlying objectives of the research (Schatzman & Strauss, 1973). In this research, there were two primary sampling strategies employed:

- (1) Convenience sampling - although the least desirable, it is the most common sampling strategy because it is based on information sources that are easy and inexpensive to access (Suri, 2011). This approach is most effective when the researcher makes use of any qualified persons available to participate in the research study (Castillo, 2009). Convenience sampling is most often used when respondents have limited availability or accessibility (Wengraf, 2001).
- (2) Purposive sampling - technique used to identify and select specific cases on the basis of their nature, whether homogenous or outliers (Wengraf, 2001).

3.6.2 Justification for Sampling Technique Employed

Convenience sampling was selected on the basis that the participants, namely board-level executives and leaders within global real estate companies, are typically relatively inaccessible and have limited **availability. In the absence of the researcher's** relationship with the case, as well as the relationship between the case and its clients, the participants would in all probability be relatively inaccessible and/or unwilling to participate.

A purposive sampling technique was also employed to ensure that participants were diverse, from an operations, management, market, type

of property and geographical region perspective. The diversity of participants would serve to reinforce common themes identified as well as highlight specific regional challenges, if any.

3.6.3 Research Participants – The Case & The Interviewees

Below is a short overview of the case and interviewees, comprising the research participants.

3.6.3.1 Overview of the Case Study

The description of the case below is based on an in-person discussion with the CEO of the case, which primarily sought to gain an understanding of **the CEO's view in relation to:**

- (1) The case, its offering and its clients;
- (2) The broad and specific technologies identified in the literature;
- (3) **The extent to which the case's clients** leveraged such technologies and further, whether there were material differences in different geographical regions (and reasons for such difference, if any);
- (4) The key benefits of technology in the real estate industry;
- (5) The key enabling and inhibiting factors impacting technology adoption in the real estate industry; and
- (6) Any trends or themes not covered in the literature worth mentioning.

As a starting point, the CEO was informed that all responses would be anonymous and confidential, as indicated in the consent form which was signed, an example of which can be found at Appendix A – Sample Consent Form

The case is a software development and services company that since its founding, over fifteen years ago, has focused exclusively on providing technology solutions to the global real estate industry, particularly in the US and UK. These solutions include consultancy services such as mobile

and web development, as well as specialist ERP consulting and outsourced IT services such as helpdesks or business process management.

The company works extensively with industry leaders and some of the largest real estate organisations in the world. In doing so, the company is exposed to international real estate technology trends and best practices.

Part of the company's success has been attributed to their long-lasting relationships with their clients, where they typically become trusted advisors. It is interesting to note that the **company's first client remains** one of its biggest. In addition to ongoing dialogue with their clients, the company also frequently attends international real estate technology conferences to ensure that they are at the forefront of innovation in the industry.

Speaking to the trends identified in the literature, the CEO remarked that the broad themes identified in the literature (Cloud, SaaS, Big Data, Mobile) were in his view representative of his experience and in his view, an exhaustive account of major trends in the industry. Mobile in particular was viewed as a particularly important trend, given widespread consumer adoption of smartphones. The CEO commented that increasingly, mobile **was no longer a "nice-to-have" but rather, a "non-negotiable"**.

After highlighting the specific technologies identified in the literature, the CEO confirmed that not all had made an impact as of yet. For example, he personally knew of organisations leveraging technologies such as the IoT, omni-channel retailing and drones. Speaking to best of breed solutions, he stressed how he had experienced first-hand, the shift in market demand from customised solutions to productised software (best of breed software), particularly over the last five years. Part of this is attributed to the accelerated investment in the sector of the past five years. Other technologies, while exciting, were in his view, not sufficiently affordable or mainstream to have a material impact just yet. This included 3D printing, driverless cars, AI and virtual reality. Looking forward however, he suggested that within ten years, all would have had a major, if not largely

unpredictable, impact on the industry. Driverless cars is a particular area **of interest and would undoubtedly be a “game-changer”, impacting everything from property development to urban economics.**

Referring to the case’s clients, the CEO noted that the business had enjoyed far more traction in the US and UK than in the SA market. Part of this was in his view, attributable to the operating environment challenges, prevailing socio-economic conditions and a lack of “IT prominence”. **In the developed markets, the CEO found that IT leaders had enormous influence within their respective organisations. In fact, some of the case’s** clients increased their investment in technology during the global recession in 2008, primarily to gain a competitive advantage. In SA, local real estate organisations tended to be conservative with their IT spend, often citing dollar-based software costs as an inhibiting factor. Other inhibiting factors highlighted included the cost of high-speed internet and negative socio-economic and political factors. While there were material differences in technology adoption between the countries in which the case operates, the CEO commented that it was likely that this gap was narrowing at an accelerating pace.

When asked what clients were wanting from technology solutions, the CEO noted that clients were driven by different factors, depending on the mandate of IT leadership. Most often however, clients were looking to implement technology to automate and streamline manual processes, increase transparency in the business, getting better insight into operations to drive better decision-making and finally, to gain a competitive advantage in the market. **Given the CEO’s relationship with numerous Chief Information Officers (CIO’s) in the real estate industry globally, he noted that these individuals tend to be highly competitive. As soon as one company gains a short-term advantage through implementing a particular solution, competitors soon follow suit. In the CEO’s experience, “...in that industry, it’s hard to keep anything a secret for very long”.**

Looking into the future, the CEO believed that the US would remain the **case's biggest market because the investment and innovation in the sector is "exceptional and on a massive scale"**. Increasingly, he saw the case shifting resources away from customised software and towards outsourced real estate services (such as lease administration). With regards to the local SA real estate market, he did envision an increased appetite for technology in the future, but that this did largely depend on whether international vendors were successful in implementing a suitable rand-based price point. Interestingly, SA real estate companies appeared to be going against the international trend and investing in custom solutions, particularly within the business intelligence space.

Given the case's experience and long-standing relationships with its clients, the case provided the researcher with a unique opportunity to access IT leaders within the global real estate industry.

3.6.3.2 Overview of Interviewees

The participants or interviewees are senior IT leaders within listed real estate organisations in the US, UK and SA. The organisational structure of each entity tends to differ. Some structures are more flat and amalgamate several roles into one, while others tend to be more hierarchical and conform to the traditional models of organisations. Where possible, the researcher has **attempted to interview CIO's (or their equivalent)**. **Where this wasn't possible for whatever reason, other senior** IT leaders have participated. **Of the case's** fifteen clients, only five agreed to participate, the balance either not responding to requests or declining on the grounds of confidentiality. Within the participants, there were two based in SA, two in the US and one in the UK.

Leveraging the clients of the single case, data was collected through a semi-structured thirty to fifty minute interview, supported by an aide memoire. Since semi-structured interviews formed the basis for the research, respondents were allocated anonymity codes to ensure their

confidentiality and to promote more candid and authentic responses. The anonymity codes outlined below were determined on the basis of geographical segregation, and classified according to the order they were interviewed. To protect the anonymity of the interviewees, each was assigned a code as follows:

Table 4: Anonymity Codes

Anonymity Codes
US – American real estate companies
SA – South African real estate companies
UK – British real estate companies

3.7 Data Quality

3.7.1 Overview

Data quality concerns two primary issues, namely reliability and validity. These determine the extent to which one is able to draw meaningful conclusions about a particular social phenomenon (Leedy & Ormrod, 2010). There is a distinct lack of agreement evident in the literature in terms of how either term is defined and its applicability to qualitative research (Golafshani, 2003). Reliability and validity have often been conceptualised as trustworthiness, rigor and quality in the qualitative paradigm (Golafshani, 2003). In this research, reliability and validity are regarded as appropriate measures of data quality.

Validity refers to the ability of a chosen method to capture desired information (Gummesson, 2000). The key issue is that the method must be the most appropriate way of achieving the desired research outcomes. In order for validity to be preserved, skilled researchers typically test, revisit and reassess all assumptions, methods and tools throughout the research process (Leedy & Ormrod, 2010). By contrast, reliability relates **to the extent which “data collection techniques or analysis processes will yield consistent findings”** (Saunders, Lewis & Thornhill, 2009: 156). This means that independent researchers, following the same methods, ought

to arrive at the same conclusion. It therefore is critical for the research process to be clearly defined (Yin, 1994). To ensure reliability in qualitative research, examination of trustworthiness is crucial (Golafshani, 2003). In summary, reliability relates to whether the result is replicable, while validity focuses on accuracy of the method of measurement and whether it actually measures as it intends (Golafshani, 2003).

Triangulation is one of the more commonly used techniques in qualitative research to probe **validity**. **It is defined as "a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study"** (Creswell & Miller, 2000: 126). It is evident that there is no consensus with regards to the definition and the use of triangulation in qualitative research (Bryman, 2004).

It has been suggested that the research quality and validity is undermined if one fails to achieve data or theoretical saturation (Fusch & Ness, 2015: 1408). Evidently, there is no magical number at which point data saturation is reached in qualitative research. A large sample size does not guarantee data saturation, nor does a small sample size prohibit **it**. **Instead, the sample selection and the sample's characteristics** is determinative (Fusch & Ness, 2015: 1409).

Data saturation is reached when three conditions are met:

- (1) There is enough information to replicate the study;
- (2) No new information can be extracted; and
- (3) Further coding is no longer feasible (Fusch & Ness, 2015: 1413).

Importantly, data saturation is not reached simply because the researcher has exhausted all resources. Put differently, data saturation is not about volumes of data, but rather, about the depth of such data (Fusch & Ness, 2015: 1409). In the context of interviews, it is critical to ensure that participants answer the same questions, failing which, data saturation is virtually impossible (Fusch & Ness, 2015: 1410). Finally, it is worth noting

the relationship between data triangulation and data saturation. Specifically, the former is a method for the achieving the latter (Fusch & Ness, 2015:1411).

3.7.2 Data Quality Applied

The following measures were implemented to ensure that the data collected enabled the researcher to address the research questions:

- (1) Validity was achieved through the use of semi-structured interviews which are regarded as the most suitable method to extract data that is not only rich in depth, but also, in context. Given the nature of the research problem and research questions, it is submitted that no other method would be more effective in addressing the research problem.
- (2) Reliability was achieved by ensuring that interviewees were asked the same questions. This allowed for triangulation techniques to be employed, the net result being that theoretical or data saturation was achieved. Furthermore, verification strategies were employed such as ensuring methodological coherence, appropriate sampling and researcher responsiveness (Morse, Barret, Mayan, Olson & Spiers, 2002).
- (3) Reliability, and trustworthiness, was further established by ensuring that interviewees were all highly experienced in the industry and associated with some of the largest real estate companies in the world. All interviewees were objectively trustworthy and credible. Aside from being senior IT leaders in global real estate companies, two interviewees held advisory **board positions in the world's largest real estate technology** association. In the context of the case, the CEO has over fifteen years of experience in the industry, providing him with the requisite authority to speak to trends, developments and direction of the industry.

It is acknowledged that the small sample size is a potential objection. It is however submitted that any concerns in that regard are far outweighed by:

- (1) The high quality of data provided by the respondents;
- (2) The depth and richness of data extracted through the semi-structured interviews; and
- (3) The use of triangulation that resulted in data saturation.

It is therefore submitted that the respondents were regarded as trustworthy and reliable and accordingly, data was of a high quality. This enabled the researcher to successfully address the research problem.

3.8 Data Collection Process

Given the researcher's relationship with the case, initially the researcher sought to obtain the CEO's approval as to:

- (1) Whether he would allow the researcher to contact and interview **the company's clients**; and
- (2) Whether he would participate in the research as an interviewee.

Once permission was obtained, the CEO contacted the clients to establish whether they would be willing to participate in the research. This was regarded as a more effective strategy than having the researcher contacting the clients directly. **Of the case's fifteen clients**, only five agreed to participate in the research. Some declined, while others failed to respond. Those who declined cited confidentiality and privacy restraints, as well as an inability to commit to the requisite time for an interview.

With regards to the five that agreed to participate, the researcher contacted them directly to highlight the research problem and questions being researched. Emphasis was placed on the fact that any responses would be both anonymous and confidential. Upon confirming their

willingness to participate, each was sent a consent form which they each duly signed and returned to the researcher.

Thereafter, the interviews were conducted telephonically at a time and date that suited the respondent. Given that the interview was semi-structured, respondents were advised that the process would take approximately thirty minutes, although in all cases, it proved to be longer. Given their respective responsibilities and roles, the timing of the interview was crucial, since a rushed or distracted respondent would be less willing to engage and provide the necessary depth of insight. To facilitate analysis and to ensure that no useful insights were overlooked, **interviews were recorded with the respondents' consent. During the** interviews themselves, the researcher made detailed notes to facilitate a richer analysis.

To ensure that the participants provided responses relevant to the research questions, an aide memoire was created to serve as an interview guide. This ensured that a number of key questions were asked to all participants, allowing for triangulation methods to be employed, leading to data saturation. The aide memoire is annexed hereto and marked Appendix B – Aide Memoire.

3.9 Data Analysis

3.9.1 Overview

Data analysis amounts to "**examining, categorising**, tabulating or otherwise recombining evidence to address the initial proposition of the **study**" (Yin, 1994;99). Whichever strategy is adopted for the purpose of **data analysis, the underling goal is to "to treat the evidence fairly,** produce compelling analytic conclusions, and rule out alternative **interpretations"** (Yin 2003:111).

Turning to different methods of analysis, thematic analysis is one technique used to identify, analyse and report on patterns (or themes) of data (Braun & Clarke, 2006). Through the interpretation and analysis

process, researchers seek to uncover patterns or themes which emerge. Critically, there are no established guidelines as to how one defines a theme, save to mention that they should emerge on the basis of prevalence and relevance. Finally, specifically to interviews, it is important to distinguish between questions pertaining to the research objective as opposed to questions asked during interviews. In the case of the latter, these are not necessarily representative of themes, but rather, the analysis of the data produced by the question forms the basis upon which a particular theme is capable of being identified (Braun & Clarke, 2006).

3.9.2 Thematic Analysis

Researchers adopting a thematic analysis must furthermore determine whether to follow either a deductive or inductive analysis approach. In the case of the former, it amounts to a process of assigning data into a pre-existing framework, allowing the research question to emerge through such a process. By contrast, the latter tends to focus on specific questions identified in existing themes in the research and is usually concentrated on an area of interest for the researcher (Braun & Clarke, 2006). Flowing from the above, researchers must similarly determine whether themes will be established on either a semantic or latent level. Semantic level themes are those established at face value. By contrast, latent themes are those that emerge through interpreting data for underlying meanings and subtext beyond what was stated (Braun & Clarke, 2006).

Within thematic analysis, Braun and Clarke (2006) argue that there are primarily six phases to data analysis:

- (1) Familiarising yourself with the data;
- (2) Generating initial codes;
- (3) Searching for themes;
- (4) Reviewing themes;
- (5) Defining and naming themes; and
- (6) Producing the report.

Specifically, in the context of interviews, it is advisable to attempt analysis soon after the interview to ensure that the ideas remain readily **accessible in the researcher's mind. It is also recommended that** if a researcher employs recorded interviews, one should make notes while transcribing to foster greater interpretation. This leads to an overall improvement in the quality of analysis. Finally, the literature argues that it is best for an interview transcript to be produced verbatim. Pauses, hesitations, sighs and the like offer grounds for additional analysis beyond that which is surface-level (Wengraf, 2001).

Hsieh and Shannon (2005: 1279), provide a useful outline of the preferred data collection process:

- (1) Read all data to achieve immersion;
- (2) Derive codes from the data;
- (3) Make notes on the side to document thought processes;
- (4) Sort codes into categories based on how different codes are related;
- (5) Group codes into meaningful clusters, ideally between 10 and 15;
- (6) Develop a tree diagram by organising categories into hierarchical structure; and
- (7) Identify the relationship between categories and subcategories further based on their concurrence, antecedents or consequences.

3.9.3 Selection of Approach

In the context of this qualitative research, namely a semi-structured interview, a thematic analysis was regarded as most suitable.

Furthermore, a mixed analysis approach was adopted that incorporated both deductive and inductive aspects. To the extent that existing literature on the topic was relatively incohesive and incomplete, an inductive approach was favoured to allow themes to emerge. However, on

the basis that the broad, over-arching trends in real estate technology were fairly well-known and documented, a deductive approach was adopted.

Finally, a latent level analysis was favoured to ensure that relevant beliefs and opinions expressed were evaluated within the context of the interview and not at face-value or in isolation.

3.9.4 Thematic Analysis Applied

Having concluded the semi-structured interviews, these were then transcribed into a format appropriate for thematic analysis using NVivo, an industry-leading qualitative analysis software package. Each respondent was assigned an anonymity code and transcribed for thematic analysis. Thereafter, each interview was scrutinised and coded according to central and subsidiary themes that emerged from the data. The themes and sub-themes provided a hierarchical tree upon which the data was analysed and interpreted. To illustrate the themes, a diagram depicting the emergent themes is annexed hereto and marked Appendix C – Emergent Themes. This formed the basis for analysis and interpretation.

Importantly, all collected data was transcribed and available in textual format to ensure that it could be analysed methodically. A randomly selected sample of a transcribed interview can be found at Appendix D - Sample Transcript. The semi-structured interviews sought to address specific broad topics and in doing so, created the necessary nodes through which themes and sub-themes could emerge. Furthermore, to **the extent that a respondent was moving towards areas that weren't** relevant, the semi-structured nature of the interview and aide memoire allowed the researcher to direct the conversation and to probe specific issues. In doing so, one could ensure all interviewees answered the same key questions and ultimately, that data collected was relevant to the research questions.

3.9.5 Criteria for Interpreting Findings

Broad and specific technologies emerged through analysis of the literature. In order to objectively assess the extent to which a broad or **specific technology was found to have impacted a participant's** organisation, a set of criteria were adopted. These criteria were used to interpret the responses elicited during the data collection process. These criteria, ranging from having the most weight to the least, are:

- (1) The technology is presently used by the business and is fundamental across core and non-core operational areas;
- (2) The technology is presently used by the business, but is either not business critical or otherwise operates in limited areas of the business;
- (3) The technology is not implemented in the business but is likely to be in the foreseeable future;
- (4) The technology is not implemented in the business and is unlikely to do so in the foreseeable future, but the respondent is aware of its current or future impact on the industry; and
- (5) The technology is not implemented and it is unlikely to do so in the future and is unaware of its current or potential impact on the industry.

3.10 Ethics

3.10.1 Overview

Ethics refers to norms of behaviour that polarise the conduct from being either acceptable or unacceptable (Resnik, 2011). Specifically, in the context of research ethics, these refer to codes or guidelines to help reconcile value conflict (Gillespie, 2014: 1). Naturally, individuals may interpret, apply and balance these norms in a number of competing and different ways, giving rise to ethical disputes. Data collection is one of the key areas where ethical issues arise. Ethically constructed research

requires that permission is obtained to gather, process and use the information (Jefferies, 1999).

While confidentiality refers to protection of actual information, anonymity **pertains to the protection of an individual's identity (Wengraf, 2001).**

Where possible, it is preferable to include the respondents' identities to facilitate more meaningful analysis. However, anonymity may be beneficial in circumstances where either the subject or the identity of the informant is sensitive (Yin, 1994).

3.10.2 Research Ethics Applied

All responses in this research were both confidential (as to the information shared) and anonymous (from both an organisation and individual level). To this extent, each candidate was requested to sign a consent form that outlined the purpose, procedures and potential benefits of the research. Furthermore, it also confirmed the confidentiality of the information and the anonymity of their responses.

Once interviews were conducted, each was assigned an anonymity code and transcribed in order to be suitable for thematic analysis. Each interview was then carefully interrogated for relevant information and was coded according to general themes that emerged through the interrogation of the data. These themes were then linked back to the interviewee through an anonymity code schedule. The confidential information contained in the interview transcripts and recordings was held in a secure password protected folder.

It is submitted that any potential ethical risks relating to the disclosure of sensitive commercial information were adequately guarded against by ensuring that all participants' responses were anonymous and confidential.

3.11 Limitations

In the context of this research, there are a number of key limitations:

- (1) Research methods: Semi-structured interviews - It is well-documented that where interviews are the primary method of inquiry, an inherent risk of interviewer bias exists (Mills, Bonner & Francis, 2006). There are conceivably a number of ways to mitigate this risk such as scheduling the interviews at a time and **place of the participant's choice, favouring a fairly flexible, unstructured approach to questioning to permit participants to drive the direction of the conversation, by sharing one's personal understanding of the key issues being investigated and by assuming an open-minded attitude towards the informant (Mills *et al.*, 2006: 5);**
- (2) Research methods: Single case study - They inevitably face the difficulty of generalisability (Willis, 2014);
- (3) Time – The limited time availability of the respondents meant that some respondents did not provide any comments on certain technologies, making it difficult to draw conclusions about the extent to which such respondent employed the particular technology or not. Given other commitments and their senior role within the business, it was not possible to secure additional time in the circumstances. It is likely that further and deeper insight would be achievable in the absence of any time constraints;
- (4) Sample size – Small sample size can potentially limit the generalisability of the research findings;
- (5) Exclusion of private real estate companies - It is conceivable that private firms around the world could be more innovative, as well as have bigger scale and resources than local listed companies. Given that the research is limited to listed firms, it does prevent one from making general comments about the industry as a whole, including private companies;

- (6) Pace of innovation - Given the rapid advancements in technology, it is acknowledged that this research may have limited relevance in years to come; and
- (7) Restricted account – While every attempt was made to address all notable real estate technologies, it is conceivable that this research does not necessarily address all existing or imminent technologies within the real estate market.

To address those limitations capable of being mitigated, the following measures were implemented:

- (1) Interview bias - The semi-structured nature of the interviews mitigated the risk of interview bias since the respondents were able to drive the direction of the conversation to a large extent. Where possible, the researcher expressed a view on a particular issue and sought to have an open-mind with regards to the types of responses obtained. Finally, each of the interviews was conducted at a time and date chosen by the respondents. Cumulatively, these factors sought to mitigate the risk of interview bias;
- (2) Research methods: Single case study –Through the strategic selection of a credible, high-quality case, it is submitted that the issue of generalisability was overcome, further expounded upon in section 3.4.4 Justification for a Case Study Approach Combined with Semi-Structured Interviews;
- (3) Sample size – The composition and quality of the participants provided the depth of data required to achieve theoretical saturation, thus mitigating issues in relation to the sample size; and
- (4) Restricted account – In an attempt to mitigate this issue, the researcher consulted just short of two hundred resources to minimise the risk of omitting other prominent technologies.

3.12 Concluding Remarks

This chapter outlined an analysis of the research paradigm and overarching theoretical context of this research. Based on prevailing literature, interpretivist and constructivist ideologies were adopted, further based on the assumption that human nature is deterministic. The topic suited a qualitative approach and a combination of convenience and purposive sampling was employed prior to collecting data through a semi-structured interviews **of the single case's clients**.

Chapter 4: Data Presentation & Analysis

4.1 Introduction

The purpose of this chapter is to present the findings and analysis of data collected in Chapter 3. This qualitative research sought to understand whether real estate companies leverage technology to achieve best value, what the key benefits of technology are and further, the enabling and inhibiting factors impacting technology adoption. To facilitate any comparison between developing and developed countries, the UK and US responses are groups together.

Having outlined prevailing global technology advances within the real estate sector, data was collected through semi-structured interviews with five real estate IT leaders. There were two respondents from each of SA and the US, and one from the UK. Once the data was collected, it was coded and analysed into key emerging themes and sub-themes. Utilising the techniques outlined in Chapter 3, a number of key themes and sub-themes were identified. Various techniques were used to assist in the identification of such trends, including tree map tools, word frequency and text-driven queries through the qualitative analysis software, NVivo by QSR International.

Each of these themes are discussed below.

4.2 Impact of Technologies

4.2.1 Impact of SaaS & Cloud Computing

All respondents surveyed leveraged SaaS and Cloud Computing to a lesser or greater extent. All recognised the immense power that SaaS solutions offer, enabled by the cloud. US and UK respondents demonstrated a strong appetite for cloud computing and SaaS across the entire organisation, from core to non-core applications. US and UK respondents leveraged multiple different applications to integrate with their core financial package. SA respondents by contrast, had fewer

disparate applications, favouring an overarching core ERP rather than best of breed individual applications. Furthermore, for SA respondents, cloud solutions appear to be focused largely on a communications and infrastructure level. These findings resonate with prevailing literature, suggesting that while immensely powerful, cloud computing and SaaS solutions are likely to gain increased traction in the coming years.

4.2.1.1 US & UK Respondents

Speaking to the wave of investments in the real estate technology space, US1 noted that cloud enablement was fuelling the most recent wave of real estate technology start-ups in the US. Aside from being a key enabler to recent investments in the industry, it is also gaining momentum from **an adoption point of view, as 70% of US1's decisions on new partners** have been SaaS-based.

SaaS-based applications appear to be even more popular with non-core applications. US2 commented that the more non-core and generic, the more likely the business would go for a SaaS solution. However, in general, US2 also noted that more applications were moving to the cloud **including the company's CRM and construction management solutions.**

Interestingly, the decision of whether to go cloud-based or not was less about location and more about functionality. US2 noted that the key was to find the right fit since they had technology in place to ensure that all systems were accessible remotely, regardless of whether it was cloud or **local. They still have that "ubiquitous experience"**. Furthermore, aside from functionality, US2 stressed how the user experience and integration into enterprise systems were just as critical in determining which solution to adopt.

Cloud-computing often leads to discussions of cyber security. UK noted that in their organisation, they had three different levels of data, each having a colour assigned to it:

- (1) Very sensitive (red);

- (2) Mildly sensitive (orange); and
- (3) Non-sensitive, publically accessible (green).

UK noted that all red data tended to be kept in-house. The other kinds of data tended to be moved to the cloud. Monthly penetration testing and two-factor authentication were some of the measures in place to ensure data security. With regards to the benefits of cloud computing, UK stressed the enormous cost saving as one shifts away from hardware to broadband connectivity. Without having to run data centres and appropriately qualified staff doing bug fixes and the like, UK had realised significant savings. Aside from cost savings, UK stressed the increased flexibility brought by the cloud, making all enterprise applications accessible anywhere. Importantly, all of UK's **operational** systems are remotely accessible, though the internet.

4.2.1.2 SA Respondents

SA1 indicated that they operated a hybrid environment and that cloud technology was largely employed on an infrastructure level. On an infrastructure level, this included services such as Office 365 and Microsoft Azure to host their Active Directory Figuration Services. SA1 noted that it was likely that over time, more of the applications would be shifted onto the cloud as their investment in cloud computing increased. Much like the other respondents, SA1 noted that it was likely that they would always have some footprint on-premise, but that it would be likely to get smaller into the future. Despite intending to increase cloud investment, SA1 described two key challenges, relating to the cost and lack of local partners.

SA2 was very positive about the cloud computing and SaaS, noting that they were one of the pioneers in the industry to take the operations into the cloud some five years ago. They further indicated that this was partially driven in an attempt to manage their telecommunications risk: Further benefits SA2 noted included the safety and real-time accessibility

of operational information. SA2 stressed that one of the key benefits results in them not having to wait until month-end to understand their financial position. Real-time accessibility meant that decisions could be made quickly based on up to date data.

4.2.2 Impact of Big Data

In general, US and UK respondents felt that despite having more data points than ever and the associated business benefit of real-time **information being provided by such data points, it wasn't on the scale and magnitude to warrant being classified as big data.** This sentiment was echoed by the SA respondents. The US and UK respondents however were seemingly moving toward big data quicker than the SA respondents. Importantly, cost and scale appear to be some of the challenges facing SA respondents. Much the trends identified in the literature, big data was not something that had enjoyed a major impact on the real estate sector as of yet, but that was likely to change in the near future.

4.2.2.1 US & UK Respondents

US1 argued that big data, in the true sense of the word, had not yet impacted their space. However, it was clear that the company was benefiting from investment in the area, indirectly. US1 noted the proliferation of building data (such as energy data), as well as the collection and analysis thereof. It was evident that US1 felt that there was a tremendous opportunity to **fine-tune a portfolio's performance and such** benefits had already been evident in their portfolio. US1 spoke about the types of technologies supporting big data, most recently an implementation of a leasing platform. This platform has already brought **about "incredible performance gains"** due to a wide range of data that is adjusted dynamically on a daily basis.

US2 shared US1's sentiments, suggesting that while big data was still to have an impact, the progress around building data was significant:

“So we haven’t really hit the level of big data...today we are really analysing what happened and forecasting out, but we are not looking for things we don’t already know about.”

US2 stressed that current analytic solutions were **“validating assumptions today instead of coming up with new ideas”**. Looking forward, the solutions would be better at predicting trends, rather than analysing historical data: **“...in big data, we try to get to the point of analytics where we are being predictive and finding trends, but it’s not just there...we are not there at all”**. The key, US2 argued, is to **“enter the data once and use it in multiple times and in multiple places.”**

UK highlighted the overarching benefit of big data, but stressed that at present, their operations and analytics could not be regarded as big data, quite yet, although they were moving in that direction:

“A big drive for us is how do we get a single source of that truth...we are more interested in becoming a data aggregator... so we working on a number of different systems to be able to do that, so in that sense, once that is live, I think that might actually make us a big data injector, because we’re going to get a lot of data from these centres that we will have to start analysing and keep coming up with insights into how that can help our clients.”

4.2.2.2 SA Respondents

SA1 highlighted the desire to obtain a single view of the organisation through the aggregation of data collected from buildings, but that this **didn’t amount to big data in a real sense. Speaking to the data points,** such as sensors around a building, SA1 noted that in many cases, the cost was prohibitively high:

“In South Africa we are way behind the curve in that space. New buildings is a different story, given older buildings and most buildings you have got analogue-based systems which don’t record the data to the same degree, but we do have building management

systems in place in the newer buildings... **but we've got a fleet of buildings that age from the most modern built in the last year or two through to something that was built 20 years ago and to retrofit that stuff into older buildings is very costly.... if the whole building is being upgraded as part of like a big upgrade, then different story."**

Importantly, SA1 suggested that even where these systems do exist in **the portfolio, it isn't leveraged to make key real-time decisions**: "... these systems do exist in some of our buildings, but by and large they are not used for key decision-making."

SA2 similarly was neither an aggregator nor analyser of big data as defined. They did however collect a wide array of data, largely through mobile and beacon technologies, that while not considered big data, provided valuable insight into their portfolio:

"The big value behind your fibre backbone is not just data flow, **it's** your information on that, so your customer information, your dwell-time, what are they buying, why are they buying it, why are they saying these things? That kind of thing...the value add."

4.2.3 Impact of Mobile

All participants leverage mobile technologies to a lesser or greater extent. The international respondents tended to regard it as business critical and vital to their IT strategy going forward, from both a business to business (B2B) and business to consumer (B2C) perspective. While the SA respondents leveraged mobile for their internal applications, the appetite for consumer-facing mobile was noticeably less. Whereas mobile appeared to be a non-negotiable technology for the international respondents, SA respondents demonstrated less enthusiasm and more caution. **This resonates with the CEO of the case's sentiments on mobile.**

4.2.3.1 US & UK Respondents

US1 embraced mobile technologies across their entire enterprise and described how it was integral in their data strategy over the past eight years - specifically noting that mobile technologies had been **"a very very powerful, enabler of our business over the last a couple of years and a competitive advantage and how we approach it."**

US1 spoke of how they were in a transition phase similar to when people moved from doing business via the phone to shifting to the web. Today, the shift is towards mobile, suggesting that **"real-time enablement of customer service is a pretty powerful"**. Besides from better customer service, other operational benefits include risk reduction and real time decision-making. Speaking to a recently implemented leasing platform, US1 spoke highly of the benefits which include **"complete transparency for brokers that are working with us, and even our own internal staff, being able to feed this transparent engine that's all facilitated by mobile."**

Interestingly, part of **what is driving this move towards mobile, in US1's view, is the "consumerisation of UI"** - "the design of applications for consumerisation is really impacting on how we do it on the enterprise side".

US2 echoed the widespread impact of mobile from both a B2B and B2C perspective, suggesting that:

"I think it's transformative especially on the deal-making side. I mean to have the power of your whole portfolio and all the information you need about it right on your iPad or your iPhone. So that when you are meeting with tenants or prospects you have that 360 view of them. You know all of their current leases, you know all of the prospect's information and you know their market demographics."

Going further, US2 described mobile as a “game-changer”, suggesting that most real estate companies are working towards a single view, although presently incomplete. Commenting on this it was noted that:

“I think we all have pieces of it. My peers all have pieces and they are somewhat disparate and now **it’s** consolidating that into a single application.”

In the B2B space, it is more about leveraging mobile leasing tools, while the B2C space focuses on the use of mobile technologies to market to consumers. Speaking in relation to marketing to consumers, US2 noted the major difficulty:

“There is a competing issue with the actual tenants. Many of the **mall tenants have their own app. So there isn’t a clear vision of how** everyone is going to work together because now you have the technology to know when somebody has entered the mall either through your WiFi or through beacon technology and you want to be **able to engage with them in a relevant way. You don’t want to have** someone who is bald come in and you send him a coupon for a haircut. So you want to be able to like identify who this person is, what their shopping habits are. Just like Amazon is able when you are on the web, knows where you shopped before, you get the relevant popups. We want that same brick and mortar experience but nobody at this point is sharing the data to be able to do anything like that.”

In terms of pushing relevant content to the right person at the right time, US2 noted that **“it’s still not quite relevant yet.”**

UK stressed that the business was pushing mobile technologies and that this involved two main phases. The first was shifting all staff from having desktops to laptops. The second phase is:

“To mobilise everyone, to ensure everybody has got a smartphone that requires one, or an iPad if they need to actually do data entry

out on the road, so that sounds **fairly simple, but as you're probably** aware, we have to create a system to support that on the back-end, so all the recent developments I have been involved with, have either been responsive websites that can be used from any device, or we are actually making mobile applications where it makes sense."

Importantly, mobile is regarded as business critical for UK and that mobile is a non-negotiable requirement for all future developments. Presently, all of UK's **operational systems** are accessible from the internet, so one can access the applications from any device or location.

4.2.3.2 SA Respondents

SA1 noted that they had leveraged mobile in a number of ways throughout the organisation to improve organisational communication and operational efficiencies. Speaking to those staff members who are mobile:

"We went and actually bought 100 iPads for these guys, so that they can run around at buildings and do their daily facilities tasks and be in contact with the Help desk as well as we have an application which is from a crowd called Web Trainer. Essentially what the app does...**it's a health and safety check list, and we** require our facilities guys to complete it monthly, again in the mobile space, they go around to the buildings on a quarterly basis and they have these **check lists ...years ago what they used to do** was they would take the check list and they used to tick the thing **on paper but today it's all just a drop-down tick list.**"

SA1 is also considering implementing other mobile technologies, such as an iPad inspection application, suggesting that they are "starting to make **use of mobile to make it more efficient out there.**"

SA2 leverages mobile to a lesser extent, predominantly within the consumer space engagement space or B2C, where each shopping centre has its own mobile application. Interestingly, despite the investment in

the mobile applications, SA2 found that face value engagements offered more value, from a return on investment perspective. Specifically, their experience has been that:

“Face value and point-to-point customer service is actually getting us much higher returns than just putting an app out there...**it is quite challenging with our apps...you develop an app but you can’t...** put it in front of their face (and compel them to use it).”

4.3.4 Impact of AI & Robotics

As a general comment, respondents provided little information on this topic although it was evident that international respondents were certainly more familiar with the technology than the SA respondents.

4.3.4.1 US & UK Respondents

US2 noted that a short while ago, operations leaders were dismissive of the potential of robots, but in a short space, have started to become increasingly influential:

“You have seen robots now doing greetings at big box stores and helping folks find the location for a product. I think that robotics will definitely invade our space.”

US2 further noted how AI is integral to predictive analytics of big data, although “we try to get to the point of analytics where we are being predictive and finding trends, **but it’s not just there, we are not there at all.**”

US1 did not mention the use of robotics within the organisation and their position is unclear.

UK did not go into any level of detail, but indicated that AI and robotics were impacting the industry.

4.3.4.2 SA Respondents

Neither SA1 nor SA2 leverage AI or robotics within their respective organisations. In fact, when presented with a list of prevailing technologies including AI and robotics, SA1 commented that they were “not looking at any of those at the moment.”

4.3.5 Impact of 3D Printing

Only UK is actively leveraging 3D printing in its operations. US2 appears enthusiastic about the possibilities, but currently does not actively employ the technology. Neither of the SA respondents indicated that they were either currently or imminently utilising 3D printing. The literature suggested that 3D printing was not at a point where it had fundamentally shifted the real estate industry, but that it was highly likely to do so in the **near future. This is reflected in the respondents’ responses.**

4.3.5.1 US & UK Respondents

US2 was familiar with the technology and suggested:

“I definitely see 3D printing being used for a whole lot of different things.... **I think 3D printing is here to stay and I think it will be used a lot in medical technologies and not sure how it’s going to be used in the retail world but there will be a store that pops up to print whatever you want.**”

US2 recalled an example of how a colleague 3D printed a broken part of the office printer. When asked about a Chinese firm that claims to have built an entire home in 24 hours, the respondent was sceptical because:

“With 3D printing, even the high-end ones are pretty slow. It must be a teeny house. Or they have hundreds of printers going at the same time.”

US1 did not mention 3D printing during the interview and the **businesses’** position is unclear.

UK confirmed that they were aware of the notion of printing entire buildings using 3D printing and confirmed that it was used in business:

“We just really use 3D printing for creating models of layouts and stuff like that, so not as exciting as printing a whole building, but it has made it easier for us to produce physical mock-ups of buildings and concepts.”

Commenting on the future of 3D printing, UK suggested that if widely used, such as printing an entire building, it would be a “big game changer”.

4.3.5.2 SA Respondents

Neither of the SA respondents indicated that they were either currently or imminently engaging with 3D printing technology.

4.3.6 Impact of the IoT

US-based respondents saw enormous value in the IoT and leveraged it throughout their portfolio, particularly from an energy management and security point of view. UK mentioned that its clients were speaking to them about it, but that they did not implement IoT solutions, instead they aimed to be a data aggregator once such solutions were in place. SA respondents did not have any notable IoT strategy in place at present. Given the relative pervasiveness and affordability of broadband internet required for the IoT, these findings are not entirely unexpected.

4.3.6.1 US & UK Respondents

US1 stressed the value of IoT in relation to building management:

“IoT is an incredible driver of how you manage a building plant..... I now have more facility endpoints on our network than operating end points meaning desktops and printers and laptops...the growth of the IP connect, the IP enablement of our building systems is going to continue to drive this curve.”

Speaking in relation to a new building under construction in a major west coast city:

“That building will have more than 500 end points when we’re done building... the technology being overlaid in that building that then supports the whole framework for additional sensors and pulling that back into data, data that allows you to optimise a building. **I mean I just don’t see this stopping in terms of where the technology goes....I mean we’re rolling out a, a high end parking system, as a revenue generator, a suburban, probably 3000 parking spots. And then it will all be, and it will probably be a couple of hundred cameras and all intelligent reading licence plates.”**

US2 similarly recognised the value of the IoT from an energy management perspective, relevant for any owners of commercial real estate whether office or retail:

“So I can see all the lighting in the parking lot and control them in the parking lot and I can turn out section A or section B. So putting policies in place to conserve energy.”

Given the nature of their business, speaking to the IoT, UK noted:

“We have a number of clients coming to us with IoT, internet of things, so that’s the thing as to how we can create smart buildings. But (company name) isn’t really helping to how to set up point sensors and how the buildings are wired up. We are more interested in becoming a data aggregator.”

4.3.6.2 SA Respondents

SA1 commented that at present, the company was not leveraging the IoT, whether in the energy management space or elsewhere. Instead, the organisation was in the process of working with a vendor to do live meter readings in an attempt to reduce the timing between billing and the paper cycle.

SA2 similarly had not implemented an IoT strategy in the business. The company was presently in the process of negotiating a fibre backbone and felt that once that was complete, one could facilitate value-adds such as the IoT.

4.3.7 Impact of Drones

US and UK respondents leveraged drones to a significant extent, predominantly for the purposes of creating marketing material. SA1 echoed these sentiments while SA2 does not utilise drones. All respondents using drones spoke of the cost efficiencies of aerial photography using drones relative to helicopters in the past. These sentiments align with insights uncovered in the literature.

4.3.7.1 US & UK Respondents

US2 noted that they presently outsource the use of drones:

“Drones were already being used in our industry for those types of things. For taking a look at the roof, taking aerial photos for marketing. We don’t own one yet but I keep working on it.”

US1 didn’t specifically mention the use of drones, however their use of drones is well documented online.

UK described how they had used drones to create marketing material when” looking to sell a particular property:

“We are seeing a lot of use of drones to basically photograph buildings and help produce collateral to sell the building.”

In discussing the benefits, it was further noted that:

“It’s definitely disrupting the cost model to do that stuff, because traditionally you have to get aerial photography of the building, you would have to hire a helicopter or an aeroplane, stuff like that. So many times we are using drones to reduce that cost.”

With regards to the future of drones, UK maintained that:

“I think that’s only going to become more widely used as more is changed, you can utilise drones, because there’s quite archaic rules around drones at the moment, so if you want to use a drone in a public space in London, you have to get a permit and have a qualified pilot actually control the drone, but I can see that being relaxed as people become more used to sort of everybody using drones.”

4.3.7.2 SA Respondents

Much like the US and UK respondents, SA1 noted that they leveraged drones from a marketing perspective:

“We use drones to take aerial views and photographs and assist with certain aspects of marketing. I mean **it’s huge, but I think they** certainly are not renting helicopters anymore to fly over buildings and take static pictures of those things anymore.”

SA2 did not specifically mention drones and their position is unclear.

4.3.8 Wearable Technology

The majority of respondents did not indicate whether they were presently or imminently utilising wearable technology in their businesses, except for UK who regarded it as important.

4.3.8.1 US & UK Respondents

It is unknown whether US1 or US2 leverage wearable technology within their respective organisations.

UK indicated that wearable was receiving attention in the business, particularly in the facilities management and surveying business units:

“I think that is a big push for us as well, especially in our sort of IFM and our surveying part of the business and because one application that we are looking into quite heavily, is around lone-working, so we have a number of situations where you might have to send a

surveyor out to a property that might not be occupied, so there could be a number of risks for that person being there, like they could trip, fall or have a heart-attack whatever, and we are **investigating variables to keep track of those people when they're out in those, also sort of having a mechanism for them to check in, that will automatically tell us when they haven't checked in, or there's been no activity in like 15, 20 minutes and then we can actually do a personal check on that person."**

4.3.8.2 SA Respondents

It is unknown whether SA1 or SA2 utilise wearable technology in their operations.

4.3.9 Driverless Cars

None of the respondents indicated that they were presently implementing driverless car technology in their business, nor did any feel that it had already impacted the industry.

UK commented that all technologies mentioned had impacted their business, save for driverless cars.

US1, commented on the technology, indicating that it was a reality but its impact on the business was not clear:

"I mean it's already a reality.... I know someone who went up to Maine and didn't touch the steering wheel. You know, but it's here....so it's really the question of what the impact of that technology will have on the distribution of where people live... I'm not sure it's going to fundamentally impact our business."

4.3.10 Omni-Channel Retailing

US1, UK and SA1 did not have a big omni-channel presence, however both US2 and SA2 described the benefits and some of the challenges behind a robust omni-channel strategy.

4.3.10.1 US & UK Respondents

US1 indicated that the businesses focus was office space and therefore, omni-channel retailing was not a priority for the business.

US2, more focused on retail, stressed how it was a priority for the business:

“For us obviously that’s a big deal. Again, we want folks to have that same experience from a mall perspective... our tenants are all trying to figure that out at this point because there is some statistic that am probably going to get wrong. Many transactions might start online but end up in malls. Something like 83 % of all retail ends up in stores in brick and mortar. Whether deliberate from there or someone came in and picked it up from there, even though folks might be starting out on the web, a lot of time they are just doing the research but they are going in to get it.”

This quote echoes a common theme in the literature in terms of which brick and mortar continues to play an important role for consumers.

Hinted to in the quote above, US2 outlined the challenge of engaging with consumers using a mall application. Notably:

“There is a competing issue with the actual tenants. Many of the mall tenants have their own app. So there isn’t a clear vision of how everyone is going to work together because now you have the technology to know when somebody has entered the mall either through your WiFi or through beacon technology and you want to be **able to engage with them in a relevant way. You don’t want to have** someone who is bald come in and you send him a coupon for a haircut....**So you want to be able to like identify** who this person is, what their shopping habits are. Just like Amazon is able when you are on the web, knows where you shopped before, you get the relevant popups. We want that same brick and mortar experience

but nobody at this point is sharing the data to be able to do anything like that.”

Speaking to vendors in the market aiming to facilitate omni-channel retailing:

“There is a couple of vendors out there....they have the app on the phone, you can push the beacon message, the coupon or whatever. But it’s still not quite relevant yet. It’s just: hey this person, we might have seen the person before through the app but we don’t really know who they are yet.”

As real estate services firm, UK is less focused on omni-channel retailing, although UK did outline their use of Google within the retail space:

“The other thing we’re exploring is with Google, so indoor street view is quite useful to us, especially on our retail side of things, so we’ve actually mapped a few of our shopping centres already and we use it to show what units might be available for rent, what your competitors might be in a retail environment. So that’s quite nice and useful for us to briefly show clients what they are likely buying into. So if we could do that from an office without people having to go to locations, you could do like 15, 20 of those in a day where you would only be able to do maybe 2 or 3.”

4.3.10.2 SA Respondents

While SA1 noted that omni-channel retailing was not something that they were involved with at this stage, SA2 described their use of omni-channel retailing:

“Each shopping centre has a mobile app... So you would walk in, we’ve got your profile, 2 kids etc....you walk into the shopping centre and if you open the mall app it would say “sale for baby diapers” and whatever that’s relevant to you is at this shop.”

SA2 rolled out free WiFi in many of their malls suggesting that:

“If everybody comes in and they just spend 15 minutes more than the normal time, the pickup on income was massive and it showed.”

Speaking to their social media presence in engaging consumers:

“We’ve got Facebook pages and Twitter account and our stakeholder engagement is on quite a few linked streams...and have got a dedicated person monitoring...especially our Twitter account and our Facebook account because we tend to... that’s more damage control.”

SA2 noted the privacy concerns around local legislation:

“I think everybody and especially **the listed companies we’re still** very skittish on the Popi act. It hasn’t been tested there, so **everybody is waiting for the first law test to see if he’s going to be burned and where and then we’ll formulate our strategies around** that. Which is actually, **it’s a pity, because now everybody’s a sitting duck.** You know, on something that can really be amazing.”

SA2 did however note that with omni-channel retailing, “if you get it right, your revenue opportunities are endless.”

In discussing the impact of online shopping on the bricks and mortar experience, SA2 noted that their experience found that:

“We’ve actually got people more impulsive buying instead of buying online...you give them a tool to research and **that’s something that we didn’t expect.”**

4.3.11 AR & VR

Neither US1 nor US2 presently made use of VR and AR technologies, while UK indicated that it was very influential and widely used in the business. SA1 had experimented with 3D AR on a pilot basis while SA2 was investigating the use of VR in creating virtual shopping experiences. These findings align with prevailing literature, suggesting that although

relevant, it has not quite reached the point of being adopted industry-wide.

4.3.11.1 US & UK Respondents

US2 indicated that in a previous role, AR and VR were utilised within the consumer-facing retail applications space but:

“Even then it was really more traditional, more around the Google analytics, the social media mining than anything else... I mean the closest thing was the magic mirror that we had looked at. You will stand in the mirror, it sizes you up and then put what you want and it tells you all the stores that has it.”

It was not established whether or not US1 utilised VR and AR technologies in the business.

UK indicated that AR and VR had already had a significant impact on the business, from leasing to tenant installations to marketing materials:

“We heavily utilise Oculus Rift for creating virtual walkthroughs and it allows us to take like an empty building and actually show different furniture options, or different layout options to clients, and we have done quite a bit of development work in that space, where we can actually change those options on the fly, you can have like a workshop with a client and actually change stuff in real time and then we can produce CAD drawings from that output. **We’ve also** invested heavily in being able to take standard CAD drawings and standard printed blue prints, and been able to load them into 3D models using AR, so we are actually just going through a proof of concept with that at the moment, so that makes it really easy and cheap for us to actually produce 3D models for that for sales staff, or just a brochure.”

4.3.11.2 SA Respondents

SA1 noted that they had used 3D augmented reality technology to showcase their green buildings:

“We have piloted with a crowd to showcase these together with letting agents that you can see an augmented reality, really of the green aspects of the building and what makes the building green **and how it got it’s green star rating using 3D augmented reality photos... you can run through your iPad to show this augmented 3D reality or through your mobile phone.**”

SA2 indicated that at present they hadn’t implemented any VR or AR technologies, but that they were investigating leveraging VR to create a virtual shopping experience:

“So we’re considering going out of our comfort zone to something that is basically taking our shopping centre to virtual, it’s not brick and mortar **it’s** not what we know and we taking a leap of faith.”

4.4 Benefits of Technology

Below is an outline of each of the **respondents’** views in terms of the organisational benefits enjoyed through the implementation of technology. Much of these benefits were indirectly highlighted in the literature, particularly around operational efficiencies, real-time accessibility of data, data-driven decision-making, scalability, transparency and revenue growth.

4.4.1 US1

US1 indicated that technology allowed the organisation to manage risks better. As a public company, technology served to provide: **“discipline on how we manage our finances...how we budget...and feed our forecasting and modelling ...and the efficiency of that being almost near real-time”**.

Other benefits include **“being able to pivot in terms of making decisions more real time”**. This ability reinforces the ability of US1 to offer **“...real-**

time enablement of customer service...is a pretty powerful thing, to basically be as responsive and efficient as he or she **can be**".

Speaking to a recent implementation of a leasing platform, the benefits were "...complete transparency for brokers that are working with us, and even our own internal staff, being able to feed this transparent engine.... leading to incredible performance **gains**".

In the context of the IoT, US1 noted numerous operational efficiencies and opportunities to increase revenue - **"data that allows you to optimise a building"**

Finally, US1 stressed that technology "...enables the scaling of the business **very effectively, efficiently**".

4.4.2 US2

Speaking to the use of mobile technology, US2 described the technology as **"transformative", highlighting the benefits:**

"I mean to have the power of your whole portfolio and all the information you need about it right on your iPad or your iPhone."

In the context of iBeacon technology, US2 noted that the technology had the ability to increase revenue. Speaking about the technology within stadiums:

"You are sitting in a cheap seat and there are seats in the front area available and they send you a message to say that for \$10 you can purchase a better seat or for ordering food, you can have food delivered to your actual seat."

Speaking about efficiencies and reducing double data entry, another benefit of technology within an organisation is increasingly about entering the data once and using it in multiple times and in multiple places.

Continuing on the trend of operational efficiencies, other benefits are:

“Around efficiency, processing transactions faster, which impacts the financials. Because the faster you can get people move in, the faster is that you can get money in that improves your financials. Also if we can streamline processes, we can have folks working on more analytics and more value add than just pushing paper.”

Another notably benefit of technology is that in the short-term, it would give you a competitive advantage, although US2 was quick to stress that the advantage was often not for long. **This aligns with the case’s CEO’s reflection that competitive advantages are often not a secret for very long.**

Within the context of greater data-driven decision-making taking place, technology could also serve to foster better tenant relationships as your analytics are able to offer insight into the consumers.

Finally, **in US2’s view, technology is also “good for employee morale and development to enhance the processes and again....so folks become more challenged to do more productive things.”**

4.4.3 UK

UK highlighted the fact that as a strategic move to remain competitive, **the company would look to “become a technology company with real estate background by 2020”.**

Speaking around the impact of cloud computing, UK noted that:

“It’s just bringing a massive amount of cost savings to us, because we’re not having to run data centres, we’re not having to provide that skill set you run at data centres, and bug fixes and all that sort of stuff. It also makes it more flexible, because it is more accessible anywhere.”

Cost savings were again brought up in the context AR and VR technologies, **suggesting that it “makes it really easy and cheap for us to actually produce 3D models for that for sales staff, or just a brochure.”**

Other benefits of technology, specifically in relation to wearables, relates to the safety of employees.

In relation to operational efficiencies, UK noted that technology would:

“Make ingesting data a little bit simpler, because most of what people do when they are out surveying a property is writing notes, making and taking photographs and stuff like that, so if they can dictate or voice dictate notes and get those written up automatically as an inspection tool, that is making a big difference in the turnaround time that we find that they can survey a property in with more efficiency gains.”

Efficiencies were again noted in the context of AI and lease administration:

“**We’ve got it down to 30 minutes** - that means we can process almost ten times the amount of leases in a day than we could before, so it means we can take on more clients, etc., **and it’s had a big impact on our business.**”

Speaking generally around the benefits of technology, UK highlighted:

“**Speeding up manual processes, so I know that’s quite an old thing,** but real estate has always been in buildings manuals, so you either deal manually, you would have to put up a bit of paperwork, and we **were certainly digitising those processes, so it’s just speeding up** our business tenfold... **I think just communications have become** easier, so now that everybody has got mobile device... (operations are) more efficient, so being able to actually process more documents, or buildings or whatever it is with less people...**and also, there’s going to be a lot of efficiency gained, because we don’t have to have any office space and you don’t have to have paper storage and stuff like that, we’re moving everybody to actually be a little more paperless than they are now, so I think that is a big driver for us.**”

4.4.4 SA1

Speaking around operational efficiencies, SA1 noted that in the facilities space, iPads were being used to conduct inspections or checklists. This would reduce the double entry of data and render employees more productive.

In the context of being able to work remotely, SA1 commented that this brought about lower overall operating costs as the server footprint gradually is reduced:

“We can run the whole business on 6 servers, it’s one tenth of what it used to be. One tenth of the power consumption in 7 years, or 8 years.”

SA1 also noted that installing fibre across its top quality assets served to attract and retain high quality tenants.

4.4.5 SA2

SA2 highlighted real-time information as a massive benefit of technology because “remember our business is basically knowing what shops to put together to **get the most turnover rental out of it.**”

Furthermore, technology also served to manage operational risks by pushing a lot of telecommunications data into the cloud:

“If my building burns down I can still get email...I can still operate on my financial information. My operational information is safe.”

Furthermore, technology, such as cloud, also proved to offer a cost saving as opposed to hosting all data locally in a centralised database.

Providing consumers with additional value such as free WiFi in their shopping centres had a positive impact on the bottom-line: **“we’ve seen a massive pick up on dwell time”**.

Other technology initiatives that had a positive impact on the profitability relates to the roll-out of mobile applications, **leading to “more impulsive buying”**.

4.5 Enablers & Inhibitors of Technology

Below is an outline of some of the key enablers and inhibitors of technology and technology adoption within the real estate industry. To the extent that enabling factors are described, one ought to consider the antithesis of the enabler as being the inhibitor.

4.5.1 US1

US1 commented that the consumerisation of technology and user interfaces (UI) had certainly contributed to adoption within the enterprise side – people are now more comfortable and familiar with technology. This has led to increasingly demanding consumers and tenants in a fast-paced environment:

“I think that was because of the awareness, the consumerisation, you know the expectation that we needed to be using some of the stuff for better business and getting through the cycle. The velocity of certain markets here in terms of the work cycle is just crazy. So, so, you know the pace of economic activity that demands a velocity **to business...so the expectations of our tenants who are technology tenants for example, they want to use their phone to get in the freaking building. They want to use their phone, I don’t want to pull an ID out, I want to be able to come into the building and then I want to be able to control my office space potentially with my phone. It’s like you’re trying to find ways of easing and facilitating work by making it easier and I mean culturally that’s kind of the economic cycle we’re in right now.”**

US1 heralded the impact of strong UI. Based on a recent experience implementing a cloud leasing platform with intuitive UI, it led to a more seamless implementation and higher rates of internal adoption:

“You know how to navigate for information, so the adoption, the ability to adopt these technologies is enormous.”

It is also evident that operating in the quality asset space increases the need to adopt technology:

“We operate in some of the best assets in the US, it’s Fortune 100, Fortune 500 companies that occupy that space. We typically have larger tenants than other companies in terms of the amount of space a single tenant will have with us, in terms of taking 10 floors or 15 floors, you know. And the way we operate our buildings, that from an operations perspective, from an engineering perspective, from a lifecycle upkeep in the quality, all have to be in alignment and technology is an enabler of how we conduct customer service.”

Another key enabler within an organisation relates to its culture. US1 noted that they had:

“A commitment to continuous improvement....when you have a commitment to continuous improvement there’s always a technology, actually you’re increasing dependency on technology...you’re dealing with process change.”

Furthermore, within the organisational culture, it helped if you had delivered a track record over time of delivery value – adopting a crawl, walk, run approach to initiatives and building on success. Importantly, **“it’s an influence model, it’s not a dictate model here”**.

It is only through having an established track record that business leaders would have confidence in leveraging technology in a negative economic environment. **While an organisation’s culture is capable of being an enabler**, it is not always the case in real estate:

“Real estate people are not necessarily technologists and don’t necessarily see the value of it....they’re really about the next deal either an acquisition, sale or lease, and so that transactional part of

business does not really lend itself to institutional investment in **technology, and I think that's fundamental, a** fundamental disconnect in many organisations, obviously in the US as well."

Speaking to the enabling qualities of robust infrastructure, US1 maintained that "the arc of our trajectory has been enabled by data connectivity".

4.5.2 US2

US2 argued that one of the key enablers is the competitive spirit inherent in capitalism:

"People are competitive. Once folks find out that someone else is doing something, they do want to do it too."

Continuing the discussion of people, US2 suggested the people were both inhibitors and enablers of technology adoption:

"It's a change management process. And the technology itself, there could be some roadblocks. A lot of these things out there are tools. Then you have to take these tools and build something out of them that works for your business, they are very flexible, **customizable which is a double edge sword...Change is tough.** People get used to doing things the way they do them and **sometimes they don't even know why they are doing it that way.** You get **the answer because I always did, well that's how we do it.** So getting people to think outside the box, to embrace it I think is one of the biggest challenges."

Speaking to the challenges behind some of the consumer technology, US2 noted that privacy was potentially an issue and that the older generations tend to be more reluctant to share their personal information (which is what drives a lot of the applications in the retail space).

When asked about the deal-focused nature of the real estate industry and reluctance to implement technology, US2 said:

“You will rather spend money on buildings than on technology....I think that is still true. But if you work with the right people within the organization to sponsor and to get them on-board (then it works).”

In relation to any infrastructure challenges related to quality, availability and cost, US2 noted that **“bandwidth is not an issue for the States”**.

Finally, when referring to the drive behind automation in SA as opposed to the US, US2 indicated that it was plausible that the drive for automation in SA was less because it was a fundamentally different economy to the US.

4.5.3 UK

UK spoke about the company’s drive to become a technology company and in that sense, the organisation’s culture of experimentation:

“I have quite a free reign to investigate and play with new tech, so it makes it quite easy for us to trial emerging technologies, partner with upstarts and just sort of have a go at stuff that may not be viable, so we can run a small proof of concept...it’s the stance and style of leadership of the company.”

Another enabling factor includes the consumerisation of technology:

“People are so used to using technology in their daily lives, that they are now more comfortable to transact in the property world digitally, so we are finding that people are now actually happy to sign leases and stuff electronically, whereas sort of 3 years ago, everybody wanted a faxed contract, or a contract sent through the post.”

A lack of education about the differences between consumer-grade and enterprise-grade applications was regarded by UK as a potential obstacle to technology adoption:

“You have to think about security and integration of other systems and that sort of thing.... **unfortunately Excel is still the** bane of my life, no option and people are still using it for day to day stuff, and **so there’s a lot of education happening on that to try and use proper systems to store data so that we don’t have that situation that we get when people can’t find reports or somebody leaves and we can’t find reports.**”

UK indicated further that expensive connectivity and a very different economy (compared to developed countries) are likely to have held SA back from a technology adoption perspective. It was also noted:

“I think companies are reluctant to invest in SA as well, because of the falling Rand price and the sort of uncertainty of the government. I think those are all factors that are affecting the development, because I can talk about us... so we have 2 companies in SA and we only put marginal investments in there, because we are a bit worried about the future, and we try to **leverage technologies that are existing in business and we don’t** really have it as a new playground or anything like that because of the uncertainty.”

Speaking to other inhibiting factors, UK also noted that the real estate industry has been slow to adopt technology:

“Well I think it is still true, so I think it’s just been the nature of how **people have always conducted business. So it’s always been a very face-to-face business, and it’s always been about sort of meeting people, having that discussion, so I think people have been a bit scared in adopting technology, because you’re going to get rid of the element of interaction. But saying that, I don’t think its 5 years behind other industries now, I think things are speeding up.**”

4.5.4 SA1

Speaking to an organisation's culture and a model of influence rather dictating:

"To succeed with technology, you've got to get the business to buy in. If the business buys in, they use it and there's uptake for it and then great. Then it's a win-win. But if you try and force things onto the business and they're not ready for them, then things fail desperately...like white elephants and then it's IT's fault."

By contrast, SA1 recognised that as an industry, the focus on deal-making often resulted in technology taking a **secondary role in a company's** strategy, and that "is **prevalent all over**".

In response to questions around the apparent lack of technology adoption in local real estate circles, SA1 cited lack of scale as being a massive inhibitor. Beyond scale, SA1 also recognised that the demographics and economy of a country like the US was dramatically different to one such as SA:

"Connectivity is costly... to provide international connectivity with the right level of redundancy for business efficiency...I mean you know it's all good and fine if you earn dollars, and you pay your costs in dollars, but when you earn rands and your costs are escalating in dollars, it becomes very expensive... especially in a market that's under pressure at the moment...cloud at this stage is not necessarily cheaper in SA."

Currency weakness and volatility remains a massive inhibiting factor:

"I think if the economy is the one thing that quashes it down at the moment. I think given the fact that all the technologies, at some point most technologies are imported into this country and the underlying base cost of those is just escalating. Unless we can find some local equivalent solution that's built locally, developed locally,

that's not reliant on foreign technologies, which are dollar-based, it's going to be a big driver going forward, because I think going forward and looking at dollar-based solutions is just going to become totally prohibitive. It's almost unaffordable."

In addition, issues like unemployment also put a dampener on technology agendas:

"You know this country that has a huge unemployment problem. Countries like ours have looked to the labour force to drive **efficiency and employ more people and thereby find a solution... So** I think as an environmental problem in the SA economy, the thing **that we're going to find is because of this, we will** try and drive efficiencies out of technology, but at the same time, technology is proving more and more and more expensive. I mean just simple things like licensing, be it Google, I mean Google Docs or Microsoft, all that licensing has just got prohibitively more expensive based on it being dollar based today."

Within the context of the local listed real estate market, current and forecast conditions are not conducive to technology adoption, but rather inhibitory:

"I think the whole scenario with SA economy being under pressure, **under-performing and property as such, well in the past it's had a good run, I think we're in for tough times ahead, if you read what everyone is saying out there, it doesn't look like it is going to be the** golden star performer like it has been in previous years. Most of the big REITS have given lower forecasted earning yields going forward for the next year or two, given a couple of factors. I mean the economy, and over supply of space versus the demand take-up for space. I think **if you're earning** rands and paying in dollars, it becomes very pricey for competitors."

Speaking about the local infrastructure and prohibitively high costs of retrofitting buildings with fibre: "...in SA we are way behind the curve in that space".

4.5.5 SA2

Speaking to the people element of technology being either an inhibitor or enabler, SA2 described how the company spent time with users to ensure that the user properly understands and sees the value:

"It doesn't help you implementing a system and nobody knows how to use it or just messes it up even further. So better to be very user-friendly."

With regards to a culture of innovation, SA2 agreed that culture played a large role in determining the extent to which technology is embraced:

"We're a fairly young executive team...So you know, they are pushing technology, they are pushing innovation... everything we do, our core focus is build and develop our shopping centres and give a good quality shopping experience but that said, everything else we do, as long as it makes business sense, we will implement new and uplifting things."

With regards to inhibiting factors, SA2 noted the impact of local **regulations such as the Protection of Personal Information Act ("Popi"):**

"I think everybody and especially the **listed companies we're still** very skittish on the Popi Act. Everybody is waiting for the first legal **test to see if he's going to be burned and where and then we'll** formulate our strategies around that. Which is a pity, because now **everybody's a sitting duck.**"

Speaking further to challenges inhibiting technology in SA and advances in recent years attributable to consumerisation of technology:

"I think our communication was an issue because Telkom was just unreliable. I mean up until about two or three years ago,

communication **very costly. Now it's getting** more affordable and accessible.”

4.6 Analysis

Below are some general comments relating to:

- (1) The extent to which the broad and specific technologies described were leveraged by each respondent;
- (2) The benefits of technology as noted by the respondents; and
- (3) The key enabling and inhibiting factors impacting the adoption of technology, as per the respondents.

4.6.1 Use of Technology

4.6.1.1 Cloud Computing & SaaS

All respondents leveraged SaaS and cloud computing to a lesser or greater extent. **This is not entirely unexpected as both the case's CEO and the literature stressed the significant impact, both present and future, of both technologies on the real estate industry.**

The US and UK respondents demonstrated more experience and use of cloud computing and SaaS across their entire organisations. One respondent noted that 70% of the new solutions it implemented over the past couple years are SaaS, enabled by the cloud. These solutions include both core and non-core areas of operation. The closer a solution was linked to non-core operations, the greater the likelihood of a SaaS model. Furthermore, the international respondents clearly leveraged multiple different best of breed applications to integrate with their core financial package. Increasingly, integration into core financial systems was seen as crucial. Security was still a concern, suggesting that the less sensitive the data, the greater the likelihood of it being moved to the cloud.

Interestingly, one respondent noted that the decision to go cloud or not was more about the features of the solution than its location as they had other technologies in place to provide the ubiquitous experience.

SA respondents by contrast, had fewer disparate applications, favouring an overarching core ERP as opposed to best of breed individual applications. Both respondents have what could be regarded as a hybrid environment. Much of the value in cloud computing was focused on the security of operational information, communications and infrastructure – in other words, core operational areas. Respondents noted the potential cost advantage to cloud, suggesting that more information would be migrated to the cloud in time. One respondent stressed that at present, cloud solutions were not necessarily more cost-effective and that finding local partners was challenging.

4.6.1.2 Big Data & Data Analytics

Big data, as defined, was not directly impacting any of the respondents' organisations at present. These findings are similarly in alignment with **the literature and sentiments of the case's CEO. While big data is** undoubtedly a powerful technology, its present impact on the sector was far less than it would likely become in the future. As buildings and real estate companies increase the volume of data collected, the use of big data analytics is likely to become increasingly prevalent.

The international respondents were all leveraging building information systems and had significantly more data points that required analysis and interpretation, leading to real-time decision-making. Furthermore, they **were leveraging those types of solutions to develop a "single version of the truth". Despite this, it was** not seen to be big data as it is traditionally understood, but rather a watered down version of it. As one US respondent noted - one of the solutions recently implemented were **applying big data technology and gave the business "incredible performance gains"**. Another US respondent commented that at present, their analysis was more about looking in the past. In the future, big data would have a much bigger role in predicting future trends.

The SA respondents were noticeably behind in this regard, citing scale and cost as some of the key challenges faced. In terms of data being collected and analysed, SA respondents were found to have far fewer data points and even then, it was established that such data was not used for decision-making.

In general, the international respondents were clearly on a trajectory leading them towards big data and predictive analytics, far more so than the SA respondents.

4.6.1.3 Mobile

All participants were found to leverage mobile technologies, to a lesser or greater extent. **The case's CEO stressed that in his view, mobile was the most prominent and influential of technologies impacting the industry.** The literature, similarly, stressed how mobile had a transformative quality. It was however evident that US and UK respondents had employed and embraced mobile to a greater extent than the SA respondents. This is likely to be the product of vastly different operating environments.

The US and UK respondents tended to regard it as vital to their IT strategy going forward, from both a B2B and B2C perspective. From improved customer service to facilitating real-time decision-making, mobile was described as a **"game-changer" by one of the US respondents.** One respondent noted that they were not responding to any development that did not facilitate mobile. In that sense, mobile was viewed as a non-negotiable, critical technology that allowed the international respondents to remain competitive.

SA respondents also leveraged mobile, largely for internal applications, allowing their staff to remain productive and efficient in their operations and communications. Their enthusiasm for the technology was however noticeable less than the international respondents. One SA respondent noted that despite having retail mobile applications, their experience

found that face-to-face engagements offered a better return on investment.

As a general comment, unlike the SA respondents, the international respondents saw mobile as crucial to their operations in order for them to remain competitive.

4.6.1.4 AI & Robotics

The international respondents acknowledged that AI and robotics had already impacted the industry in some areas, with one correctly highlighting the fact that it would be vital in the evolution of predictive analytics in the future. By contrast, the SA respondents had neither practical experience with the technology nor had they seen its impact across the industry. The literature highlighted how in developed countries, the technology was still in an experimental phase. It is therefore not surprising that SA respondents did not yet see the benefits of the technology within the real estate sector.

4.6.1.5 3D Printing

Two of the international respondents noted the value of 3D printing and how it may have even a greater impact on the industry in the future. One respondent currently used the technology for creating 3D models, describing it as a potential “game-changer” in the future (to the extent that entire homes could be printed). Another had also experienced the technology first hand and witnessed the impact in the medical industry. By contrast, none of the SA respondents either commented on 3D printing or described any experience or potential impact it had or could have on the industry. Similar to AI and robotics, 3D printing is in its infancy and is still to be refined in developed countries. It should therefore be expected that SA respondents have less insight and experience with the technology.

4.6.1.6 IoT

US respondents described their experience with the IoT and saw tremendous value in the technology, particularly from an energy management and security point of view. In fact, they saw the technology as increasing in momentum and today, is part of any new real estate development. UK mentioned that its clients were speaking to them about it, but that that they did not implement IoT solutions, instead they aimed to be a data aggregator once such solutions were in place. By contrast, SA respondents did not leverage any IoT devices at present, however one described the possibility in the near future. Given the scale and proliferation of data being collected in developed countries (relative to developing countries such as SA), these findings make sense.

4.6.1.7 Drones

All international respondents, as well as one SA, noted the impact of drones on the industry. This was particularly relevant for the purposes of marketing real estate and less so for other uses, such as aerial inspections. Together with the literature, this finding makes sense, particularly if one considers that drones have become increasingly accessible and affordable around the world.

4.6.1.8 Wearable Technology

While none of the US or SA respondents spoke of the extent to which they leveraged wearable technologies, the UK respondent spoke very positively about its impact. Focusing on its application for facilities and surveying staff, the technology was found to be most useful in keeping the personnel safe. The literature highlighted many potential uses of wearable technology, but it was evident that few organisations have widely **embraced the technology. This sentiment is reflected in the respondents' present and imminent use of wearables.**

4.6.1.9 Driverless Cars

None of the respondents presently or imminently leveraged driverless car technology. In terms of the impact on the industry, none described its present impact, while US **respondent noted that it wasn't clear what the impact would be on urban economics and the industry.** The literature is clear that the impact of driverless cars is likely to be experienced in the near future, with its current impact being extremely limited. The **respondent's** sentiments reflect this reality.

4.6.1.10 Omni-Channel Retailing

Those respondents whose business focused outside of retail were found not to leverage the technology. One US respondent stressed how it was a priority in their business but highlighted the associated challenges and how there was still plenty of room for its impact to grow. The SA respondent with experience in the technology utilised it to a lesser extent (from a hardware and IoT perspective) and spoke of concerns of privacy and compliance with privacy legislation. Both of these respondents saw omni-channel retailing as an important element in the modern consumer shopping experience. Given the prevalence of broadband internet, consumer culture and smartphone adoption in the US, it is not entirely surprising that the US respondent operating in the retail market demonstrated greater enthusiasm, experience and knowledge of the technology than the SA counterpart.

4.6.1.11 AR & VR Technology

Both US respondents did not actively leverage the technology. One SA respondent described their experience with AR or VR technology, focusing on the showcasing of green technology using 3D models. The UK respondent utilised the technologies extensively, specifically for conducting virtual walkthroughs of a property, as well as assisting in the reproduction of 3D models. The literature suggests that this technology is widely used in developed countries around the world. Unlike in the US and

UK, based on the SA interviewees' responses, it would appear as if AR and VR technology has not yet reached a point where it has become mainstream and widely adopted.

4.6.2 Benefits of Technology

Although not specifically discussed, almost all of the benefits of technology listed below were either expressly or implicitly referred to in Chapter 2: Literature Review. Below is a summary of the key benefits of technology as described in the literature and by each of the respondents:

- (1) Compliance with financial and other statutory obligations relevant to public companies;
- (2) Real-time and data-driven decisions;
- (3) Transparency;
- (4) Operational efficiencies, reduced costs and increased revenue;
- (5) Automation of manual processes, improving efficiencies (reduce double data-entry, reliance on paper processes etc.);
- (6) Real-time availability of key operational data, accessible remotely;
- (7) A competitive advantage in the short-term (until competitors implement);
- (8) Improved understanding and insight into the business;
- (9) Improved staff morale as staff focus less on pushing paper and more on adding value;
- (10) Direct cost savings (i.e. cloud technologies meaning less server space required);
- (11) Promotion of employee well-being and safety, in the context of wearable technology;
- (12) Being capable of attracting and retaining quality tenants;
- (13) Protection of operational data (in the case of the cloud); and
- (14) Better understanding of tenants and consumers in the case of retail.

4.6.3 Enabling & Inhibiting Factors Impacting Technology

Adoption

Based on the feedback from the respondents, below is a non-exhaustive list of the key enabling and inhibiting factors that are said to impact the adoption of technology.

The enabling factors include:

- (1) Consumerisation of technology– technology is more prevalent and people are more comfortable with it than ever before;
- (2) Consumerisation of UI– meaning that people intuitively understand how to navigate an application, leading to higher rates of adoption within an organisation;
- (3) **On the back of consumerisation of technology, tenants’ and consumers’ expectations** of real estate companies are increasing – they want real-time, instant service and seamless experiences such as unlocking an office with a smartphone;
- (4) A fast paced and growing economy with low unemployment and a large base of skilled individuals has a greater incentive to automate and speed up manual processes;
- (5) Companies with prime assets and tenants have a greater push to leverage technology to remain competitive and to attract and retain the best tenants;
- (6) An organisational culture where leadership recognise the value of technology and give IT personnel the freedom to experiment and innovate, based on a drive to remain relevant and to retain a sustainable competitive advantage in the market;
- (7) Robust, affordable and reliable infrastructure;
- (8) A positive attitude towards change and strong leadership who embrace change and facilitate change management;
- (9) A thriving competitive capitalist spirit; and
- (10) Scale to take advantage of economies of scale when rolling out a technology.

The inhibiting factors include:

- (1) **People's resistance to change, a culture of fear towards change** and poor change management processes in place. In real estate the fear was that technology would remove the face-to-face nature of the business;
- (2) Weak, unreliable and expensive infrastructure;
- (3) A culture focused on deals and not technology - the real estate industry has traditionally been deal-focused and run by those with a financial background – meaning they often are keen to invest more in assets than technology;
- (4) Distrust of technology and concerns around privacy and security of personal information;
- (5) A stagnant or declining economy with high levels of unskilled labour and unemployment, coupled with a real estate industry with a bleak outlook, creates conditions where there is less incentive to automate technology since resources are cheap and policy frameworks encourage and incentivise employment;
- (6) A country with significant political and economic uncertainty dampens the enthusiasm of companies investing in technology;
- (7) Lack of scale – whether due to the size of the market in general or the company concerned;
- (8) Currency weakness and volatility – many technologies at some points are imported and priced in dollars, creating costs that are unpredictable and often prohibitively expensive;
- (9) Prohibitively expensive costs of retrofitting or iteratively implementing technology;
- (10) Policy frameworks that incentivise employment rather than automation; and
- (11) Legislation relating to privacy and data storage with harsh penalties.

4.7 Concluding Remarks

Chapter 4 sought to outline the key findings extracted from the data collected in semi-structured interviews with real estate companies. Having established the extent to which each of the respondents leverage specific and broad technologies outlined, it was necessary to address the **secondary research questions relating to the respondents' stated benefits** of technology, as well as the inhibiting and enabling factors impacting adoption. Chapter 5 attempts to outline conclusions based on the findings in Chapter 4. Furthermore, it shall also seek to identify areas warranting future research in the area.

Chapter 5: Conclusions & Recommendations

5.1 Introduction

In this chapter, the findings of the research are presented and it is submitted that the:

- (1) Research problem is validated;
- (2) Research questions are addressed; and
- (3) Research aims and objectives have been attained.

Finally, based on the research findings, conclusions are drawn and areas warranting future research are highlighted. For the sake of clarity, the problem, question, aim and objective and methodology is briefly set out below.

5.2 Research Problem

There is no cohesive, comprehensive and current account about the nature and extent of technology adoption within the real estate industry, the inhibiting and enabling factors impacting technology adoption and finally, the benefits of leveraging technology to achieve best value.

5.3 Research Question

For the purposes of this study, there is a primary question, as well as three secondary questions.

The primary question is:

“Do real estate companies leverage technology to achieve best value?”

The secondary questions that follow are:

- (1) **“What are the key benefits of technology experienced by real estate companies?”**
- (2) **“What are the key inhibiting factors behind technology adoption in the real estate industry?”**

- (3) "What are the key enabling factors behind technology adoption in the real estate industry?"

5.4 Research Aim

The purpose or aim of this research is:

- (1) To determine the nature and extent of current and imminent real estate technology solutions employed in the market;
- (2) To analyse the benefits of technology solutions in the real estate market; and
- (3) To establish the key enabling and inhibiting factors impacting technology adoption within the real estate sector.

5.5 Research Objectives

The research objectives are:

- (1) To establish a comprehensive descriptive account of all major current or imminent technologies employed or being tracked by leaders within the global real estate market;
- (2) To establish the nature and extent of technology use within industry leaders in the real estate market;
- (3) To establish the key benefits of leveraging technology in the real estate industry;
- (4) To establish which factors inhibit technology adoption and which promote adoption; and
- (5) To distribute the key findings of this research to large, medium and small real estate organisations to promote awareness of the potential benefits.

5.6 Research Methodology

Based on prevailing literature themes, a single case was selected and key issues were canvassed with **five of the case's clients'**, specifically senior IT leaders, in the format of a semi-structured interview.

5.7 Findings of the Research

5.7.1 "Do Real Estate Companies Leverage Technology to Achieve Best Value?"

The nature of the question and the wide range of technologies considered suggests that in making an assessment with regards to the primary research question, a pragmatic approach is most suitable. Rather than assessing specific and broad technologies one by one, it is preferable to consider the **respondents' use of technology on a holistic basis**. Although not specifically a research objective or required by the research question, in an attempt to highlight geographical differences, the respective use of technology of US and UK respondents is considered separately to those in SA.

Speaking to the broad technologies, the interviews revealed that SA real estate companies leverage the majority of broad technologies in the market, namely cloud computing and mobile. However, of those technologies presently leveraged, the nature and extent of both use and reliance on the technologies was found to be materially less than the international respondents. International respondents demonstrated extensive knowledge and experience with the technologies and in many cases, regarded them as business critical. By contrast, the SA respondents had less experience with the technologies, did not have them active across all areas of operation and generally, did not appear to view **them as "non-negotiable" to doing business**.

In implementing technology, it is evident that an iterative approach is often used – gradually introducing and scaling within the business – it is fundamentally a process. The international respondents, although not necessarily amounting to big data as defined, were found to be significantly further along the continuum in the use of big data and big data analytics. They were found to have substantially more data points within their operations used for ongoing analysis, interpretation and

discovery. By contrast, the SA respondents appeared to have far fewer data points, suggesting that they were materially behind the international respondents in this regard.

With regards to the specific technologies, the international respondents demonstrated a far greater degree of implementation, knowledge of the **area and its impact on the industry, as well as being significantly “further down the track” than the SA respondents.** In many cases, the SA respondents had little to no experience of the technology or knowledge on its potential impact on the industry – this includes technologies such as 3D printing, AI and robotics, wearable technology and AR/VR. Surprisingly, even the more accessible of these technologies, the IoT, was found to have little influence in the SA respondents’ **business. By** contrast, the international respondents viewed the IoT as critical to operations and intrinsically part of how they conduct business. In terms of omni-channel retailing, it would appear as if SA companies are on the right trajectory, but otherwise still materially behind the technology employed by the international respondents. Interesting, SA respondents were found to be at a similar level to the international respondents in terms of drone-usage.

For the reasons outlined above, the conclusion can be drawn that while real estate companies leverage technology to achieve best value, the nature and extent of the best value achieved tends to vary across organisations and geographical regions. Having said that, no real estate company is likely to be in a position where best value is entirely optimised – it is ultimately a question of degree. As a general comment, SA **real estate companies’ use of technology appears to be significantly less than** the international real estate companies. SA real estate companies also appear to have far less experience and/or knowledge of the key trends that are evident in more developed international markets. Due to a substantially reduced reliance and use of technology, coupled with a lack of knowledge and/or experience of international technology trends

impacting the industry, SA real estate companies, relative to their international counterparts, appear to achieve best value to a lesser extent.

5.7.2 What are the Key Benefits of Technology Experienced by Real Estate Companies?

Based on the feedback from the respondents and the benefits outlined in the literature, it is evident that technology has the ability to positively impact the real estate market in numerous different ways, depending in part on the nature of the technology concerned.

In terms of the major benefits of technology, the literature is consistent with the feedback from the respondents – technology is an enabler that allows the real estate industry to become more streamlined, efficient, transparent, competitive and relevant in an ever-changing environment. The two most significant broad benefits with the biggest impact are operational efficiencies and remote accessibility of key real-time data.

5.7.3 What are the Enabling Factors Behind Technology Adoption in the Real Estate Industry?

Implicit in the literature and the interviewees' express responses, the key enabling factors, amongst others, are the consumerisation of technology, scale, tech-focused leadership, robust, affordable infrastructure and an enabling economic, political and legislative environment.

5.7.4 What are the Key Inhibiting Factors Behind Technology Adoption in the Real Estate Industry?

By contrast, the key inhibiting factors include change resistance, weak infrastructure, a stagnant or declining economy with high levels of unskilled labour and unemployment, lack of scale and generally, a lack of affordability.

5.8 Future Research & Possibilities

The scope of this research was limited and serves to identify a number of key questions warranting research and investigation into the future.

These include:

- (1) **What are the leading causes behind SA real estate's** apparent laggard status?
- (2) What is the impact of the macroeconomy and performance of local listed real estate on rates of technology adoption within local listed real estate companies?
- (3) Does scale have a material impact on technology adoption in developing countries?
- (4) What is the relationship between the real estate technology venture capital industry in the US and the rate of technology adoption?
- (5) Does currency volatility in developing countries have a negative impact on technology adoption (assuming most technologies originate in the US or Europe)?
- (6) Is there a direct correlation between availability and affordability of high-speed internet, and rates of technology adoption?
- (7) To what extent do consumers drive innovation within real estate companies (by demanding it)?
- (8) What is fuelling the so-called real estate technology bubble in the US and is there likely to be a similar situation in developing countries in the future?
- (9) How does one reconcile a global economy under pressure and accelerated venture capital investment in the real estate technology sector?
- (10) Assuming costs are not an issue, are there any material reasons why international best of breed SaaS international solutions are not suitable to the local real estate market?

- (11) What is the size, in numbers, of the local SA real estate market, in terms of companies and potential users of software within such companies?
- (12) To what extent does the labour market and underlying regulatory framework impact technology adoption?

Arguably, one of the key reasons for real estate companies in the US being at the forefront of real estate technology is the existence of a common association. Developing countries such as SA may well benefit from establishing a local real estate technology association or forum in which learnings and innovative ideas are shared and discussed. Within such a forum, it is likely that one will begin to not only identify, but also address some of the key challenges that are limiting real estate companies' **ability** to achieve best value through the implementation of technology.

5.9 Concluding Remarks

Speaking about the impact of technology on business, the CIO of one of the largest office REITS in the US recently provided an insightful assessment of the industry:

"The business world is in transition as the technological revolution changes the way we design, construct, operate, transact and use real estate space. Fuelled by increased mobile device capabilities, consumer-driven technology, social media, data analytics, the cloud and the internet of things – all tools for automation, innovation and **change...With technology no longer the inhibitor, what is now** needed is organizational realignment at the personnel, departmental and organizational level. Technology, automation and innovation are poised to change every business process in the industry and the question is: How fast can an organization embrace new ideas?"

(The Real Comm Conference Group LLC, 2015: 11).

While these comments speak largely to an American context, the sentiments are significant and relevant to global real estate markets. Looking forward, real estate companies in developing countries would do well to learn from the experiences in developed markets and adapt their **strategies to “future-proof” their business and ensure relevance and sustainable competitiveness into the future.**

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Appendix A – Sample Consent Form



CONSENT FORM

UNIVERSITY OF CAPE TOWN CONSENT TO PARTICIPATE IN A RESEARCH

Research Topic: Real Estate Technology

Dear potential participant:

You are being invited to participate in a research study conducted by Dale Warburton, an MSc student at the University of Cape Town. The research is supervised by Associate Professor Kathy Mitchell of the University of Cape Town and the results of the study will be presented to the Department of Construction Economics and Management in fulfillment of the requirements for the degree of Masters of Property Studies.

If you have any question or concern about the research, please feel free to contact me, Solomon Sertse, anytime at +27 713551402 or dalewarburton@gmail.com. The research supervisor, Associate Professor Kathy Mitchell, may also be contacted at Kathy.Mitchell@uct.ac.za.

Purpose of the study

The purpose or aim of this research is:

- (1) To determine the nature and extent of current and imminent real estate technology solutions employed in the market;
- (2) To analyse the benefits of technology solutions in the real estate market; and
- (3) To establish the key enabling and inhibiting factors impacting technology adoption within the real estate sector.

Procedures

Your participation in this study is voluntary. If you volunteer to participate in the study, I request that you sign this form as a declaration of your consent, and complete the self-reported questionnaire that I will email you in a link, the contents of which are self-explanatory. Should you require any additional clarification, I am happy to answer any questions you may have.

Potential benefits to participants



At your request, the research findings will be shared to you. It is hoped that through this research, real estate companies will gain a better understanding of how technology can be leveraged to achieve best value, at present and in the future.

Confidentiality

Every effort will be made to ensure that subjects are anonymous and safeguard any proprietary information. Confidentiality of any information is maintained. The information gathered through the interview process will be used solely for this research purpose. The raw data of the questionnaires will only be revealed to personnel directly related to the supervision and marking of this dissertation. Furthermore, none of the information will be disclosed for any other commercial purpose, including disclosure to the participants' competitors in the industry.

Participation and Withdrawal

You may choose to withdraw from this study at any time of your wish. You may also refuse to answer any question that you do not want to answer.

Rights of research participants

You may withdraw your consent at any time and discontinue participation without any penalty. This study has been reviewed and received ethics clearance through the University of Cape Town Research Ethics Board.

Signature of Research Participant/ Legal Representative

I have read the information above and had any questions answered to my satisfaction. I therefore give my fully informed consent and agreement to participate in this study. I have been given a copy of this form.

Name of Participant (please print)

Company of Participant

Signature of Participant

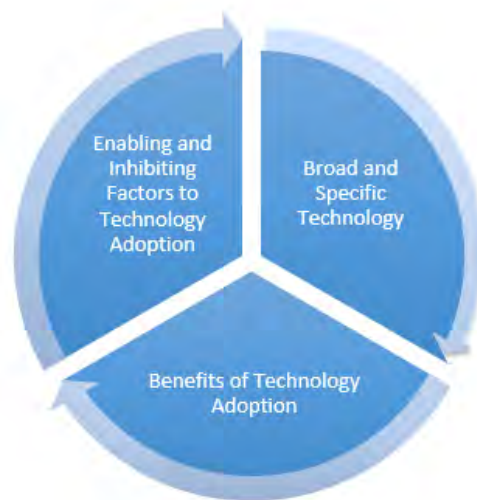
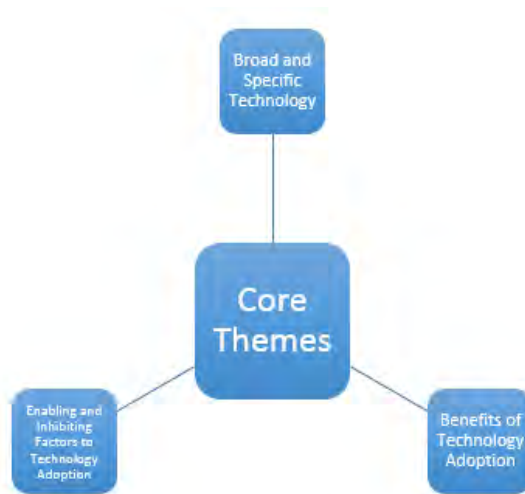
Appendix B – Aide Memoire

Aide Memoir for Semi-Structured Interview

- 1) Thank participants.
- 2) Discuss key research questions, objectives and aims
- 3) Discuss format of interview, 5 broad themes to cover
- 4) **Theme 1** – broad technologies – Mobile, SaaS, Cloud and Big Data/Data Analytics – what impact on the business?
- 5) **Theme 2** – specific technologies - omni-channel retailing, the internet of things, drones, wearable tech, driverless cars, 3D printing augmented reality and virtual reality, AI and robotics.
- 6) **Theme 3** – what are the benefits of implementing technology in the business?
- 7) **Theme 4** – what are the key inhibiting or enabler factors impacting technology adoption in the real estate industry?

Consider specific impact of: culture, broadband, change management, type of economy
- 8) **Theme 5** – (time permitting) – what is the view in relation to over-investment in the real estate technology sector in the US and none in SA?
- 9) Discuss next steps

Appendix C – Emergent Themes



Appendix D - Sample Transcript

DW: Great. Thank you very much (name) for agreeing to assist us here. I think I mentioned the context to you recently but let me just quickly give you an overview. Essentially, what am looking to achieve is I want to first establish to what extent do South African listed companies leverage technology to get best value and by technology I mean more specifically software. And by best value I mean financial and non-financial considerations. And sort of related to that question is saying what are some of the inhibiting and enabling factors that have led to the position that South Africa is in, whatever that might be. Sort of at par with the US and UK. Or maybe significantly behind. So the reason why am interviewing some of the overseas companies is to get the sense of what I regard with the industry leaders around the globe are doing. So let me dive straight to it. So there is sort of five main themes and you can go into as much or as little details as you like and I might interrupt every now and then just to ask for clarification and ask specific questions so. The first one really is about, I picked up that there are a number of sort of broad things that impact technology and in our space we are talking about mobile, big data and data analytics, cloud computing and SaaS solutions. So could you chat me a little bit about the extent to which you leverage these technologies at present? How influential they are and what kind of value they add and where in the business have you seen the most value for these kinds of technologies.

US2: I am going to use past and present experiences. Am somewhat new here I can talk to mall businesses. Lets start with the mobility side. And the mobility side is really relevant from two areas. From B2B, from employee usage, you have three areas and from B2C especially in the mall space. From B2B its more of leveraging mobile tools

for leasing and this is the same on the employee side the broker side is creating tools for our leasing folks, pushing marketing campaigns and things like that on the B2B side using mobility. When I say mobility that also means your sort of web development tools. So websites, they could be on any platform whether iPhone, iPad, or browser. So am going to clump into mobility. So I think it's transformative especially on the deal making side. I mean to have the power of your whole portfolio and all the information you need about it right on your iPad or your iPhone. So that when you are meeting with tenants or prospects you have that 360 view of them. You know all of their current leases, you know all of the prospect's information and you know their market demographics. So I think that somewhat becomes a game changer and we are working towards this single view. I think we all have pieces of it. My peers all have pieces and they are somewhat disparate and now its consolidating that into a potentially a single application. On the mall side, there is the push on B2B on how do you engage the consumer with your mall app. The problem is that there is a competing issue with the actual tenants. Many of the mall tenants have their own app. So there isn't a clear vision of how everyone is going to work together because now you have the technology to know when somebody has entered the mall either through your WiFi or through beacon technology and you want to be able to engage with them in a relevant way. You don't want to have someone who is bald come in and and you send him a coupon for a haircut. So you want to be able to like identify who this person is, what their shopping habits are. Just like Amazon is able when you are on the web, knows where you shopped before, you get the relevant popups. We want that same brick and mortar experience but nobody at this point is sharing the data to be able to do anything like that.

DW: Okay

US2: You can push coupons to, there is a couple of vendors out there. ya they have the app on the phone, you can push the beacon message, the coupon or whatever. But it's still not quite relevant yet. Its just hey this person, we might have seen the person before through the app but we don't really know who they are yet.

DW: Okay

US2: Or where they shop. So until there is this global database of who this person is or where they shop and their transactions, you are not gonna have that from a mall experience. From a tenant experience I think they are starting to get the hang of it. And because they have better loyalty programs, I think they are going to get there faster. So if you are going to Target with your mobile phone or you have the Target app, then you are signed in it will know who you are, what you have bought in the past and it can push you relevant content.

DW: Exactly.

US2: I still have not seen it yet in retail. But we see it at trade fairs or trade shows but have not seen it in practice yet.

DW: Okay.

US2: The only place that I could really see it in practice is more in stadiums where you are seating in cheap seat and there are seats in the front area available and they send you a message to say that for \$10 you can purchase a better seat or for ordering food, you can have food delivered to your actual seat. So I've seen the beacon technology. So the beacon technology and the mobile technology are actually doing better in the stadium than they are in shopping at this point. I think we will get there.

DW: And I think a lot of the things have read (name) also centres on privacy too so there is a lot of privacy concerns and you know there is a sort of growing distrust of this body of information that has been collected of you and so it really, security and privacy are matters of concern for consumers but that might also be an additional challenge.

US2: Yeah, and its really funny being in IT. We were looking for ...there are plenty of tools to do social media mining that we were looking at and we purchased one of these tools in my prior life. and when we were looking at these stores we could find a Facebook account and you could click on it and you could link them to all forms of social media...it would troll and find their Linkedin account, .twitter account, whatever that is posted. Anyway so my team and I, we are not very big. Nobody wanted to work on that project with me. Nobody wanted to deal with social media. And the guys and girls in IT are not really into social media. And my own thesis was because these either 1) they are introverts and it's just not entertaining to them and it's not what they want to be doing in their free time. Or 2) they know the ramifications of sharing to your privacy.

DW: There we go.

US2: And I think that really was the case that for my generation and above they know the privacy implications and they don't want to share so they stay away from it and when they saw these demos, their heads spun around. And for the younger guys who were introverted, they just had no interest in being on social media.

DW: Absolutely, ya. I think that makes sense.

US2: Then the marketing folks, they don't care. They feel well if I share I will get something in return. So I think people will share that information in the end if they get

something out of it. So if they get something like a coupon for something that they want and its now 20 % off. The extroverted people will be more willing to share.

DW: I think that is probably a fair assessment. So with you mentioned ibeacons and those kinds of things, I think taking it further to other kinds of sensors around buildings, what experience have you had with big data and analytics around it, particularly with the internet of things and that kind of stuff?

US2: Yes so, we have not really, the only data that was the wifi analytics, the beacon analytics, credit card data and building automation systems data. So we haven't really hit the level of big data and I'm gonna move into cloud. There are a lot of cloud solutions at this point. They can aggregate those data sources and provide the reporting and analytics to handle those specifics that we have not purchased any in house solutions for big data. And because again we are not so big on the consumer side yet.

DW: Yip

US2: I think we are a little ways out on big data. Not to say that we don't have analytics needs. So one of the things we are looking at next year is that in driving our business are there more analytics about our portfolios, our peer portfolios, and our tenants and demographics that we should aggregate and should be reporting to start to find trends that aren't obvious. So we are looking to potentially bring someone on to help in that role.

DW: Okay.

US2: Now it is still millions and millions of records, probably not. But the types of analytics may fall more into the big data because you are looking more at predicting

trends than looking in the past. Today we are really analyzing what happened and forecasting out but we are not looking for things we don't already know about.

DW: That makes sense.

US2: We are validating assumptions today instead of coming up with new ideas.

DW: Okay, interesting. And then of course, it's not just from a (company) perspective. But I guess in your experience with (company), to what extent did you use SaaS solutions, how much content did you have hosted locally versus in the cloud?

US2: So both (company) and (company) use solutions especially for the things that are non-core. That is how it started like HR payroll. When I was at (company).we had a home grown system and we were going through a merger and we knew that the system will not be able to support the new employee population. So we went with a SaaS solution. Same here we have SaaS solution. Ah we basically will evaluate either or just to find the right fit. Again if this is a non-core application and more generic I am more opt to go with the SaaS solution but more and more things going into the cloud like CRM, our construction management systems is now a cloud based solution. So it's really what the feature functions not so much about where it is located whether its cloud or in house.

DW: Okay.

US2: We still run two data centers here. We host our equipment using a big name data center in two locations. And at (company) they self-host. They have a data center in Philly and another on in one of the properties. But they too have several cloud solutions. Not all but some of the same ones. But like I said we have got cloud hosting for our email and (COMPANY) is just looking into that now. So it's a mix and I think we will probably see more cloud solutions in the future.

DW: Sure. That seems to be the general trend. I think, I mean perhaps if am reading between the lines what you are kind of saying is you don't necessarily, the decision whether or not to go cloud or local really depends on the actual product itself and I would also imagine the kind of users you are going to have. So your construction team, they will basically want information on the fly. So they would need it in the cloud. Versus maybe HR maybe it's not that critical. So does that potentially play a role too?

US2: Yes well. At this point everything is accessible whether its.. or cloud...it does not really matter, everything is acceptable from anywhere. It does not really matter if it's a cloud provider or us providing it. We still have that ah ubiquitous experience. I think when you started to say what is the best solution for that business problem that we are trying to solve or that initiative, we really just wanna hone in on what is going to be best experience for our users that we can integrate with whatever else we have. We do have a lot of cloud solutions but we have also integrated them into our core financial package or imaging system. For example we outsource both at (COMPANY) and here. Accounts payable. All the accounts payables go to a lockbox... that gets scanned by a third party or uploaded, it get coded. Its gets to routed to the right person hopefully for approval. Those images and those transactions are sent back to our document management systems and JD Edwards ERP systems. So that anyone working in JD Edwards can see those transactions and they can actually post them for payment through JD Edwards. And to look at the images so that whatever system you use, you still have access to that information. But you don't have to go into that post AP system to see it, its in the system that you use.

DW: okay alright, that makes sense.

US2: that is important and even now, construction management systems we bring back, that gets paid through JD Edwards and then we bring back all the invoices into JD Edwards. So the folks working in JD Edwards have visibility into the same information. And we are going to be integrating that, we are going to be implementing the CRM system so we will be integrating the construction management piece and the scheduling piece right into the CRM so the deal folks they can see the statuses of their tenant improvement and where the deal is. So that the important thing is enter the data (1) and use it in multiple times and in multiple places.

DW: Absolutely.

US2: Whether cloud or self-hosted.

DW: Okay, that is a great point ya. Ok cool I think am going to move on to the next sort of segment and I know your experience has been largely focused on retail. Am just going to name some couple of specific technology that I have come across or that have covered or that are at least present in the literature. And perhaps just spend 2 to 3 minutes chatting about the ones that you think are most relevant, you know if any and we can move on. Let me go to the list that I have got here. So the first is on omni-channel retailing, the internet of things, drone, wearable tech, driverless cars, 3D printing, augmented reality and virtual reality, and then AI and robotics. I guess to what extent do you use these technologies or think that they have got value?

US2: Okay lets start with what was the first one? Omni-channel retailing. For us obviously that's a big deal. Again we want folks to have that same experience from a mall perspective, our tenants are all trying to figure that out at this point because there is some statistics that am probably going to get wrong. Many transactions might start online but end up in malls. Something like 83 % of all retail ends up in stores in brick

and mortar. Whether deliberate from there or someone came in and picked it up from there, even though folks might be starting out on the web, a lot of time they are just doing the research but they are going in to get it.

DW: That is exactly what have read about.

US2: I might have gotten the statistics wrong but so omni channel is really important. And those analytics around it. But I think we have touched some of that in the B2C stuff. The next was internet of things. This is really prevalent in the the building automation system, you know you have all these lighting control, HVAC, all feeding now into a data depository and you are going along with it and you are honing in on your usage, your consumption. So I think the internet of things....and being able to control them. So I can see all the lighting in the parking lot and control them in the parking lot and I can turn out section A.. section B. So putting policies in place to conserve energy.

DW: Ya.

US2: So that is the big way that anyone who owns any kind of building, whether its office or mall or shopping center ...

DW: And drones

US2: And I think

DW: Drones

US2: Oh drones. Two years ago I got laughed at when I said I want to get a drone for two reasons. I wanted to start flying it to do inspections over our properties and two, we were on multiple floors so I said hey would it be nice if we could fly drone with a battery to the next floor and I got laughed at. And then six months later Amazon came

out said oh we want to deliver packages via drones. They didn't think I was so funny anymore. And then they hired someone to fly drones over the property to do aerial shoots for marketing material. Drones were already being used in our industry for those types of things. For taking a look at the roof, taking aerial photos for marketing. We don't own one yet but I keep working on it.

DW: Okay.

US2: Ah robotics, that's another one where I said hey, wouldn't it be nice if we could stick a robot at the help desk (laughing). That didn't go over well either. But I think you have seen robots now during greetings at big box stores and helping folks find the location for a product. I think that robotics will definitely invade our space. 3D printing. Again, I had a guy in my group who had a 3d printer and we broke a part that we actually needed for an actual printer and he printed one for us and it worked.

DW: Wow

US2: So I definitely see 3D printing being used for a whole lot of different things. He also brought a lot of gadgets for us to try so. It definitely has its uses. I think if folks who wanna make guns with it are idiots, because they are going to end up blowing themselves up but hey.

DW: Did you hear about the Chinese firm that they claim to have built a house with all the furnishings inside, like all done within 24 hours. They built like a proper full story home.

US2: That I find hard to believe because with 3D printing, even the high-end ones are pretty slow. It must be a teeny house. Or they have hundreds of printers going at the same side. Even industrial ones are relatively slow. Look, they showed a kid the other night who they printed an artificial movable hand, but it's too expensive to have one

made cos he will outgrow it, but here you can have multiple colours, multiple styles, they can design it themselves and keep...as it grows so I think 3D printing is here to stay and I think it will be used a lot in medical technologies and not sure how it's going to be used in the retail world but there will be a store that pops up to print whatever you want.

DW: Okay, I can imagine. And then on the marketing side have you guys embraced any of the AR and VR technologies like in immersive marketing and all that?

US2: not really. Right now at (company)we are more B2B not B2C. (COMPANY) did a little more of it but even then it was really more traditional, more around the Google analytics, the social media mining than anything else. No real artificial intelligence. I mean the closest thing was the magic mirror that we had looked at. You will stand in the mirror, it sizes you up and then put what you want and it tells you all the stores that has it.....

DW: yap have seen that.

US2: that did not go too well. There is actually one of our peers who put one in and they had one of the news anchors go try it out on air. She wanted a pair of jeans and it came up empty handed.

DW: it's a terrible demo. Okay. I think (name) I am happy with that sort of little detail on the specifics, I guess that in general these things are happening in the industry, perhaps not (COMPANY) and (company)specifically but to a lesser or greater extent, pretty much all the players are playing some of the most if not all these technologies to a lesser or greater extent.

US2: Ya I think that like the artificial intelligence in health care, which is where I came from. You are seeing it. That was what (indescript) was designed for and I think it sort

of marries with big data and I think that in big data we try to get to the point of analytics where we are being predictive and finding trends but it's not just there, we are not there at all.

DW: Sure.

US2: But it's something that as the technology capability increase and the cost decreases, we will evaluate.

DW: Absolutely.

US2: Right now it's not on the cards for next year.

DW: Okay

US2: It's a more manual approach to get someone that is smart to look at all the data and see if they can find anything.

DW: Okay, that makes sense.

US2: It's the manual (indescript).

DW: so I think that is like theme one and two covered in the sense that it's the broad and specifics. I guess that you have mentioned several throughout one and two but perhaps if you have not mentioned any other benefits. This question is about well, to the extent that you have implemented tech, what are the benefits to the organization? You know you have mentioned greater insights, into your operations and that kind of stuff but perhapsspend a couple of minutes, just chat to me about what the benefits are to an organization in general.

US2: I think it depends on what you are implementing, some of the technologies when you implement them, if you are an early adopter, it does give you short term

competitive advantage because you may have insights into the operations before others do. It quickly evaporates because again we are not big enough really to be the front runner in the technologies and in our industry. In the real estate industry, technology is not considered competitive advantage, relationships are, so there is a sharing amongst peers as well as because we are small we kind of have to band together to get momentum to get products that we need for our verticals. So nothing stays secret for very long or the results are bragged about it gets out to the world pretty quickly. But from an efficiency perspective or even for the relationship, I know a lot about tenants and maybe have insight that I can share with them that helps the relationship. So I have analytics, you perform best when your store is located near these other stores. That's good insight for this tenant.

DW: Totally.

US2: And that fosters a better relationship. Some of the other initiatives that we have implemented have really being around efficiency, processing transactions faster, which impacts the financials. Because the faster you can get people move in, the faster is that you can get money in that improves your financials. Also if we can streamline processes, we can have folks working on more analytics and more value add than just pushing paper.

DW: Absolutely.

US2: It's also good for employee morale and development to enhance the processes and again so folks become more challenged to do more productive things. Not the menial task that we can automate.

DW: Absolutely. I have been to quite a few companies where there has also been a big change there. The automation of manual processes. That is sort of seen as the

starting blocks when it comes to implementing technology in quite a few of these real estate companies trying to take some of the manual processes out and what nobody has mentioned thus far, I think it's a great insight is the employee morale. It makes a big difference to people when you doing more than just pushing paper and adding value. Yes I think it's a great point.

US2: Well also you consolidate and you automate and so folks don't relying on on Excel so you have better accuracy, better transparency and you are also reducing your cost. Because there are some staff that can now be put into more analytical positions. And not paper pushers.

DW: Cool and then I think that the last kind of major theme is, it really talks to the enablers and inhibitors of tech. I guess the question is really what do you see as the key enablers or inhibitors behind the implementation of tech within the real estate industry?

US2: People, people

DW: Are enablers and inhibitors.

US2: Yeah it's a change management process. And the technology itself, there could be some roadblocks. A lot of these things out there are tools. Then you have to take these tools and build something out of them, that works for your business, they are very flexible, customizable which is a double edge sword.

DW: Yap

US2: But I think the biggest challenge is always the change management process of making sure that everyone is on board, everyone understands the requirements, the scope, the effort and these is going to..., I have never. Very infrequently. I should not

have said never. Technology implementations are a little painful. If there is no pain, no gain. There is some work upfront to reap the benefits, it's getting everyone on board. Change is tough. People get used to doing things the way they do them and sometimes they don't even know why they are doing it that way. You get the answer because I always did, well that's how we do it. So getting people to think outside the box, to embrace it I think is one of the biggest challenges.

DW: Okay I am just going to list a couple of other things that perhaps some local players here, perhaps in South Africa have indicated here, not sure if it impacts. One is that people have spoken about the conservative style of leadership, sort of financial deal focus and so not necessarily innovation and tech driven. That's one thing. So that is contributing some sort of a stumbling block. In South Africa probably until two to three years ago was dominated by a single state owned enterprise and was prohibitively expensive and weak so that limited the ability of companies to leverage any internet based solutions.

US2: Ya. I don't think we have those kinds of obstacles. The technology obstacle of bandwidth is not an issue for the state. The obstacle of people like you were saying of you will rather spend money on buildings than on technology. I think that is still true. But if you work with the right people within the organization to sponsor to get them onboard, then they should sell them to the folks who feel that technology is invaluable as real estate.

DW: Absolutely.

US2: It's how you position it. People are competitive. Once folks find out that someone else is doing something, they do want to do it too. So there is also that well you know so and so is doing this. There is also that way of pushing an agenda.

DW: Okay

HS: You don't really want to be caught behind the curve.

DW: And I think some other things that we have spoken about particularly the local players. Is that in South Africa perhaps we have the challenge of scale, I mean our biggest REIT I mean the rand devalued significantly in the last week but our biggest REIT is US\$ 8bn. So that is a really small REIT in global standards and that is our biggest by quite a long shot. And we have spoken about scale being an issue and so we don't just have the scale here in South Africa. And then I also spoke to how the drive behind automating a lot of processes isn't quite as strong because our economy and demographics are very different so we have got between 25 - 35% unemployment depending on what stats you look at. So there is plenty of menial jobs.

US2:Cheap resources

DW: So there is not a huge push. So there isn't a major tenant or consumer driven push towards a lot of these tech because a lot of the stuff can be done very cheaply with people.

US2: Ya now I guess we have unemployment now at 5% so it's kind of normalized level now and resources, the skilled resources you have to pay for again. So I think we have a different economy than you do.

DW: Yap

US2: And look the one thing is that they don't want to spend a lot on resources. They want to minimize the number of resources they have. They can capitalize the expenditure for hardware and software. They rather capitalize and depreciate it rather than pay for people.

DW: Ya, that makes sense

US2: So it's a different financial model where they want to keep the expenses equation low and they are okay though spending some capitalized money to buy hardware and software.

DW: Ya. I have got experience at a property management company and I know that it doesn't have much significance in relative terms. But we had people that literally, manually just take municipal invoices and then allocate them to a property and scan it in, PDF and attach it to the client record and then are getting about \$ 750 a month. And I thought why don't you guys automate this and for them as well they said we have got these people here. And they are super cheap. So why not.

US2: Because once they get a couple of invoices wrong and you don't collect on that money.

DW: Yes that's when things got pear-shaped?

US2: And what is the cost to outsource? And you pay how many people that 750 a month, you can pay a company that will do it for you. It depends because wages are that low , but up there but here wages are relatively high. If I can get rid of the expense of people and the solution is a third of the cost and its accurate and integrates with multiple systems at once, and it provides greater transparency, I am going to automate it.

DW: 100% ya. I think (name) question I have got relates to what the future holds. In 2015 I did a reading and there has been about \$ 1.5 bn in venture capital money invested into real estate tech. I mean that on a global level and people are now talking about sort of real estate tech bubble reminiscent of the dot com days. So do you reckon that that is happening or what is your kind of view of the investment in the sector?

US2: Ah they are knocking on my door. They are banging on my door. There is a lot of money out there. Some of the big VC companies all have invested. They are all trying to go after the same kind of business and I think some will make it and some won't. And I keep watching to see who is going to win the prize.

DW: Ya

US2: Ya. It would be interesting.

DW: It's anyone's guess what will happen right.

US2: Ya it's a problem because there is one solution I like but its not fully baked for retail, it started in the office space. They have two other companies are trying to do the exact same thing. I need to make a decision on the product in February. They won't be fully baked and am I'm not going to take a risk on their product being ready when I need it because its too new, they don't have enough money behind them yet. I have to go with the sure thing

DW: Ya.

US2: So would they make it or won't they? I don't know. They want my RFPI wont give it to them. They want my RFP for intellectual property, like here are all the things somebody in retail needs and I have worked with them and have told them that am not sure am comfortable giving them the playbook of how to build the system for free.

DW: Totally, okay.

US2: For free. Im on the fence about it. I think there is a niche player that will continue to do well because they do an area, they have been doing it for a while. The big time players are going to fade out.

DW: Totally

US2: some of these. And you see it in the analytics side too on the the beacon market, wifi, there is a bunch of niche players right now. But they are all not going to make it.

DW: There is plenty. They say that New York City is kind of the epicenter of real estate tech and there is a couple of incubators there and have actually met one of the founders of one incubator. There are some very interesting companies out there and as you said, a lot of it are not tested yet. I looked through one today and they are like little beacons that you can attach to different parts of your home and it just has different kinds of sensors. Motion, temperature and you can have somewhere where you put on your fridge. You don't want people opening your fridge or gun safe, your front door or whatever. But its kind of like preorder now \$ 140 and see what happens. I don't really like being a guinea pig.

US2:....Its like Kickstarter..Some of these companies are backed by some of big names. So I don't know. The beacon market, we were looking at beacons. I had a guy come in with a little beacon that he made in his basement and showing me what he did. I think there is sort of a dot com in the real estate business right now that will go burst but I don't think its big dollar, I don't think it's any of the big dollar players. I think there is still a lot of garageplayers trying to.... I saw some folks who want to do legal documentation for real estate. Two small guys but they are too late for the game. There is already ways to do it not elegant but they may even think about integration. I think it's going to be hard for these companies to get traction because they are too late. We have already figured out how to do it some other ways.

DW: Absolutely. Thank makes sense. Okay (name) that concludes all the questions I have. Thanks so much for agreeing to participate and as I said, I would be happy to

give you the results of the content of the actual research when am done. I don't think you are going to find anything that is absolutely brand new information because you might find a kind of synopsis of the industry interesting.