The LIQUID Report: Leading the digital transformation of global Real Estate

Contents

Foreword

Robert Noel,
Chief Executive, Landsec

The modern world is characterised by change. Change, which, more often than not, is created by, facilitated by or inspired by technology. In the midst of a changing political and economic landscape, it's clear that it is technology that has the potential to truly transform the world as we know it.

Across all sectors, increased technological capability will drive efficiency, change ways of working, and increase and improve our connections with our customers, partners and peers. The UK is a global leader in real estate. Technology, correctly embedded and embraced with enthusiasm by the sector, will allow us to pioneer, to challenge and to innovate further.

Across our industry, there is already a sizable amount of investment in understanding the specific benefits that technology can bring to real estate businesses. It's clear, too, that we have an opportunity to learn from other sectors; to build on their successes and to learn from their mistakes.

The built environment impacts us all. It is technology that will enable us to be agile and nimble enough to reflect the changing needs and demands of the communities, people and businesses we serve faster than ever before. The future of innovation in technology will transform our core relationships – it is up to all of us to ensure that we capitalise on this opportunity and drive our sector forward with the diversity of thought that increased interaction with our partners will bring.

There is no universal model of technological innovation that will apply to all; each company in this sector will face challenges and opportunities that are unique. However, the importance of synergy should not be overlooked. The benefits that technology can bring to real estate will be reflected across the UK and, indeed, the world.

Much of the ground work – data regulation, the financial and regulatory framework required for technological development, and a business environment which is attractive to and suitable for technology companies – already exists. We now need to coordinate and capitalise on these activities.

There is no doubt, as you will see from this report, that a digitally enabled real estate sector will not only be recognised as a global leader but will also deliver tangible benefits for the economy of the UK.

Melanie Leech,
CEO, British Property Federation

The world around us is changing. Our legislative and constitutional system is to be transformed by Brexit, while the wider environment is adapting to the rise of the 'gig economy', an aging population and a working world that increasingly places the onus on companies to sell the virtues of working there to the most talented employees. We must learn how we can embrace these changes as an industry.

Last year, with the Future Cities Catapult the BPF published a report, 'Lost in Translation' about how the adoption of technology could drive productivity benefits in real estate. That report made a series of recommendations which are being taken forward by the BPF's Technology and Innovation Working Group and as part of their programme we are publishing this report, commissioned from LIQUID REI, examining the UK proptech market, how it is positioned globally and what is needed for the UK to capture and maintain the lead in this space.

The British Property Federation has for over 50 years provided the voice for the British property sector working in partnership with businesses, communities and with government. We want to be the industry body for those who own or invest in real estate tomorrow, as well as today.

As technology's impact and influence on our sector grows, we are putting in place a number of initiatives to make sure that the sector is positioned to capitalise on the opportunities that technology and innovation can deliver, and to manage the risks that stem from transformation effectively.

Technology and property are very different worlds, often moving to different beats. As these two worlds come together, we must make sure that we have the culture, the environment and the policies in place to harness the benefits. We commend this report as a start of a dialogue between government and industry as to how to make this happen

Executive Summary

Real Estate is at a time of tremendous challenge and opportunity. Every aspect of the sector is at the early stages of technology-driven change; not just the use of technology to do what we have always done quicker or better, but a fundamental change in the way we do our jobs and the way we use buildings.

Real Estate is a significant part of the UK economy and is increasingly important to solving the key global and national challenges that countries face; housing, the environment, worker productivity, increasing a nation's exports and attracting inward investment. Digital transformation of the Real Estate sector will become imperative for the success of an economy, and leading in this space will become a key market differentiator on a global stage.

Real Estate, by its very nature, has not in the past faced the rate-of-change that other sectors have experienced which means that it is often not equipped with the culture or processes to adapt to these new market needs.

In order to adapt, it is essential that the right environment is created for this digital transformation and that the whole industry works in new and collaborative ways.
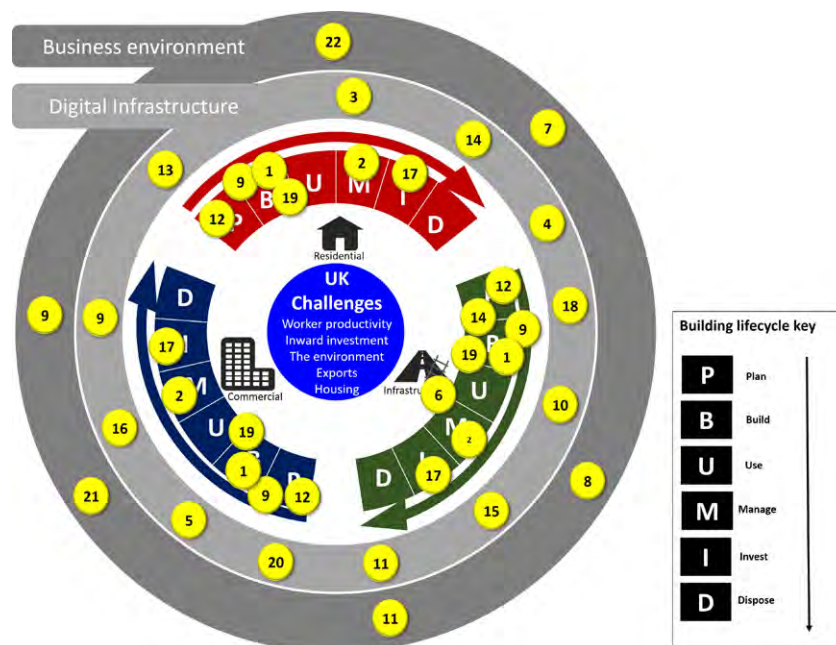

Figure 1: Market Initiatives Mapped to the Building Lifecycle

The UK has an amazing range of activities and initiatives to help drive change across the Real Estate sector, but as it is such a large and fragmented sector, the initiatives often focus on specific building types, stages in the lifecycle or technologies. As traditional sectors blur and we move to a lifecycle approach to the built environment, initiatives must become more outcome focused. Figure 1 shows a selection of relevant market initiatives underway in the UK. Whilst it demonstrates that there is a lot of activity across every part of the sector, it is often not connected to the other relevant initiatives or focused on the sector outcomes (See section 3.2 for further detail).

To enable the successful digital transformation of a country's Real Estate, and in turn to allow this to become an economy's global differentiator, it is essential that the right environment and infrastructure exist. For the purpose of this report we identified that the most important indicators were investment in technology start-ups, data infrastructure, Real Estate market-transparency and maturity, innovation, technology infrastructure and education. Figure 2 shows these criteria with a score for each of them for the UK and ten key global markets (See section 4.1 for further detail). The UK can clearly be seen as having a number of the important environment or infrastructure elements in place, some of which have high barriers to entry for other nations.
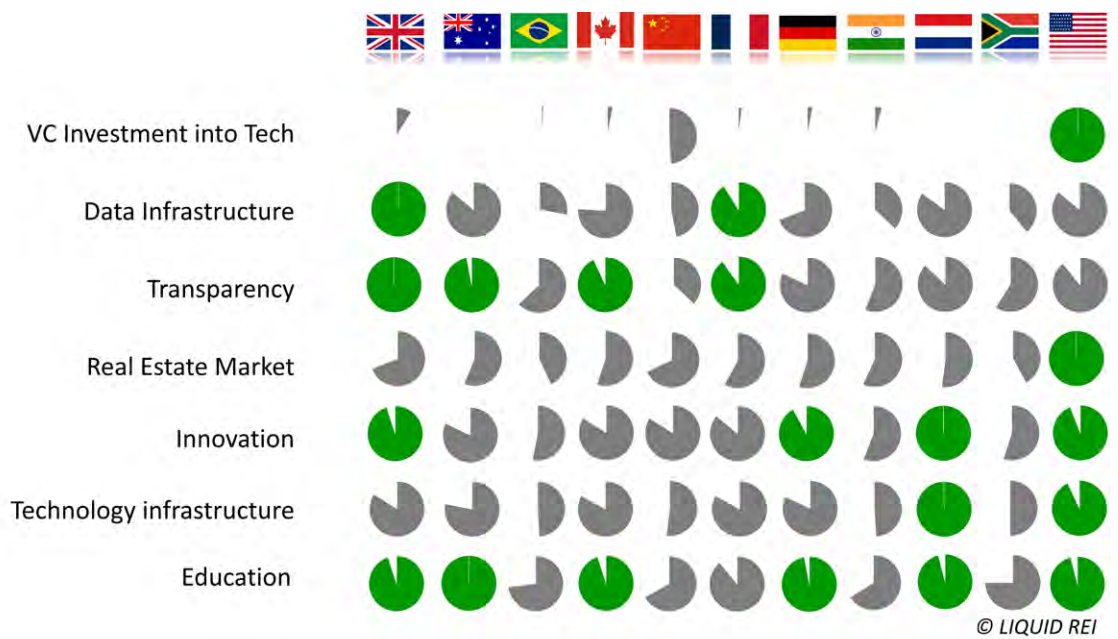
Figure 2: Comparison of Indicators of Digital Transformation Preparedness

Around the world, the UK is currently considered amongst the leaders in the digital transformation of Real Estate. This digital transformation is in its early stages and as it gains momentum the UK is well placed to be the leading market, in turn helping to support and drive the wider UK economy. However, there is much work to be done in ensuring that all parts of the sector work together and create the necessary culture and environment to allow the UK to thrive.

We believe there are three specific areas for the UK to prioritise:

1. FOUNDATIONS FOR THE FUTURE

Many of the foundations necessary for the UK market are incredibly difficult or expensive to establish, yet are already in place such as property market transparency or the data infrastructure, however there needs to be further visibility of market wide initiatives, awareness and alignment of standards and to ensure that employees have the necessary skills to thrive in the future.

1. Foundations for the future

a. UK Government to publish a roadmap of Real Estate-relevant digitalisation plans,

b. A cross-sector coalition to map built environment data standards, to research priority use cases and ways to improve data sharing across the whole lifecycle,

c. Real Estate companies to build digital skills into all staff training and ensure digital transformation feeds directly into business plans.

2. JOINED-UP GOVERNMENT

There are a wide range of public sector initiatives focused or having an impact on the Real Estate sector. Due to the size and historic stability of the structure of the market, initiatives have often focused on specific types of property or particular stages of the lifecycle. Going forward, there needs to be more co-ordination between the various initiatives with an increased outcome focused approach, whilst also using this as a key market differentiator on a global stage.
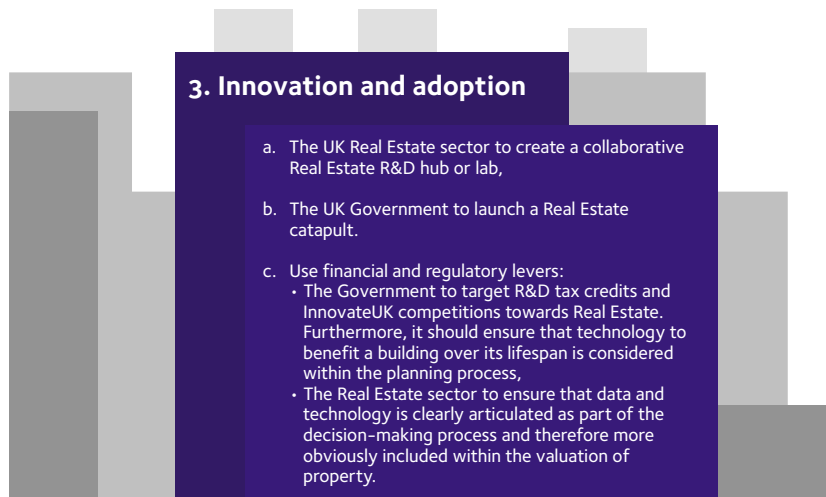
2. Joined-up Government

a. A Minister-led digital Real Estate forum to be created,

b. Government to create a digital government interface or hub for people to discover and access Government activity relating to the digitalisation of Real Estate,

c. UK Government to actively promote digital Real Estate on a world stage.

3. INNOVATION AND ADOPTION

Due to the historic slow pace of change in Real Estate, the sector is not set up with the investment, capability or culture of R&D. Industry and Government must work together to change this to provide a catalyst for new ideas, drive adoption and build the business-cases for continued investment into R&D.

3. Innovation and adoption

a. The UK Real Estate sector to create a collaborative Real Estate R&D hub or lab,

b. The UK Government to launch a Real Estate catapult.

c. Use financial and regulatory levers:
  - The Government to target R&D tax credits and InnovateUK competitions towards Real Estate. Furthermore, it should ensure that technology to benefit a building over its lifespan is considered within the planning process,
  - The Real Estate sector to ensure that data and technology is clearly articulated as part of the decision-making process and therefore more obviously included within the valuation of property.

01.
Introduction

Dan Hughes,
CEO, Liquid REI

This report comes at a time when the UK is considering its place in the world and the UK Government is also grappling with how to deliver public challenges like increased worker productivity, sufficient levels of housing, attracting inward investment, increasing exports and reducing carbon emissions.

Real Estate, both in terms of the people that make up the sector and the assets and expertise they can bring to bear, can contribute to these high-level goals. Moreover, we are at a point in time where the sector is increasingly looking to generate longer-term value, to delight its customers and to be welcomed as a positive force in communities and cities. Other sectors have been disrupted by technology, and insights from those who have gone before are starting to help the industry to change how it designs, builds and uses Real Estate. It is important that the UK leads in embracing technology to realise the opportunities and avoid the risks that this transformation presents.

The UK has a reputation for a beneficial operating and financial environment for innovative technology companies. Yet the Real Estate sector has not significantly changed in the past and as a consequence, the skills and business processes often needed to drive the change now needed can be lacking. Real Estate is also becoming more entwined into the fabric of life, no longer can an office be considered a box within which people work. Premises are increasingly becoming a fundamental part of how companies generate value, attract staff and serve their customers.

A key trend is that technology allows us to increasingly work from anywhere and with anyone which is leading to greater collaboration and increasingly porous international borders. But at the same time, technology is also lowering barriers-to-entry with a greater than ever need for countries to position themselves and compete on a global stage.

Real Estate is tangible, evolves slowly and is intensely local. Technology is often virtual, transforms rapidly and is global in nature. The coming together of these two different characteristics inevitably brings challenges.

The successful economies and Real Estate markets of the future will be the ones that are adept at collaborating and embracing change. The development of technology will not cease and so in order to solve some of the challenges that exist, the Real Estate sector, Government, occupiers and regulators will all need to work together to ensure the right environment and support exists going forward.

To inform the recommendations of this report, we have gathered insights from a number of thought-leaders in the built environment, technology and their intersection.

This report looks at the digital transformation of the Real Estate sector in the UK, how it is placed on a global platform, what should be done to ensure that UK Real Estate continues to be seen as a leading global market and supports the wider UK economic and social challenges.

"Customers' needs are diversifying and evolving, and the property industry must be attentive to that. This trend is reflected across real estate asset classes and certainly true in the industrial sector. The rapid expansion of the digital economy means that the range of activities carried out in our buildings now goes far beyond distribution and logistics, from testing and research to data centres, among others. It is vital that we are alive to these trends in order to support innovation and productivity in the economy and develop properties that anticipate the needs of the future. "

David Sleath, SEGRO

02.
Real Estate digital transformation

The global Real Estate market affects everyone in multiple ways, whether in providing a place to live, a place to work or a vehicle for pensions to invest in. It is estimated by the World Green Building Council that we spend 90% of our time indoors highlighting the role property plays in our lives.[1]

In recent years, Real Estate has started to become even more important to how a nation develops, a company operates, or a person lives. Buildings are typically around for decades or even centuries, and each "step" in the life of a building has often been approached in isolation of the prior. The Real Estate sector working in silos is an often-used cliché.

Part of the attraction of Real Estate and the built environment is that it is tangible and offers relatively low investment risk. The built environment employs huge numbers of people around the world, often including some of the brightest talent, but the skills and business models that have been developed over years are designed to serve the market as it was, not as it might be in the future. The speed of business decision-making and the appetite for risk can be low across the sector whilst the skills needed for innovation and change management haven't been developed as much as other sectors.

In 2018, Amazon is expected to spend $22.6bn on R&D [2]. Notwithstanding the size of Amazon, and there being no Real Estate equivalent, this equates to 12.7% of its revenue. Something that few companies in Real Estate could claim. Amazon have already had a significant impact on retail and industrial markets and are now increasingly active in the residential market.

The use of technology is not in itself a new thing. However, the rate at which it is evolving is having a significant impact on our economy. With 90%[3] of the world's data having been created in the last two years and the continuing validity of Moore's law[4] (suggesting that the growth of computer processing power grows exponentially) the ever-increasing impact that technology can and will have is set to continue. From the survey of our senior leaders, 93% saw digital transformation as essential for the future of the Real Estate sector.

"PropTech" is literally the fusion of "property" and "technology" and is the catch-all label often attached to the digital transformation that every part of Real Estate is undergoing. Within PropTech are a range of other acronyms that focus on more specific parts of this ecosystem, such as BIM, GIS or AI. Further information about the acronyms used can be found in a glossary in Appendix B.

> " For Real Estate, digital transformation is no longer a what, when or if, it is quite simply what do we need to be doing to embrace the changes necessary and how quickly can we bring them on board to make a difference to our business and the services we can provide our clients. "
>
> Amanda Clack, CBRE

Figure 3: Word Cloud of PropTech Terminology

1   www.worldgbc.org/sites/default/files/20181204_WGBC_Homes-Research-Note_FINAL_spreads.pdf
2   www.strategy-business.com/media/image/41165807_exbb.gif
3   www.ibm.com/blogs/insights-on-business/consumer-products/2-5-quintillion-bytes-of-data-created-every-day-how-does-cpg-retail-manage-it/
4   en.wikipedia.org/wiki/Moore%27s_law

" How are we going to manage and gain value from the data generated from our built environment, the volume of which is growing at an unprecedented rate, if we don't embrace new advancements in AI and Internet of Things platforms? As real estate professionals, if we don't adapt, change and grow our thinking, someone else will. "

Claire Penny, IBM

A key development in recent years has been the drive to an increasingly connected world which in turn allows technology to be delivered "on-line" as a service. Examples of this are Software (SaaS) or Data (DaaS). However, the ability to deliver in this way, means that major technology companies are now able to offer their own products as a platform for others to build on. This in turn significantly lowers the barriers-to-entry. A new company can now offer customised market solutions with unprecedented sophistication and security with minimal lead times, and relatively low cost.

For many years, despite the overall size of the Real Estate sector, it has not been an attractive or accessible market for many technology companies due to its fragmentation and high volume of small businesses. However, these same technology companies are now turning their focus to the built environment as routes to market have improved and barriers-to-entry lowered. We have also seen some of the big tech companies directly enter the Real Estate market with examples such as Facebook building housing[5], Google entering the smart city space through Sidewalk Labs and Amazon moving into the smart home with Amazon Alexa.

With the ever-growing influence of technology in Real Estate, we are at the early stages of a fundamental change in the sector; new companies and business models are appearing into what has traditionally been a difficult to enter market. As these two worlds come together, the likely winners are those that collaborate and engage rather than ignore or fight the change. There are some broad themes being driven by the increasing digitalisation of the Real Estate sector that can be identified:

2.1 Product to service

In line with the much talked about 4th Industrial revolution, real estate is transforming from a product-based industry to a service industry. No longer is the focus so much the building, but what the building does for the productivity of people inside. This is much harder to measure than traditional sizes and values, but technology is increasingly allowing this to happen, for example through the increased ability to collect and analyse data. To quote Antony Slumbers, a leading thinker in this space; *"Just as it is now easy to buy almost any Software-as-a-Service, so it will become with Real Estate. Space, as-a-Service, is the future of Real Estate. On demand and where you buy exactly the features, and services, you need, whenever and wherever you are."*

2.2 Technology in a whole-life view

Real Estate tends to work in silos, but as we increasingly start considering the whole lifecycle, these silos are blurring. A large driver of this is not just the consideration of the whole life of a building, but the fact that the technology, and particularly data, needed in the operational life of a building can only be collected if considered in the early stage of building design and construction. As occupiers gain access to more data and better understand how buildings affect their operations, we will see some buildings and companies performing better. This, in turn, will lead to

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5   uk.businessinsider.com/facebook-building-employee-housing-silicon-valley-headquarters-2017-7?r=US&IR=T

new ways of assessing the value of the property. Building owners will need to have a full view of all of the data that informs the factors that drive value. Whilst people silos may still exist in the future, the data and technology must be joined up to allow a full lifecycle view.

2.3 Impact on jobs

It is widely accepted that technology will change the shape of jobs in the future. This has always been the case, but with increased sophistication of technology, the rate at which these jobs will be automated will increase as more and more tasks are automated. McKinsey[6] has estimated that up to 44% of Real Estate and construction jobs could be automated in the future. A report released by RICS[7] in 2017, went into detail about the tasks of a property surveyor that could be automated. See Figure 4 summarising findings.

2.4 New entrants

As barriers-to-entry fall and geographical restrictions reduce, new companies are entering every part of the Real Estate sector. Some companies are using technology as a way of increasing the efficiency of what they have always done, others are simply looking to use technology to either leapfrog competitors or transform the way the sector works. These new entrants into the market are often fuelled by increasing amounts of venture capital investment into this space which has increased significantly over recent years. With this high volume of tech driven, new entrants there can at times become too much focus on the technology, rather than the customer or market needs and relationships. This in turn provides challenges with getting traction, but also presents opportunities in other areas such as partnerships with incumbents.

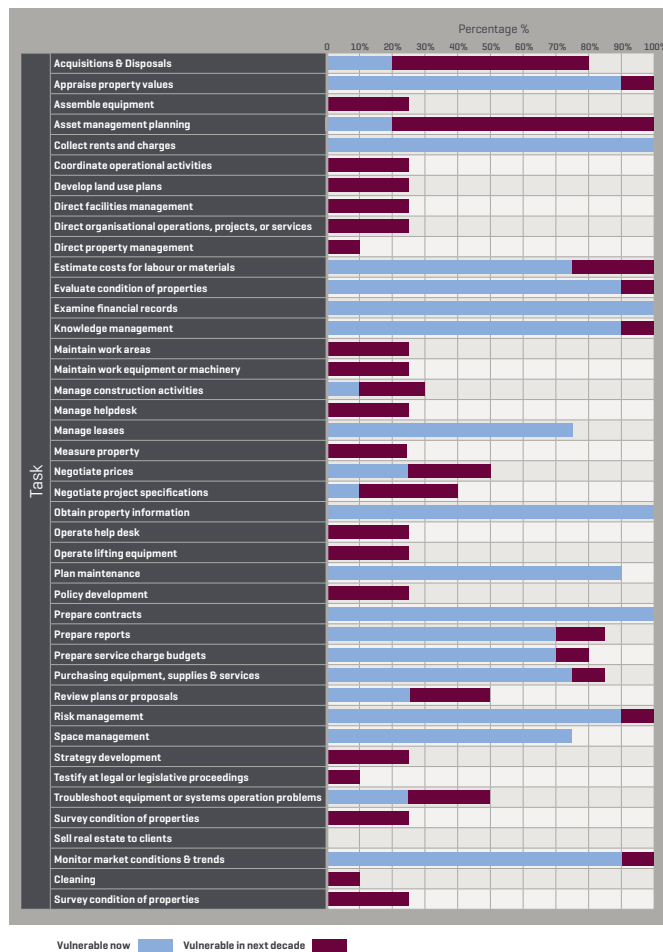

Figure 4: Automation of Surveyor Functions

6   public.tableau.com/profile/mckinsey.analytics#!/vizhome/InternationalAutomation/WhereMachinesCanReplaceHumans
7   www.rics.org/globalassets/rics-website/media/knowledge/research/insights/impact-of-emerging-technologies-on-the-surveying-profession-rics.pdf

2.5   Changing business strategies

Business strategies and business models are starting to change. Thorough and risk-averse decision-making processes have worked for Real Estate for many years, but as customer expectations, new competitors and new solutions increase, these strategies need to be challenged. Other sectors tend to invest in R&D to speed up the process and use it as a competitive edge, however the Real Estate sector invests very little in R&D. An additional challenge to the business models of many Real Estate service companies is that they are valued by the services they provide to clients. These services are becoming increasingly automated meaning there is a danger to the perceived value, especially given that many companies "give away for free" insights and advice in the hope of securing transaction or other paid-for services. This has not traditionally been a problem whilst the overall service provided has remained as one steady package, however now that certain tasks are becoming automated or specialised, business models will have to change.

To compound this problem for traditional Real Estate, a number of the new entrants have substantial amounts of funding enabling them to more easily invest in technology and new skills without being restricted by existing structures and processes. Investment in a loss-making business may be a long-term risk, however it does provide an advantage over incumbents, at least in the short-term, for many of the new entrants in the market.

It is no longer an option to think about the present business or the future, both must be balanced at the same time. It is about "And" not "Or". Good examples of this can be seen in other sectors such as energy or automotive where companies are proactively aiming to disrupt themselves.

2.6   Regulation and standards

Both the Real Estate and technology industries have been subject to regulation for many years, but as these worlds come together there will be a growing challenge for regulators to keep up and bring together the combined skills needed in this space. A key challenge for regulation is the pace-of-change; we have already seen examples of regulation trying to keep up with technology firms and struggling. The regulation of an increasingly tech-enabled Real Estate sector is made additionally complex as regulators need to achieve the balance of regulating the market, but without unnecessarily increasing barriers-to-entry or restricting innovation. The adoption of standards across the industry, especially around data will become increasingly important to the functioning of the whole sector. It is also worth noting that whilst technology creates challenges for the future regulation of Real Estate, it also provides new tools and methods for regulators to use to manage the changing market.

AT A GLANCE

Technology is changing the structure of Real Estate. It is not just a tool to be used to do what we have always done, but it is transforming the way we do our jobs and use buildings which in turn will change the fundamental structure of the industry.

" Our primary objective for digital transformation and innovation at AEW is for our clients to benefit from achieving better risk-adjusted returns in the long term as well as improving our reporting. We do this by working together to expand our use of the latest technology and systems, while updating staff skills and optimising our organisational structure and decision-making processes. "

 Hans Vrensen, AEW

03.
Digital transformation of Real Estate in the UK

For many years, the UK has been considered a global leader in the Real Estate market and the use of data and technology within it. As the influence and pace-of-change increases, the UK market is actively working in a number of different areas to address and lead the benefits that technology can deliver. Positioned as one of the leading voices in the digital transformation of Real Estate, in this section, we take a look at the UK Real Estate market, some of the historic and more recent examples of digital activity, market level initiatives that are currently in progress and finally some quantification of the opportunity and challenges the industry is facing.

3.1 Technology-use today

Here we look at a few examples of the use of data or technology in the UK Real Estate market. Whilst not exhaustive, it does demonstrate the breadth of activity.

" Digital transformation is essential for all businesses in the real estate sector. The UK has been one of the leading voices in this space, but things are moving fast so there is a lot of work that remains to be done. "

Andy Pyle, KPMG

DATA

Data has become a hot topic in many parts of the sector recently, yet high quality and accessible market data has been available for many years. Ordnance Survey, one of the world's leading geospatial data providers was formed in 1791. BCIS (Building Cost Information Service) was set up in 1961 and the IPD (Investment Property Databank) UK Index dates from 1980. This data infrastructure is well-established and has developed over time with more recent examples such as the EG Radius Data Exchange, created to support sharing of data across the industry. We have also seen growth in many new start-ups with data at the heart of their business, whether providing Real Estate with new ways to manage, collate or analyse data.

AUTOMATED VALUATIONS

The use of Automated Valuation Models (AVM) has been well established in the UK residential sector for many years. One example is Hometrack, which was recently purchased by the Zoopla Property Group, and launched its AVM in 2002 which, it is reported, provides over 50 million automated valuations each year.

Commercial property AVMs have been less widely used to date, but examples do exist and the sector is growing quickly. For example, Aviva Investors have had a proprietary commercial property AVM in use for several years.[8]

8   www.avivainvestors.com/en-gb/about/company-news/2017/11/why-valuation-professionals-should-embrace-technology/

DRONES

The impact of drones is increasing, both on how they affect our jobs and how we use our buildings. The use of drones is becoming established for buildings surveyors with more and more options available in the market. In the right situation, it can save significant amounts of time and cost for building surveys.

Drones are not only being used to help surveyors do their jobs, but they are starting to have an increasing impact on infrastructure. Amazon has been testing drone deliveries in the UK since 2016[9] and whilst legislative complexities exist for the mass adoption of this, a number of these barriers are being addressed. For example, the UK Government published 'Drone legislation: use, restrictions and enforcement'[10] in July 2018. This obviously has an impact on infrastructure, but also on building design, for example Alexandra Notay, build-to-rent Fund Director at PfP Capital has stated that she has "drone delivery pads in my baseline specification for all build-to-rent developments." [11]

OFF-SITE MANUFACTURE

Whilst most of the manufacturing industry has moved forward over a number of decades with automation and the use of technology, property construction has largely ignored this innovation. In large part, this is due to the bespoke nature of buildings and the controlled environment needed to leverage these technological advances, such as a factory, not having been practical for the construction of buildings. However, construction is now seeing a rapid adoption of off-site manufacturing whether by large construction companies such as Laing O'Rourke[12], Real Estate owners such as Legal & General Modular Homes[13] or from housing developers such as ILKE Homes.

PROFESSIONAL ADVISORY FIRMS

The rise of technology in the larger advisory firms in the last couple of years has been stark. Most firms are now at least talking about technology and how it can be used to better serve customers. This covers all sectors and all parts of the value chain. Examples of this include JLL launching its NxT Office in London, a digitally immersive studio designed to help tenants to better find their next office and engineering consultancy ARUP offering digital transformation services. It's not only the more traditional Real Estate advisors that are actively engaged, but other professional services firms are also actively engaged such as law firms and accountants. For example, Mishcon de Reya are actively engaged with Real Estate digital transformation and start-ups, as are KPMG with their annual PropTech survey.

START-UPS

There has been an influx of new technology companies coming into the Real Estate sector over the past few years. All aspects of the Real Estate value chain are being examined by technology and data-led companies. A substantial number of these have focused on digitising existing processes, either through increasing efficiency or through capturing data and information that has traditionally been lost. However, there are a number of new companies looking to fundamentally change the way the market works. The UK has been a hot-bed of growth for this new breed of company and is home to lots of new Real Estate start-ups, incubators and accelerators. In line with the new companies, investment is also growing with UK based Real Estate tech funds such as Concrete VC based in London or international ones active in the UK market such as New York based MetaProp.

9   www.standard.co.uk/tech/amazon-drone-deliveries-next-year-a3782276.html

10 www.gov.uk/government/consultations/drone-legislation-use-restrictions-and-enforcement

11 www.twitter.com/aknotay/status/1033003243910176769

12 www.laingorourke.com/what-we-do/dfma-and-offsite-manufacturing.aspx

13 www.legalandgeneral.com/modular/

GOVERNMENT

There are a substantial number of UK Government initiatives underway in the UK to support the Real Estate sector and create the environment for Real Estate technology to thrive. We look at these further in section 3.2, however one such example is the work currently underway at HM Land Registry which is seeking to create a centralised Local Land Charges (LLC) digital register[14] , traditionally managed by individual local authorities. Not only should this project lead to increased overall efficiency, it will make it easier to access and analyse data needed to support Real Estate decisions.

AUTONOMOUS VEHICLES

The rise of autonomous vehicles is well-documented and the UK has been carrying out a variety of different tests around the country. The Government has stated that it wants the UK to be "at the fore-front" of self-driving cars and along with support of the trials, has started creating the infrastructure and environment for them to operate in, such as looking at codes of practice and insurance implications. Autonomous cars are likely to have a significant impact on transport, on urban design and on system wide energy management.

KEY POINTS

A significant number of companies are working on digital transformation of Real Estate in the UK.

3.2 UK market initiatives

In addition to the wide range of activities happening at a company level, there are many market-led initiatives under way that directly or indirectly effect the digital transformation of the Real Estate sector. In this section we look at a selection of some of these initiatives.

Figure 5 shows a map of current initiatives and their key area-of-focus. This is split into three categories aimed at: improving the UK business environment, improving the UK digital infrastructure or focussing on a particular element of the built environment. We have then further split the built environment into residential, commercial and infrastructure and in all three categories, we consider which stage of the lifecycle of the asset the initiative is focused on.

The diagram demonstrates that there are a significant number of stand-alone, market initiatives happening that will drive the digital transformation of Real Estate. However, as the sectors and lifecycle become more closely interconnected, it is imperative that these initiatives are joined up and aligned for them to have maximum impact on the underlying national challenges facing the nation.

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14   www.gov.uk/government/news/migration-begins-on-hm-land-registrys-national-local-land-charges-register
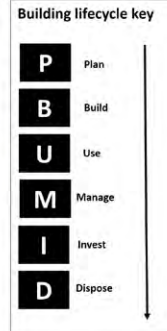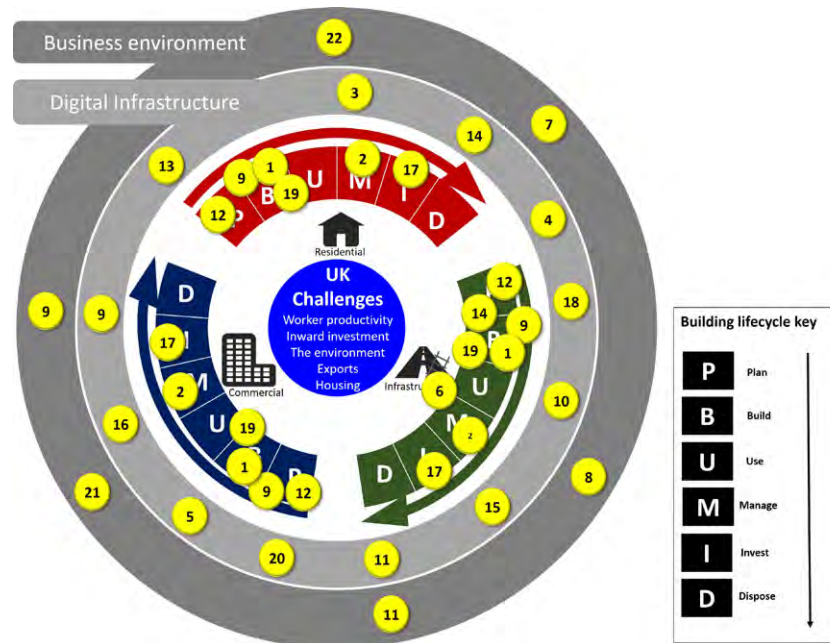
1	BIM	8	Department for International Trade	15	London Data store
2	Government soft landings	9	Innovate UK	16	Digital Policy and Roadmap 2018-2022 - Bristol City Council
3	Open Data	10	UK Artificial Intelligence funding	17	RICS Data standards
4	Geospatial commission	11	Geovation	18	BSI
5	Government Digital Services	12	Future Cities Catapult	19	Digital Built Britain
6	Infrastructure and Projects Authority	13	National Graphene Institute	20	MHCLG
7	BEIS PropTech	14	Smart cities	21	R&D Tax credits

Figure 5: Market and Government Initiatives Mapped to the Building Lifecycle

" Adoption is already well–underway, and very much a commercial issue. Darwin's rules apply as always, and it's up to each company to make their own decisions instead of applying a general formula.

Regulation is a far more interesting topic. Where government revenue is transaction based, facilitating greater liquidity is a huge opportunity for both the residential and commercial stakeholders. "

Taylor Wescoatt, ConcreteVC

Below we look at some of the initiatives demonstrated on the map in a little more detail.

1. UK BIM PROGRAMME

As UK Government Chief Construction Advisor, Paul Morrell instigated the UK Government Construction Strategy which in 2011 directed the sector to work more collaboratively and to use information technology – specifically through BIM (Building Information Modelling) – to improve cost and efficiency of both construction and operation of buildings.

With the UK government responsible for around 40% of the construction industry's workload, the UK BIM Programme mandated the use of BIM Level 2 methodologies for all public sector construction projects from 2016. The Construction Industry Council (CIC) has been heavily involved in developing and leading this programme with Government.

In order to allow the industry to adopt BIM, a large amount of work around process and standards has been undertaken, such as the PAS 1192 series of standards.

2. GOVERNMENT SOFT LANDINGS (GSL)

Following publication of the Government Construction Strategy, a number of task groups were established. One of these was the FM / Soft Landings task group which was asked to produce a policy document on Government Soft Landings (GSL) supported by appropriate guidance and a process map.

The flow of information is often lost during the construction phase, so the purpose of the GSL work is to align the interests of those that build and those that manage an asset and ensure a smooth transfer of information. GSL sits alongside the wider BIM agenda.

3. OPEN DATA

The UK Government has done a lot of work to make its data more accessible. In 2010 the Open Government Licence (OGL) and the data.gov.uk site were created, and in 2011 a now superceded Public Data Group was created alongside a Data Strategy Board.

A wide range of data relevant to the Real Estate sector is available under the OGL.

Alongside Government work in this space, the Open Data Institute (ODI), founded by Sirs Tim Berners-Lee and Nigel Shadbolt in 2012, is a not-for-profit organisation with the mission to connect, equip and inspire people around the world to innovate with data.

4. GEOSPATIAL COMMISSION

The Geospatial Commission, announced by the Chancellor of the Exchequer in 2017, is tasked with bringing together HM Land Registry, the Ordnance Survey, the British Geological Survey, the Valuation Office Agency, the UK Hydrographic Office and the Coal Authority to improve the access to and quality of their data, make more geospatial data available, and set regulation and policy for geospatial data created by the public sector. The Geospatial Commission has a £40m budget over two years.

5. GOVERNMENT DIGITAL SERVICES (GDS)

Government Digital Services (GDS) is a unit of the Cabinet Office set up in 2011 to implement the UK Government "Digital by Default" strategy. The role of GDS is to drive a digital service delivery across government and provide support, advice and technical expertise for departments as they embrace technology. Much of the Real Estate sector is linked to government policy and in 2013, 25 exemplar projects were published, including ones focused on rural payments and land registry.

A GovTech Catalyst with a £20m fund has been launched to support public sector organisations to find innovative solutions to operational service and policy delivery challenges.

In 2018, GDS also published a "Technology innovation in government survey" which maps out many of the innovative projects happening around Government. This lists 427 different programmes, projects or initiatives that relate to Government technology. A visualisation of this is shown Figure 6.[15]

Figure 6: Visualisation of the "Technology Innovation in Government Survey" Results

6. INFRASTRUCTURE AND PROJECTS AUTHORITY

Formed in 2016, by bringing together Infrastructure UK (IUK) and the Major Projects Authority (MPA), the Infrastructure and Projects Authority report to both the Cabinet Office and HM Treasury.

They support the successful delivery of all types of infrastructure and major projects: ranging from railways, schools, hospitals and housing, to defence, IT and major transformation programmes. Their stated purpose is to continuously improve the way infrastructure and major projects are delivered, in order to support government priorities and improve people's lives.

7. BEIS PROPTECH

The Department for Business, Energy and Industrial Strategy (BEIS) Future Sectors Team was founded to connect government policy makers with innovators and end-users. The team is currently focusing on PropTech, having been tasked by the Ministry of Housing, Communities and Local Government (MHCLG) to better understand the sector, and how it might support innovation.

Initiatives run by the Future Sectors Team and its predecessor have, through evidence gathered from businesses, supported changes including: working with sector bodies to deliver new tools (e.g. SME housebuilders "finance finder" tool); developing new representative bodies and challenge funds; initiating sector reviews; supporting new legislation (satellites, drones); and delivering tax changes and clarifications (e.g. on satellites, ISAs, crypto currencies).

A workshop with officials and a follow-up workshop with the Housing Minister were held in the winter of 2018. From this the Government intends to identify ways to support the emerging PropTech sector.

8. DEPARTMENT FOR INTERNATIONAL TRADE (DIT)

The Department of International Trade aims to increase international trade, both inward investment and exports. The Real Estate sector is already an area of focus for DIT, for example their programme of activities at MIPIM in Cannes, however there is a very real opportunity to use technology as a key theme for this. Both in terms of creating a more attractive and transparent Real Estate market for inward investment and through the export of Real Estate technology expertise and products.

15   https://graphcommons.com/graphs/406e9195-962e-42e6-abf7-8ed2739655c3__01f6e9de?sel=86e87279-5a15-43ba-ba40-30abd273b109&auto=true&show=info

9. UK RESEARCH AND INNOVATION

UK Research and Innovation (UKRI) is the national funding agency investing in UK science and research and with a combined budget of more than £6 billion. UKRI is an independent organisation principally funded by BEIS that brings together a number of Research Councils, Innovate UK and Research England.

Competitions for funding of various sizes are run through Innovate UK and a UK Industrial Challenge fund. A number of challenges have been identified where Real Estate and the wider built environment has a substantial role to play in successful outcomes, however the challenges are often more focused on the technologies, rather than the desired outcomes. There is a challenge titled "Transforming Construction" which has a number of initiatives targeted at the construction sector.

10. UK ARTIFICIAL INTELLIGENCE

Artificial Intelligence has been identified as one of the opportunities for the UK and it will have a significant impact on most parts of the Real Estate and wider built environment. In April 2018, the UK Government announced a UK AI Sector Deal to support the UK in this space which included a commitment of close to £1bn in funding.

11. GEOVATION

Geovation started as a concept in 2009 and works with start-ups in the geospatial and Real Estate sector. It has had its own physical space since 2015 and has supported 79 start-ups as of the end of 2018. Geovation is an initiative created by Ordnance Survey and subsequently joined by Land Registry and provides funding of up to £20k and a range of data, business and network advice.

12. FUTURE CITIES CATAPULT

The Future Cities Catapult (FCC) states their mission as being to help UK firms develop innovative products and services to meet the changing needs of cities, and to sell them to the world. In doing so, they are supporting the emerging sector to become an enabler of national productivity and a central plank of the UK economy. The FCC supports companies tackling city challenges, such as congestion, housing and placemaking.

13. NEW MATERIALS

For the Real Estate sector to move forward and achieve the benefits expected, it will be essential for new or currently niche materials to become more widely used. This could be the use of composite wooden frames in construction, materials that can be printed on-site or that allow the next generation of batteries. Key to all of these is investment and research into material engineering, a strength for the UK.

An example of this is the National Graphene Institute. Opened in 2015 and based in Manchester, it was funded by a combination of the UK Government and the European Union and is the centre for Graphene research in the UK, which includes ways of successfully using and exploiting in industry.

14. SMART CITIES

Smart Cities is a topic that is often spoken about at a national level, but with much of the activity at a local level. However, in 2018, the UK Government launched the £1.7bn Transforming Cities Fund for local regions to bid for to help boost local economies.

A good example of a local Smart City initiative is "Bristol is open[16]", a joint venture between the University of Bristol and Bristol City Council which delivers research and development initiatives that contribute to the development of a smart city. In 2018, Bristol won the Smart City Award at the GSMA's 2018 Global Mobile Awards (The GLOMOs)[17] from a shortlist that included Barcelona, Dubai, New York, Singapore and Yinchuan. The award provides global recognition on how Bristol has raised the bar on defining the "smart city" of the future.

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16   www.bristolisopen.com
17   www.bristol.ac.uk/cabot/news/2018/smart-city-award.html

Other examples of cities with smart city initiatives include the Manchester Smarter City Programme, "Future City Glasgow", Nottingham's "Smart Campus – Smart Cities", SmartSheffield, Sheffield's open smart cities forum or Belfast which is set to become the first city in the UK to have Pulse Smart Hubs installed on the city's streets with free WiFi, sensors for capturing environmental data, a defibrillator, a free phone call service, and a touchscreen visitor information service.[18]

15. LONDON DATASTORE

The London Datastore, created by the Greater London Authority (GLA) is an example of a local initiative to release data for a specific geographic area. The purpose is to enable anyone and everyone to access data and use for free as they see fit. Not only does the London Datastore provide access to the data, but also provides tools to help find, understand and visualise the data.

Within the London Datastore, data can be sorted by topic which includes multiple datasets on planning, housing and infrastructure amongst others.

16. DIGITAL POLICY AND ROADMAP – BRISTOL CITY COUNCIL

Cities and local authorities are using data and technology to deliver and enhance services, many of which are focusing on the built environment; from planning to housing and infrastructure to city navigation. A good example of this is Bristol City Council, has published a 2018-2022 Digital Roadmap[19] and has a comprehensive register and map service.[20]

17. RICS DATA STANDARDS

The Royal Institution of Chartered Surveyors (RICS) has developed a suite of Data Standards that work in parallel with its International Standards and Professional Statements, to ensure the quality and consistency of data.

Implementing RICS Data Standards ensures that data is captured, verified and shared both within organisations, and across external stakeholders.

As an example, the RICS International Property Measurement Standards (IPMS) data standard is an XML schema allowing users to capture, denote and share IPMS measurements of buildings.

18. BSI

The BSI is a global business standards and certification company covering many sectors and disciplines, one of which is the construction and built environment. They provide numerous detailed standards across the built environment which is a key element of the enabling infrastructure. In 2018, BSI launched the BSI Kitemark for BIM (Building Information Modelling) Level 2[21] to help organizations demonstrate that they can deliver infrastructure projects that meet the requirements of the UK Government's condition of contract.

19. THE CENTRE FOR DIGITAL BUILT BRITAIN

This is a partnership between the Department for Business, Energy & Industrial Strategy and the University of Cambridge. It aims to deliver a smart digital economy for infrastructure and construction, transforming the UK construction industry's approach to the way we plan, build, maintain and use our social and economic infrastructure.

Their mission is: "to develop and demonstrate policy and practical insights that will enable the exploitation of new and emerging technologies, data and analytics to enhance the natural and built environment, thereby driving up commercial competitiveness and productivity, as well as citizen quality-of-life and well-being."

18   www.information-age.com/the-uks-current-smart-city-developments-examined-123474013/
19   democracy.bristol.gov.uk/documents/s18397/A1iv%20-%20bristol-culture-digital-policy-and-roadmap-2018-22.pdf
20   maps.bristol.gov.uk
21   www.bsigroup.com/en-GB/about-bsi/media-centre/press-releases/2018/october/bsi-launches-new-kitemark-for-bim-level-2/

20. MINISTRY OF HOUSING, COMMUNITIES AND LOCAL GOVERNMENT

A department that is instrumental in many aspects of the built environment is the Ministry of Housing, Communities and Local Government (MHCLG). It is undergoing a substantial digital transformation and has a stated ambition to be the leading digital policy department.

In 2018, MHCLG and GDS published a joint-initiative called the Local Digital Declaration[22], which is a set of guiding principles that will help support local authorities of all sizes or capabilities to deliver digital services and platforms that meet the needs of citizens.

21. R&D TAX RELIEF

The UK Government provides R&D tax relief to support companies working on innovative projects in science and technology. As technology and R&D becomes increasingly important to the Real Estate sector, this should become of increasing influence and can be claimed irrespective of success of the project.

In a market such as Real Estate, that has traditionally carried out very little R&D, this is a good example of where Government financial policy can help companies drive innovation in a sector.

22. APPRENTICESHIPS SCHEMES

There has been a strong drive from the UK Government to encourage and drive apprenticeships through several financial schemes, such as the Apprenticeship Levy, and wider initiatives. The whole of the built environment sector is already a huge employer and as technology skills are increasingly needed, the Real Estate technology sector should see a growth in apprenticeships.

KEY POINTS

There are a significant number of wider market and Government initiatives in the UK addressing the impact of technology on Real Estate. However, these are often focused on a specific technology, a particular building-type or a specific stage in the building's life, and not joined-up. This is as-opposed to being outcome-focused and co-ordinated.

" Technology continues to impact the way we use space and real estate companies have to embrace this to attract, and retain, customers. It can be used to boost productivity, save time and money for our customers but we have to create places that can adapt to changing developments in technology. "

Chris Grigg, British Land

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22   www.localdigital.gov.uk/declaration/

3.3 The UK market in numbers

There are few quantifiable measures for digital transformation in the UK Real Estate sector. Here, we look at the size of the Real Estate market, the technology market and where the two come together. The Real Estate sector's importance to the UK economy is often overlooked due to its fragmentation, however Figure 7 shows the significant size and value of it and suggests the change that will happen in the coming years.
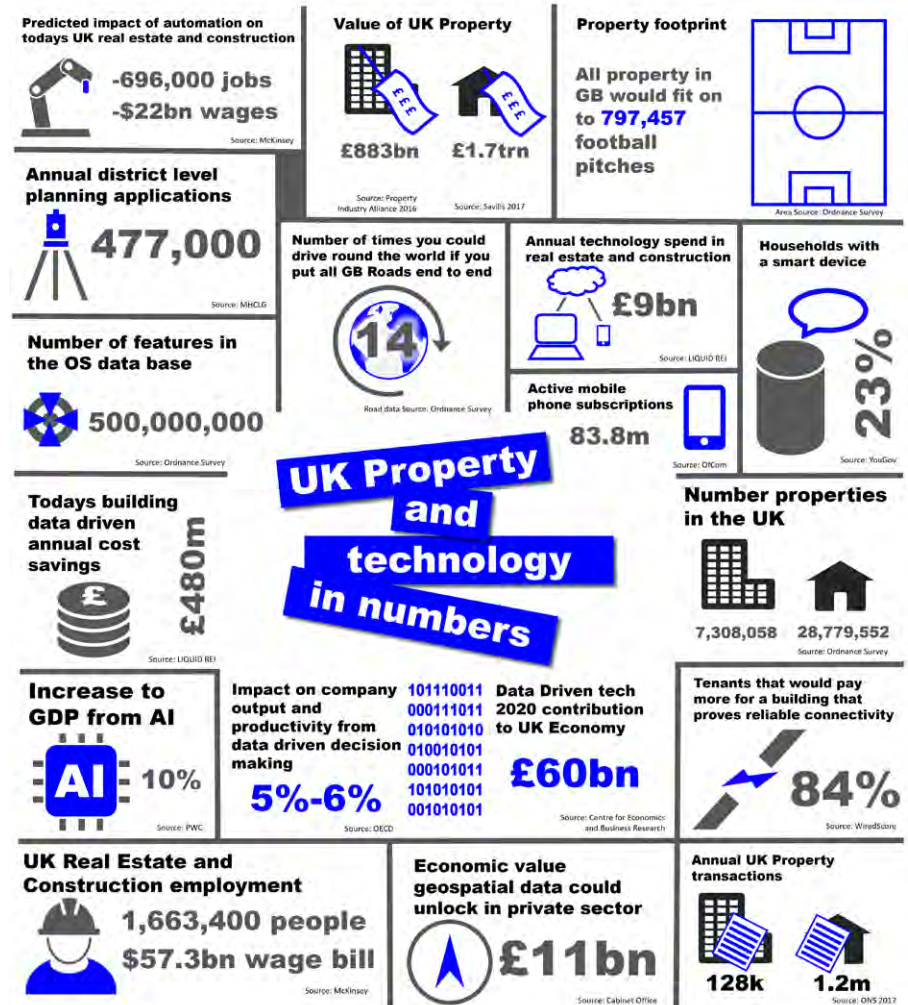

Figure 7: Indicators of Digital Transformation in the UK Real Estate Sector

04.
The UK on
a global stage

Whilst much of institutional Real Estate investment, and a small number of occupiers or service providers, work across international borders, most of the Real Estate market works at a very local level. Technology, on the other hand, is often comparatively easy to apply to any application anywhere in the world. The application of technology within the Real Estate market can become much more complicated due to the localised nature of the sector. The correct environment and underlying infrastructure are essential for the effective adoption of technology in Real Estate.

The UK is a well-established Real Estate market and to date has been a global leader in the conversation on the adoption of technology. As an example of this, Figure 8 suggests the geographical spread of the term "PropTech" as a search term on Google in 2018.[23] The darker the blue, the higher the share. 57% of the senior leaders surveyed felt that the UK was well equipped, but needs to do more to be considered amongst the global leaders.

However, measurement of the digital transformation in a market is very difficult as there is no one right way of doing things, making it hard to measure the adoption, uptake or impact that technology initiatives have. Investment in start-ups or the amount of discussion in a market is often used as a proxy to represent the maturity and uptake, but in truth, measuring digital transformation of a market is impossible without significant research into the benefit that the adopted technology has delivered.
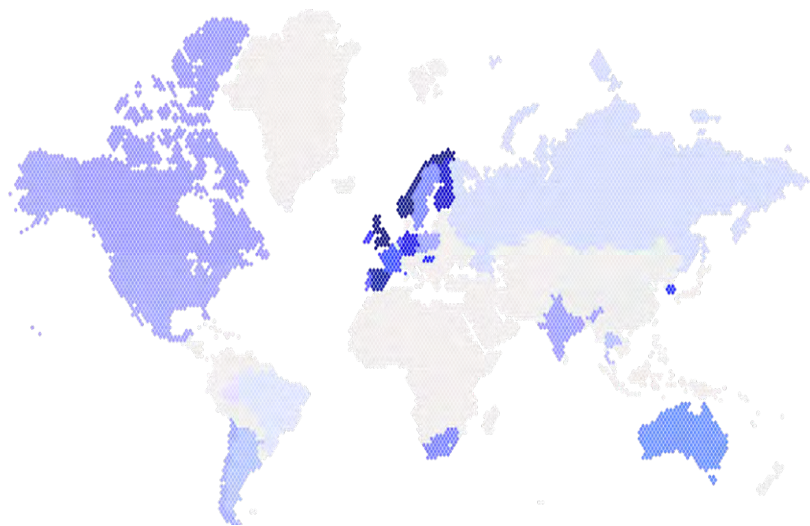

Figure 8: Google Trends Analysis of Searches for 'PropTech', November 2017 – November 2018

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23 Google trends for the last 12 months as of Nov 2018.

" The UK has a great chance to lead the way [in the digital transformation of real estate]. We have some of the most innovative property companies in the world, who are willing to accept challenge and disruption, and understand that things won't be perfect the first-time round, in the drive to give a better product to tenants. If we continue to work together as an industry, uninhibited by ego, fear or bias the UK has the ability to achieve a phenomenal transformation and leadership on the global stage.

The world is becoming smarter, better connected and more customer focused. If there is not a more concerted drive to embrace and evolve new technology property risks being left behind. *"*

William Newton, Wiredscore

4.1 Analysis

The market environment and underlying infrastructure is one of the key elements to enable digital transformation of Real Estate for a local market. In the cases of attracting inward investment, driving exports or the productivity of staff, this market environment will become a country's competitive advantage. Here, we take a look at a number of the key characteristics and then assess how different countries around the world are positioned relative to each other.

INVESTMENT IN TECHNOLOGY START-UPS

Digital transformation of Real Estate is complex and will ultimately be measured by impact and outputs from all companies. However, the ability for focused technology companies to attract investment is a good indicator of the wider health and impetus of a market. A large amount of venture capital funding means that there will be more, well-funded companies focused on solving specific problems.

DATA INFRASTRUCTURE

Almost all applications of technology are based on data in some shape or form. Data is often the competitive advantage for companies, however a mature and robust data infrastructure for a market is essential for the wider sector's digital transformation.

MARKET TRANSPARENCY

Market transparency has long been a factor and with the ever-growing complexity of markets, particularly where technology is involved, transparency and trust become more and more important. This is particularly true for both investment or regulation.

REAL ESTATE MARKET MATURITY

There are times when a young Real Estate market can be an advantage, but overall, we deem a mature, well-established and robust Real Estate market to be at a significant advantage for digital transformation. Inevitably, much of the focus to-date has been in the more-established markets, that are stable and of high value.

INNOVATION

Innovation is critical for the success of a future Real Estate market. As our business models, how we do our jobs and the way we use buildings changes, an ability to adapt and do things differently is imperative for future success.

TECHNOLOGY INFRASTRUCTURE

Much of the technology that is being used in the Real Estate sector is based on the physical technology infrastructure it is built upon. From connectivity to computer processing power, the better the infrastructure available, the better the technology solutions that can be built.

EDUCATION

Up-to-date insight, knowledge and skills are a key factor in creating a thriving and successful environment for organisations. This includes the education system such as schools and universities as well as the ongoing skills-development and training required throughout an employee's career.
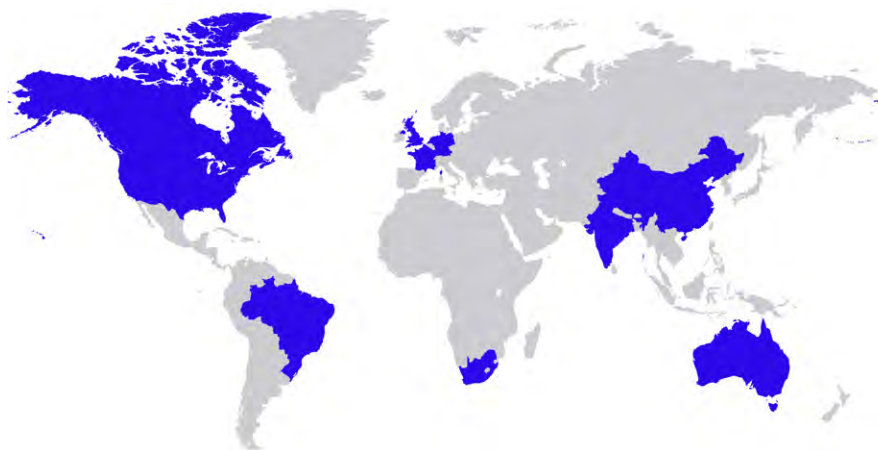
Figure 9: Map of Markets Compared on Digital Preparedness (see Figure 10)

Real Estate technology is a global challenge however for the purpose of this comparison, we have identified ten key markets (Figure 9) to compare against the United Kingdom; Australia, Brazil, Canada, China, France, Germany, India, South Africa, Netherlands and United States. The results of this analysis are shown in Figure 10. Scores of more than 90% are highlighted in green as they are considered a regional strength. A full methodology can be found in the Appendix C.

4.2 Regional commentary

When compared on a global scale, a country can only be fairly compared with another on a category by category basis, therefore an overall "score" is not possible to estimate. It should also be reiterated that this analysis looks at the conditions required for digital transformation in real estate to thrive, not the current adoption of technology or digital transformation that already exists. From the results it is clear that the United States performs well in more categories than any other nation, with the UK close behind. Two of the key advantages of the US market is its size and the amount of VC investment. This is not the only form of investment available, however the ability of technology companies to raise funds, and the willingness of corporates to spend money on digital transformation in the US, is one of its key strengths.
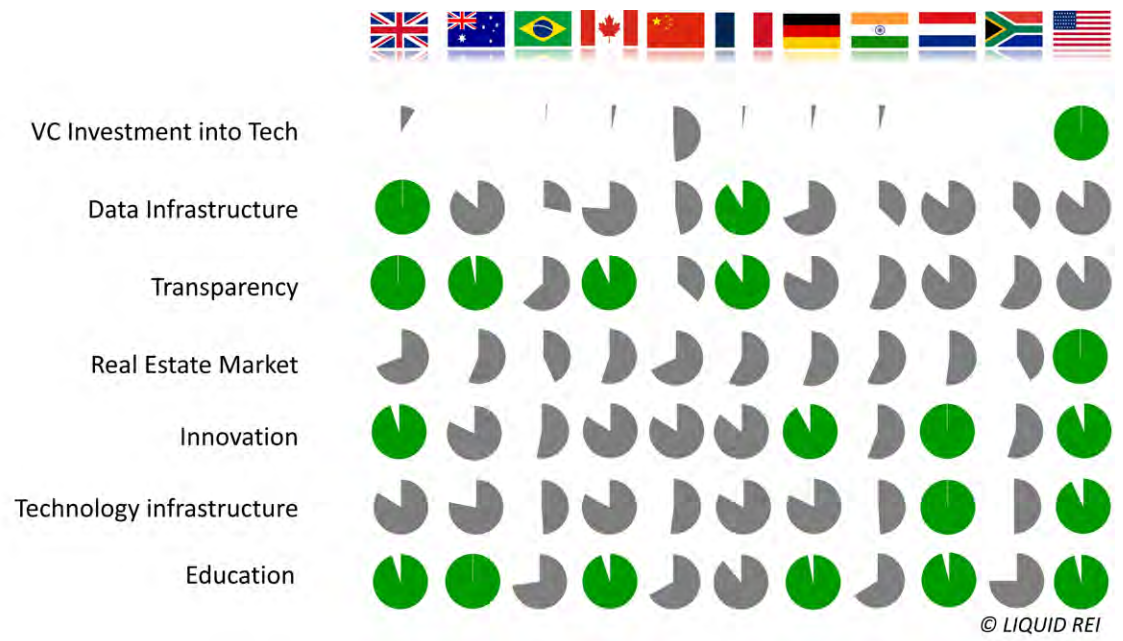
Figure 10: Country Comparison of Indicators of Digital Transformation Preparedness

The UK is well-positioned in different aspects with a strong Real Estate market and technology infrastructure. It can be considered as a market leader in Data infrastructure, market transparency, Innovation and Education. For the success of digital transformation in the UK, it is essential that the UK market focuses on these strengths and maintaining the competitive advantage in these areas. There is also a need to further improve the technology infrastructure and better provide an environment that eases investment and access to capital for real estate digital transformation.

KEY POINTS

The UK is a leader on the global stage in many of the elements that create the right environment for digital transformation. To maintain its position, the UK must maintain its strengths and develop the weaknesses.

05.
Conclusion and recommendations

The UK is a leading global economy but is facing several key challenges. The Real Estate sector has a significant part to play in solving each of these. As we move into a new digital age, it is imperative that the UK Real Estate market embraces this digital change to enable it to play a central role in solving the wider challenges of the UK economy. Of the senior leaders who provided input into this report, 80% felt that digital transformation of the Real Estate sector could be a key differentiator for the UK Economy.

The UK is well placed with an already highly-respected, mature and large Real Estate market and is also currently regarded as a leader in the digital transformation of Real Estate. However, these are such early days and things will change rapidly, so all parts of the sector need to work together to maintain the UK leading position at the forefront of global Real Estate transformation.

To do this, the UK must maintain its strengths and look to improve on its weaker areas. The feedback that we have received from industry leaders includes many different ideas with some common themes. Figure 11 details the three headline recommendations that we believe will keep the UK at the forefront of global digital Real Estate transformation.

1. Foundations for the future

a. UK Government to publish a roadmap of Real Estate-relevant digitalisation plans,

b. A cross-sector coalition to map built environment data standards, to research priority use cases and ways to improve data sharing across the whole lifecycle,

c. Real Estate companies to build digital skills into all staff training and ensure digital transformation feeds directly into business plans.

2. Joined-up Government

a. A Minister-led digital Real Estate forum to be created,

b. Government to create a digital government interface or hub for people to discover and access Government activity relating to the digitalisation of Real Estate,

c. UK Government to actively promote digital Real Estate on a world stage.

3. Innovation and adoption

a. The UK Real Estate sector to create a collaborative Real Estate R&D hub or lab,

b. The UK Government to launch a Real Estate catapult.

c. Use financial and regulatory levers:
  • The Government to target R&D tax credits and InnovateUK competitions towards Real Estate. Furthermore, it should ensure that technology to benefit a building over its lifespan is considered within the planning process,
  • The Real Estate sector to ensure that data and technology is clearly articulated as part of the decision-making process and therefore more obviously included within the valuation of property.
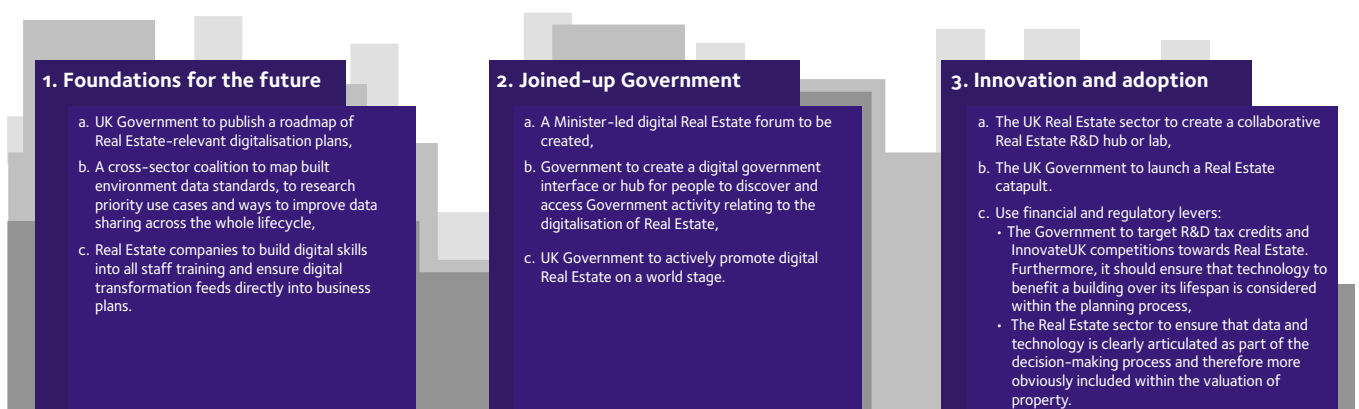
Figure 11: Our Recommendations by Theme

5.1 Foundations for the future

Real Estate has changed little in decades, and until recently has been slow to consider technology as part of its strategic thinking. However, as technology has an increasing impact, it is imperative that the UK ensures that the appropriate foundations are in place. To do this, we recommend the following three actions:

a. The Government needs to continue to work towards digitalising and connecting its services, particularly the continued digitalisation of land registration, conveyancing and improving interoperability, awareness and access to data.

   UK Government to publish a roadmap of Real Estate relevant digitalisation plans.

b. An increased focus on providing appropriate data standards and mechanisms for sharing data across the whole lifecycle of a building. At the moment, standards exist for different disciplines, for different data points or for different stages of the built lifecycle. The whole industry, standard-setters, regulators, Government, property companies and technology

companies across the whole lifecycle, must come together to provide an understanding of the data standards that are already in existence, the use cases for improved data-exchange and ways to improve data-sharing.

A cross-sector coalition to map built environment data standards, to research priority use cases and ways to improve data-sharing across the whole lifecycle.

c. Embed digital skills across the built environment. The ability to programme or carry out complex data analysis is not necessary for most organisations working in Real Estate today, however as technology becomes more influential, it is essential that people working in the sector have a basic grasp of what is happening and how the sector is changing. In addition to this, it is essential that digital transformation and technology is a fundamental part of any Real Estate company's strategy and decision-making process. It can no longer be a choice between today's business and tomorrow's business; it must be both. This may be achieved in different ways which is for individual companies to decide, a common suggestion is to have a dedicated person on its board, responsible for future digital transformation of the business, separate from the traditional IT team.

Real Estate companies to build digital skills into all staff training and ensure digital transformation feeds directly into business plans.

5.2 A joined-up Government approach

There are a significant number of different initiatives that are underway in the UK that directly or indirectly impact the digital transformation of Real Estate. However, that activity is often disconnected from other initiatives, is hard to discover and difficult to access from the outside.

Real Estate is key to solving the biggest challenges facing the UK and as Real Estate is such a sizable and diverse sector, initiatives tend to focus on small elements of it. However, as technology blurs sectors and drives increasing importance on the whole-life of a building, a more joined-up and outcome-focused approach is needed.

We recommend that the Government aligns existing activities to be more joined-up and focused on the outcomes needed. We believe the first steps should be:

a. A single forum that brings together all of the different government departments, policies and activities that affect the built environment. This should have a single minister responsible for ensuring current activity is shared, coordinating future activity to solve national challenges and ensuring appropriate amounts of Government Innovation funding is targeted towards the Real Estate sector. For example, InnovateUK competitions to line up with other initiatives to solve a specific Real Estate challenge.

A Minister-led, Digital Real Estate Forum to be created.

b. When it comes to the digital transformation of Real Estate, it can be very challenging to identify relevant activities, initiatives or people within Government. Often initiatives, support or data are/is available, but can be difficult to discover or to access. We recommend that a single, market-facing, digital interface be created that allows start-ups, through to corporates to identify and understand the Government's relevant activities.

Creation of a digital Government interface or hub for people to discover and access Government activity relating to the digitalisation of Real Estate.

c. The UK Real Estate market is capable of becoming the global leader in the digital transformation of the sector. It is already one of the most active geographies in this space and considered as a thought leader. It also has many of the environmental elements to lead the world. The UK should be promoting itself on a world stage to make sure the current achievements are recognised, ultimately driving increased inward investment and increase exports.

UK Government to actively promote Digital Real Estate on a world stage.

5.3 Innovation and adoption

The Real Estate sector is by its very nature, slow-to-change. Buildings take a long time to plan and build, and people normally use them for many years at a time. This is the case whether buying a house or leasing an office. It is therefore unsurprising that many Real Estate processes, structures and skills are not designed to react to short-term market change. Technology, on the other hand, changes rapidly and the rate of change is getting quicker. It is this change that has driven a need for companies in Technology to invest significant amounts of time and resource in R&D exploring the future. As technology increasingly changes Real Estate, Real Estate companies will also need to invest more into future business models whilst maintaining existing ones.

There is already anecdotal evidence of some companies from other sectors, particularly from the technology sector creating the products of the future for the Real Estate industry, and exploring the transformation of the Real Estate sector itself. As technology provides an increasing threat to Real Estate companies, it also creates new opportunities for those that invest in exploring and being prepared for the future.   It is these companies that will thrive going forward in an increasingly competitive environment. To achieve this, we believe that three things should happen.

a. The market of tomorrow, both how we do our jobs and how we use buildings will change dramatically. The Real Estate sector must start investing time and capital to prepare for this, ensuring they can best serve both their own needs and those of their customers and employees. All Real Estate companies should both invest in R&D and ensure that it is not looked upon as just a cost, but an essential investment in the future of their business, as is the case in other sectors. Testing ideas within an R&D environment allows much more efficient business adoption and adaption to technology in the future. The amount companies choose to invest in innovation and R&D is clearly a matter for them, however we believe that all organisations should commit to investigate how much they currently spend and whether they have the appropriate structure to allow innovation to flourish. As a benchmark from other sectors, 10% of gross revenue is quoted as being invested in R&D within the technology sector.

Alongside this, we would recommend that a collaborative Real Estate industry R&D hub be created. This will be a space for Real Estate companies, technology companies and the wider community to work together to explore the future opportunities in the market. All participants will share in the benefits of the outcomes. Competitive advantage can then be gained in the execution of the ideas and concepts. This collaborative hub should not be in lieu of organisations carrying out their own work in this space.

The UK Real Estate Sector to create a collaborative Real Estate R&D hub or Lab.

b. Alongside the UK Real Estate Sector hub, the Government should create a separate, but related "catapult" aimed at solving the nation's Real Estate-related challenges. The focus of this should be to specifically fund projects aimed at national problems or challenges that bring together various Government initiatives. Unlike the R&D function, the purpose of this should be to actively support companies, projects and concepts in the Real Estate space to grow. The focus should be on two primary stages of a company, initial concept and scale up where there is often insufficient support for small companies.

Funding for this should be provided by the Government, however commercial partners should be sought to provide appropriate funding and support.

The UK Government to launch a Real Estate catapult.

c. Understanding what is going to happen, focusing on the wider national challenges and joining up existing work is all essential, but there is also an important role for Government and the wider sector to play in driving adoption. Adoption of technology is often wanted, but difficult to justify without a clear return-on-investment. Properties are usually built to be used for many years and transact very rarely, so measuring the return-on-investment for a technology can be very challenging. We believe that there are a number of financial levers that may be used to encourage adoption of technology and to ensure the UK benefits from digital transformation as quickly as possible. These include:

- Financial instruments exist to help companies investing in R&D and we would encourage Government to ensure that these clearly support activity within the real state sector.

- We believe that there should be a number of Real Estate related InnovateUK challenges launched.

- The sector should explore how technology feeds into the valuation of a building. By ensuring that building technology and data is considered more specifically by all parties there will be a much more tangible financial incentive and it will be easier to calculate a return-on-investment. This is highlighted at the point of any transaction, specifically in the valuation of a building.

- The proposed use of data and technology to benefit the whole-life of the building should be taken into consideration at planning application-stage to influence the outcome.

Use financial and regulatory levers.

- **The Government to target R&D tax credits and InnovateUK competitions towards Real Estate. Furthermore, it should ensure that technology to benefit a building over its life-span is considered within the planning process.**

- **The Real Estate sector to ensure that data and technology is clearly articulated as part of the decision-making process and therefore more obviously included within the valuation of property.**

Appendices

Appendix A
Acknowledgements

Appendix B
Glossary

3D Printing	The ability to print a physical object from a design "on-site". Most commonly spoken about in terms of construction, but also likely to have wider impacts on the wider use of the built environment, for example on infrastructure and logistics.
3G, 4G, 5G	These all refer to mobile networks with the G standing for Generation, for example 3G represents the 3rd generation. Each new generation brings a step up in the amount of data that can be transferred over the network. 5G is on its way which will allow significantly more data to be consumed by mobile devices. 5G also works over a much shorter distance than previous generations, with implications for Real Estate since it is likely to function best in urban environments and will require masts to be placed on buildings and other infrastructure.
Application (App)	Applications, most commonly referred to as apps, are computer programs that can be used by technology. These are usually self-contained programmes that are downloaded to a device. Typically, they are a piece of software that sits atop a proprietary operating system.
Artificial Intelligence (AI)	Artificial Intelligence is used to mean different things at different times, but in essence is where machines display what we would consider intelligence. For example, the ability to learn or solve problems and typically behave in a more "human" way of doing so. AI would also include other areas such as machine learning (see below).
Automation	The use of technology to carry out repeatable tasks automatically.
Big data	The use of very large data sets to identify patterns. People refer to the characteristics of big data through the "4 V's" - Volume, Velocity, Veracity, Variety. At LIQUID REI, we consider a 5th V - Value which we believe is going to become increasingly important in time.
Blockchain	Blockchain is a distributed ledger. This is a record of transactions that is kept on multiple computers meaning that if a record is changed, it is easy-to-identify. The records are referred to as blocks and each one contains a small part of the previous block creating a chain, hence blockchain. Blockchain was originally developed as a technology upon which Bitcoin was based, but has multiple uses. The primary thing that most people in Real Estate need to know about blockchain is that it does away with the need for a central authority figure. Examples of where it might be used are with a currency, where blockchain replaces the need for a central bank or Land Registration where it can do away with a single Land Registry authority figure. However, blockchain also has downsides, so is most likely in our opinion to be an important part of long-term technology solutions, but not the solution to everything.
Broadband	Normally refers to high speed internet access, usually delivered to a building by cable.
Building Information Modelling (BIM)	Building Information Modelling (BIM) is the use of 3D digital models throughout the life of a building which has been shown to lead to significant benefits both during construction and most importantly through the operation of the building. BIM has been mandatory in the UK for all Government construction projects in the UK since 2016. BIM is not a stand-alone technology with culture, collaborative ways of working, etc. all being essential to its adoption.
Building Management Software (BMS)	A BMS is a piece of software designed to monitor and manage a building, typically this is the electrical equipment and systems. Normally found in larger buildings they can cover a wide variety of systems such as security, machinery or temperature.
Computer-Aided Facilities Management (CAFM)	Typically a system that is similar to CMMS, but with additional operational functionality for facilities management that would include a wider scope, such as purchasing, room booking, or resource scheduling.
Computerised Maintenance Management System (CMMS)	A technology system that is focused on the maintenance of a building, typically with complete workflow and allocation of maintenance resources.
ConTech	A subset of the broader PropTech, ConTech is a label used for the digital transformation within the construction sector. As the lifecycle of a building becomes increasingly important, few built environment technologies are going to be unconnected from others.
Cryptocurrency	A currency reliant on technology rather than a single authority figure to manage its creation, propagation, record keeping and exchange.
Data	Data is a record of something, normally in digital format.

Data Lake	A data lake is usually a single large collection of data, normally stored in its original format. This allows organisations to access multiple data sets to help with reporting, visualization or analytics.
Data Science	Data science is the use of scientific methods, processes, algorithms and systems to extract knowledge and insights from both structured and unstructured data.
Data Standards	Standards that can be applied to data. These can come in a number of forms, from prescriptive technical standards through to principles-based standards.
Database	A database is an organised collection of data, generally stored and accessed electronically from a computer system.
Drone	An unmanned vehicle without the need for a human aboard. Most commonly refers to aerial drones, but may also include other autonomous vehicles.
Environmental Management System (EMS)	EMS systems are technology systems aimed at running the building with a focus on environmental factors.
FinTech	A label attached to the digital transformation happening in the financial sector. There is often a cross over between PropTech and FinTech where the technology is aimed at the financial side of Real Estate, such as raising funds, investment management, etc.
General Data Protection Regulation (GDPR)	Is an EU regulation on data protection and privacy for all individuals within the European Union and the European Economic Area and is applicable to all companies working in these markets.
Geographic Information System (GIS)	A geographic information system (GIS) is a technology system that enables the capture and analysis of spatial, geographic or location data.
Geomatics	Geomatics is the discipline of gathering, storing, processing, and delivering geographic information or spatially referenced information.
Geospatial Information	Geospatial information, also referred to as location information, is information describing the location and names of features beneath, on or above the earth's surface.
Graphene	A material that is a simple structure of carbon that was first discovered in Manchester through use of sticky tape and a pencil. Graphene displays incredible material performance abilities in terms of strength, conductivity, etc. Currently costly and difficult to manufacture at scale, but significant investment is being put into research in this area.
Hardware	Typically refers to the tangible and physical aspects of a computer or technology.
Hologram	A three-dimensional image formed by the interference of light beams from a light source.
Image recognition	Image recognition is the use of technology to identify objects from a digital image or video.
Infra-Red	Infra-Red is a form of light which is not visible to the naked eye, so often used in applications such as sensors.
Integrated Workplace Management System (IWMS)	These are similar in principle to CAFM.
Intellectual Property	Intellectual property typically refers to intangible creations of people and includes copyrights, patents, and trademarks. Data and software is often covered by some form of intellectual property restrictions or requirements.
LiDar	LiDar is a technology for measuring distance by illuminating the target with pulsed laser light and measuring the reflected pulses with a sensor. It can provide highly accurate measurements.
Machine Learning	Machine learning is where a computer uses statistical techniques to give computer systems the ability to "learn" from data, without being explicitly programmed. Machine Learning is particularly focused on the result, as opposed to the methodology.
MetaData	This is a set of data that describes other data. Often as important as the data itself, it can describe such things as who, where or when the data was created.
Mixed Reality	Mixed reality (MR) is the combination of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real-time.
Neural Network	An artificial neural network is an interconnected model comprising a series of mathematical functions inspired and loosely modelled on the workings of a brain. A feature of the network is its ability to tune itself to obtain greater accuracy, which can mean that pretrained models can be used for similar tasks relating to data they have not previously seen. In some applications, accuracy can exceed human levels.
Off-Site Manufacturing	Off-site manufacturing is a construction technique in which prefabricated and standardised components or modules are manufactured in a controlled factory environment, transported, erected, and assembled into the on-site structure.

Open Data	Open data is the idea that some data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control.
PropTech	PropTech is a catch all label associated with the digital transformation of property and the wider built environment.
Quantum Computing	Quantum computing is the area of computer technology based on the principles of quantum theory, which will lead to significantly more powerful computer processing power. A quantum computer makes use of Qubits that can hold many more states than the on/off state of a bit used in a conventional computer; this means they can hold more information and achieve certain tasks faster. However, there are certain tasks for which there is not a satisfactory algorithm and for such problems, quantum computers may be bound by the same limitations as current computers.
Quantum Cryptography	Quantum cryptography is the science of exploiting quantum mechanical properties to support cryptographic tasks, for example the use of quantum key distribution.
Robot	A robot is a machine – especially one programmable by a computer – capable of carrying out a complex series of actions automatically. Robots can be guided by an external control device or the control may be embedded within.
Schema	A schema is a framework or concept that helps organise and interpret information.
Sensors	A sensor is a device that detects events or changes in its environment and passes that information on. Typically this would be an electronic signal sent to a computer system.
Smart Building	Typically a building that uses automated processes to automatically control the building's operations. Examples could include the internal environment, people flow or building services.
Smart City	An urban area that uses different types of electronic data collection sensors to supply information which is used to manage assets and resources efficiently Typically an urban area that uses automated processes to automatically control the areas operations. Examples could include the energy performance, people or traffic flow or citizen connectivity.
Software	A collection of data or computer instructions that tell a computer or piece of technology how to work.
Topographic Identifier (TOID)	A unique reference identifier assigned by the Ordnance Survey to identify every feature that they capture in Great Britain.
Unique Property Reference Number (UPRN)	A unique identifier for a property. Most commonly this refers to the Government UPRN associated with every spatial address in Great Britain. It provides a comprehensive, complete, consistent identifier throughout a property's life-cycle, from planning permission through to demolition.
Venture Capital	A form of financing that is provided by firms or funds to small, early-stage, emerging firms that are deemed to have high growth potential, or which have demonstrated high growth.
Wearables	An electronic device that can be incorporated into clothing or worn on the body as implants or accessories.
Wifi	Technology for radio wireless local area networking of devices.

Appendix C
Methodology

LIQUID REI carried out three key pieces of analysis to estimate market factors in support of this report. Below is an overview of the methodology and data sets used.

ESTIMATE OF CURRENT SPEND ON TECHNOLOGY

In order to estimate the current overall spend on technology, we estimated the spend on data, hardware and software for the Real Estate market, the construction market and for each transaction ensuring any duplication between the three categories were avoided.

Data sources included YouGov, ONS, McKinsey, Ordnance Survey, Argus, Coyote, Re-Leased, RICS, Rightmove, Zoopla, Autodesk, Landmark, ESRI, UK Planning Maps, Microsoft, Salesforce and Sage.

ESTIMATE OF COST SAVINGS FROM USE OF DATA

In order to estimate the current annual cost savings achieved from the use-of-data to improve building-performance, we estimated the saving achievable for residential and commercial property from data and scaled to the whole-market based on LIQUID REI market penetration estimates.

Data sources for this included Ordnance Survey, McKinsey, LSH and PWC.

REGIONAL MARKET ENVIRONMENT COMPARISON

In order to compare different markets, we identified some of the key elements that inform the environment for successful digital transformation of the Real Estate sector. For each of these, we built a score based on the methodology and data described below.

Each category has not been weighted, therefore countries may only be compared on a category by category basis and so an overall score cannot fairly be calculated at this stage.

- VC Investment into technology – figures from the KPMG Venture Pulse report (Q4 2017) were used.

- Data infrastructure – In order to produce a robust score for each country, we looked at a wide range of key data sets for the built environment including available government data, investment market data, cost data, sustainability data and geospatial data. Data sources included the Global Open Data Index, MSCI, JLL and GeoBuiz augmented with opinions of market experts in the individual data sets where appropriate.

- Transparency – country transparency is based on a combination of the JLL transparency Real Estate Index, Transparency International data and the Global Open Data Index.

- Real Estate market maturity – To identify the Real Estate market maturity we considered transparency of Government data such as land ownership, residential and commercial market size, and wider market transparency.

- Innovation – we used data from the Global Innovation Index.

- Technology infrastructure – to assess the technology infrastructure, we considered broadband, 4G network, smart phone use and the world wide web foundation web index.

- Education – we used the United Nations Education Index.

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