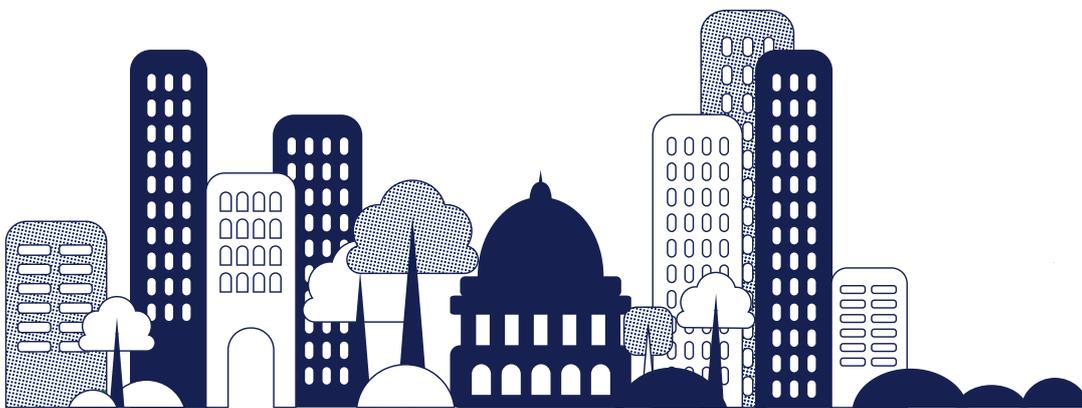


PropTech 3.0: the future of real estate



PropTech 3.0: the future of real estate

Right now, thousands of extremely clever people backed by billions of dollars of often expert investment are working very hard to change the way real estate is traded, used and operated. It would be surprising, to say the least, if this burst of activity – let's call it PropTech 2.0 - does not lead to some significant change. No doubt many PropTech firms will fail and a lot of money will be lost, but there will be some very successful survivors who will in time have a radical impact on what has been a slow-moving, conservative industry. How, and where, will this happen?

Underlying this huge capitalist and social endeavour is a clash of generations. Many of the startups are driven by, and aimed at, millennials, but they often look to babyboomers for money - and sometimes for advice.

PropTech 2.0 is also engineering a much-needed boost to property market diversity. Unlike many traditional real estate businesses, PropTech is attracting a diversified pool of talent that has a strong female component, representation from different regions of the world and entrepreneurs from a highly diverse career and education background. Given the difference in background between the establishment and the drivers of the PropTech wave, it is not surprising that there is some disagreement about the level of disruption that PropTech 2.0 will create.

In this research we interviewed over 50 real estate professionals, entrepreneurs and capital providers. From one side, we heard that none of these startups know what they are doing and that young entrepreneurs misguidedly regard real estate as a sure thing. From the other, we heard that real estate people are not good at strategy and are determined to protect inefficient fee-earning practices.

2017 seems to mark a turning point. PropTech 2.0 has been building such mass and momentum that it will change the world. But real estate is a slow moving asset class, and the real estate industry is highly conservative. How will this play out?

This, the Said Business School Oxford's first real estate research report, maps this emerging sector and focusses in particular on the impact of tech change on the character of this enormous asset class.

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Notes

Material from interviews is quoted verbatim in the text. Verbatim quotes and materials taken from websites are set in italics. Where interview materials are unattributed, this is at the request of the interviewee. The views are of the interviewees and should not be assumed to be the views of the companies they work for.

I should acknowledge my personal interest in the following tech businesses: Property Funds Research, Real Estate Strategies, Source Central and Infabode. My view of these businesses may not be objective.

Andrew Baum
Oxford
April 2017

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Chapter 1

InfoTech, FinTech and PropTech – beneath the buzzwords

In this chapter we attempt to come up with an initial definition of PropTech and its scope

1.1 Introduction: PropTech is about information, transactions and management

The internet and mobile telephony have enabled a boom in technology platforms applied to nearly all areas of our lives – jobs, homes, education, health, leisure, finance and even romance. This has happened through the facilitation of three different activities. These are as follows.

Information provision

Wikipedia, the BBC website and on-line newspapers are examples of on-line information engines. Initially, the internet, mobile telephony, social networking and e-mail were all about information, hence the previously ubiquitous use of the term 'infotech'.

Transactions

Information is the key input into the due diligence phase of a transaction. Shopping on-line was therefore the natural next phase of technology development. Paypal, Amazon and on-line banking are examples of internet and mobile telephony being used as a medium for the exchange of money, goods and services.

Management and control

PCs, tablets and mobile phones are potential dashboards for controlling electronic functions. The Internet of Things (IoT) allows objects to be measured (information provision) but also sensed and/or controlled remotely across the existing network infrastructure, creating opportunities to adjust or turn systems on or off remotely. As an example, Google's 2014 acquisition of Nest to create a Google IoT division was seen at the time as a significant moment. Also, the remote control of driverless cars and delivery vehicles, plus bots offering a range of services, are setting in motion many thought processes imagining the likely future of logistics and retail real estate.

1.2 Background: the FinTech revolution

The FinTech industry – in particular, online payment systems, crowdfunding equity and debt platforms and online exchanges – provides the foundation for a large part of the PropTech 2.0 revolution. The development of intelligent control engineering is another plank. Much relevant work has already been done in other places and real estate can, as usual, be a late entry to the party, using the lessons learned from what works and what does not in the wider world of banking and engineering.

In this report, we set out to contribute toward a better understanding of PropTech and Real Estate FinTech. Ideally, the report would develop an authoritative classification system for the thousands of PropTech startups, SMEs, larger mature companies and unicorns which appear to connect the world of technology with the world of real estate. Unfortunately, however, this is unlikely to be easy or uncontroversial. This is partly because the world of real estate defies authoritative classification. (To what extent does it include infrastructure, cities, forests?) It is also because the relationship between FinTech, Real Estate FinTech and PropTech is less than obvious or uncontroversial.

In the 2015 World Economic Forum report *The Future of FinTech* (produced in cooperation with Saïd Business School at the University of Oxford) FinTech is defined as “*the use of technology and innovative business models in financial services*”.

KPMG and CB Insights’ *The Pulse of Fintech Report* (2016) suggests that while FinTech covers a diverse array of companies, business models and technologies, companies generally fall into several key verticals (industry sectors), including:

Lending tech: Lending companies, primarily peer-to-peer lending platforms, as well as underwriter and lending platforms using machine learning technologies and algorithms to assess creditworthiness.

Payments/billing tech: Payments and billing tech companies providing solutions ranging from the facilitation of payment processing to subscription billing software tools.

Personal finance/wealth management: Tech companies that help individuals manage their personal bills, accounts and/or credit as well as manage their personal assets and investments.

Money transfer/remittance: Money transfer companies including peer-to-peer platforms to transfer money between individuals across countries.

Blockchain/bitcoin: An emerging technology that uses distributed databases maintained by the users, allowing for a record and transfer of digital assets across all participants in the network without a third party or exchange.

Institutional/capital markets tech: Companies providing tools to financial institutions such as banks, hedge funds, mutual funds or other institutional investors. These range from alternative trading systems to financial modeling and analysis software.

Equity crowdfunding: Platforms that allow a collection of individuals to provide monetary contributions for

projects or companies provisioned in the form of equity.

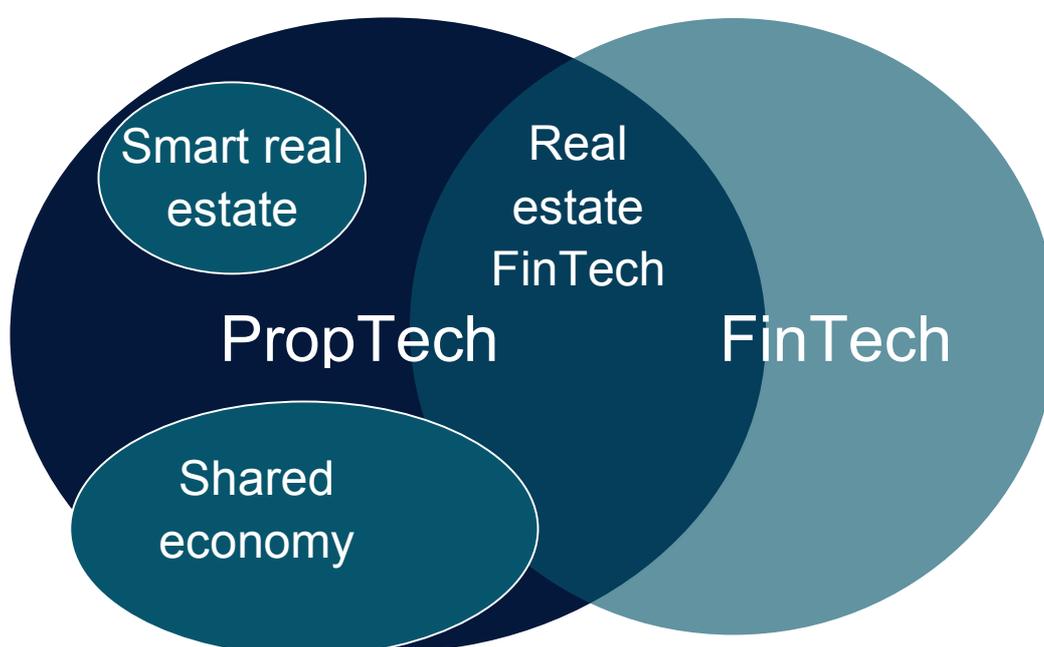
InsurTech: Companies creating new underwriting, claims, distribution and brokerage platforms, enhanced customer experience offerings and software-as-a-service to help insurers deal with legacy IT issues.

From this list the following is clear.

FinTech could be seen as a very good guide to where a lot of PropTech activities will be directed. All of the above categories are relevant to real estate, and there are examples of PropTech firms operating in all of these industry verticals. From this point onwards, we call this Real Estate FinTech.

PropTech is not a subset of FinTech. For example, technology designed to make a building smart through data collection and analysis, and responsive through control mechanisms, is not FinTech. In addition, FinTech, as described by the categorisations above does not capture what is called collaborative consumption, the sharing/shared economy or the peer economy, in which owners rent out something they are not using, such as a house or office (or car, or bicycle) to a stranger using these peer-to-peer services. Airbnb is the category killer here: this is not quite FinTech, but it is clearly a PropTech venture.

Figure 1.1: PropTech and FinTech



Hence our Venn diagram (Figure 1) shows PropTech and FinTech to be separate groupings, sharing one overlap which is Real Estate FinTech. Smart buildings (or, more generally, smart real estate) and the shared economy are examples – perhaps the best or only examples – of non-FinTech PropTech sectors, albeit subject to the possibility that short term leases of office space offered by, for example, WeWork, will have some

connection to Real Estate FinTech. (The shared economy also works for the temporary use of personal, rather than real, property, so some shared economy activity is not PropTech).

There are three PropTech sub-sectors (verticals), and three drivers (horizontal). The verticals are Real Estate FinTech; Shared Economy; and Smart Real Estate. The horizontals are information; transactions (or marketplaces); and control. Not all segments seem likely to be populated.

Table 1.1: PropTech verticals and horizontals

	Real Estate FinTech	Shared Economy	Smart Real Estate
Information	yes	yes	yes
Transactions/marketplace	yes	yes	
Management/control			yes

We will test this taxonomy by reference to the many current PropTech ventures in Chapter 3. Before proceeding, however, we need to suggest working definitions of these three PropTech vertical subsets.

1.3 PropTech sectors – the verticals

Smart Real Estate describes technology-based platforms which facilitate the *operation and management* of real estate assets. The assets can be single property units or entire cities. The platforms may simply provide information about building or urban centre performance, or they may directly facilitate or control building services. This sector supports real estate asset, property and facilities management. We discuss this vertical in Chapter 4.

The Shared Economy describes technology-based platforms which facilitate the *use* of real estate assets. The assets can be land or buildings, including offices, shops, storage, housing and other property types. The platforms may simply provide information for prospective users and sellers of space, or they may more directly facilitate or effect rent- or fee-based transactions. This sector supports the real estate occupier markets. We discuss this vertical in Chapter 5.

Real Estate FinTech describes technology-based platforms which facilitate the trading of real estate asset *ownership*. The assets can be buildings, shares or funds, debt or equity; ownership can be freehold or leasehold. The platforms may simply provide information for prospective buyers and sellers, or they may more directly facilitate or effect transactions of asset ownership or leases with a (negative or positive) capital value. This sector supports the real estate capital markets. We discuss this vertical in Chapter 6.

What related platforms or businesses does this report exclude from the PropTech universe? Primarily, we

exclude technology which supports the design and/or construction of buildings or infrastructure.

In 2016, CB Insights tracked 31 Construction Tech (ConTech) startups. The emerging (ConTech) sector, newer than PropTech, is increasingly a defined area for investment by VC firms such as Brick and Mortar Ventures (San Francisco). Defined by this VC as a sector focussed on the 'built world', involving architects, engineers, construction firms and facilities managers, ConTech bumps into and at the same time underpins PropTech. The first unicorn in this area, ProCore, and newer firms such as Plangrid, Holobuilder, Micello, Kahua and Rhumbix, focus on data-driven efficiencies across the construction process, such as recording and benchmarking productivity, facilitating the exchange of information between main and sub-contractors, sharing plans and simply replacing paper-based reporting in a huge industry whose IT spend is believed to be below 1% of total costs.

Excluding undisclosed deals, \$2.2B was spent on acquiring companies in the Construction Tech sector in 2016. This figure is six times the total funding secured by the sector (\$357M in 68 rounds). Out of the eight M&As reported in 2016, five of the acquired companies belonged to either project management or marketplace segments, traditionally the most funded business models in Construction Tech. Iron Planet (acquired by Ritchie Bros, \$750M), Textura (acquired by Oracle, \$663M), and ConstructConnect (acquired by Roper Tech for \$632M) emerged as the top M&A exits in 2016. Despite an overall dip in total funding, companies in the building tech (from \$26M to \$38M) and visualisation (from \$11M to \$34M) space saw a spike in YoY total funding.

Tracxn blog, February 2017

Although we may see later that investors include the ConTech vertical in their definition of PropTech, and the overlap with smart building tech is very obvious (the distinction between the operation, refurbishment or construction of a building might be a fine one), we regard this sector as being adjacent to – but not part of – the universe we are concerned about. By doing so, we are reflecting the cleave between the real estate and built environment industries. This distinction may well disappear over time.

Finally, we should also differentiate between endogenous or internal PropTech, as defined here, and the broader impact of exogenous technology developments such as autonomous vehicles and artificial intelligence on buildings, cities and the entire built (or rural) environment. Blockchain is an example of exogenous tech whose impact on real estate transactions could be revolutionary. This – PropTech 3.0 – is covered in Chapter 7.

We return to our broader themes in Chapter 8, when we will review the tension between the nature of real estate as an asset class and the instant nature of a tech-facilitated transaction; between ambitious millennials and conservative baby boomers suddenly confronting each other inside the real estate industry; and between a narrow view of PropTech and a wide view of the impact of technology of real estate and lives.

Next, in Chapter 2, we will trace the forerunner of the current PropTech boom, which we will call PropTech1.0, nested in what was called the Dotcom boom of the late 1990s.

Chapter 2

From PropTech 1.0 to PropTech 2.0

In this chapter we describe the drivers behind the first PropTech wave of 1980-2000, describe the conditions which led to the current PropTech 2.0 wave, and examine the limitations of real estate as an asset class which are driving much of this activity

2.1 The background to PropTech 1.0

Real estate is a very large - the largest - asset type and one of the last to adopt technological change and the innovation that tech can bring. This should present a massive area of opportunity for entrepreneurs. The opportunity is driven not only by the size of the industry and its lack of tech adoption, but also by industry practices plagued by inefficient processes and unnecessary transactional costs defended by self-interested professionals and institutions.

Real estate is not known as an industry which readily embraces change. The nature of the asset class, which comprises large heterogeneous assets traded in a largely private market, is perhaps a good reason for this. Homes may be too important a part of a private portfolio to take any risks with the process whereby it is traded, held or valued. It may also be the case that there is an agency problem: the professional advisors that dominate the transaction process clearly have an interest in protecting their income sources, so chartered surveyors, brokers and lawyers might all be expected to resist tech-driven innovations designed to 'disrupt' their work.

Nevertheless, in current times we are witnessing a battle for market share between traditional advisors and a discernible second wave of technology-based innovation. The first wave (PropTech 1.0) took place in the US, UK and elsewhere in the mid-1980s. This was all to do with data and computing power.

The invention of computing in the 1930s and 1940s and the subsequent 40 years of development made little or no impact on property markets. The key driver of change was the introduction of the personal computer in the late 1970s/early 1980s. The Apple II and the twin floppy disc IBM PC XT (introduced in 1983) both supported spreadsheet applications (VisiCalc and Supercalc) before Lotus 1-2-3 and, later, Excel became industry standard platforms for the organisation and analysis of data. Alongside the development of the personal computer (PC), the mainframe computer was becoming more and more efficient and affordable. It was in the mid to late 1980s that this started to have an impact on property practice.

The growth of indirect private fund vehicles with different styles, debt and asset-backed securitisation, the arrival

of REITs, the growth of a derivatives market – all of these developments fed on and demanded a much more quantitative and research focussed approach to performance measurement and investment strategy; and the rapid globalisation of the real estate industry in terms of investors, sources of capital and advisory services substantially reduced the insularity of the industry and brought increased demands for a more research-led product. Growing data availability enabled more finance-grounded quantitative modelling, and valuation software and property and portfolio management systems became computer and technology based. Excel became an essential real estate tool.

Alongside these parochial developments, e-commerce had become increasingly popular in the wider world in the 1980s, followed by the internet and e-mail in the 1990s. There was no internet access or ease of transfer of files via emails until the late 1990s, by which time internet and e-mail use had facilitated mass data storage and analysis. Table 2.1 describes the growing volume of internet traffic in the US over this decade. The tipping point came in 1995 and 1996, after which the world changed. The dotcom boom, associated with the years 1995-1999, and bust, 1999-2001, were the perhaps inevitable result. Market places such as Craigslist (US) were established, and print market places such as Exchange and Mart and (UK) began the transition from print to web, selling real estate alongside household goods and holidays.

Table 2.1: Traffic on US internet backbones, 1990 - 2000

1990	1
1991	2
1992	4.4
1993	8.3
1994	16.3
1995	not known
1996	1,500
1997	2,500-4,000
1998	5,000-8,000
1999	10,000-16,000
2000	20,000-35,000

Source: Coffman and Odlyzko, 2000

2.2 PropTech 1.0

Property Market Analysis (PMA) was founded in London in 1982 to develop and sell the outputs of PC-driven property research. Using mainframe computing, NCREIF was established in 1982 to establish a property index for the US going back to 1978 and the Investment Property Databank (IPD) was founded in 1985 to organise and analyse data describing the performance of commercial property in the UK. In 1987 Prudential in London and (the wholly unconnected) Prudential in New York both set up the first institutional property research teams on either side of the Atlantic, using PCs.

In the construction technology world, 1982 saw the launch of Autodesk, an American and now multinational software corporation that makes software for the architecture, engineering and construction, industries employing computer-aided design or CAD.

Argus, which has become a leading global provider of software and solutions for the analysis and management of commercial real estate investments, was first established in the mid to late 1980s. Yardi, another leading provider of software solutions for the real estate industry, was established in 1984. CoStar, a provider of information, analytics and marketing services to the commercial real estate industry in the United States, Canada, the United Kingdom, France, Germany and Spain, was established in 1987. These companies established market leading positions which they continue to hold, alongside the less limited Excel, in 2017.

These dominant technology-based businesses established themselves by providing apparently comprehensive closed-form enterprise services, often requiring significant and expensive customisation by the client. They were not open, or collaborative. The dotcom and telecom collapse of the early 2000s – triggered by investors realising that the transmission capacity in place and under construction greatly exceeded the demand for traffic - allowed the hoovering up of failed competitors and the growth of market share. This period – 1980 to 2000 - was the period of PropTech 1.0.

The bridge between PropTech 1.0 and PropTech 2.0 appears to be the on-line residential market sector. For example, in the UK Rightmove was started in 2000 by the top four UK estate agencies at the time (Countrywide, Connells, Halifax and Royal and Sun Alliance). Zoopla launched in 2007, followed by OnTheMarket in 2015. In the US, Trulia was founded in 2005 and Zillow launched in 2006; Trulia was acquired (for \$2.5bn) by Zillow in 2015. Given the recent activity in residential tech startups (see Chapter 3), we regard these activities as late stage PropTech 1.0.

PropTech 2.0 has continued the early PropTech 1.0 focus on residential because it is a homogeneous real estate asset type with more public information (prices and rents), and because it is a huge asset type that everyone interacts with, presenting entrepreneurs with clear opportunities to disintermediate existing information providers and market places.

2.3 PropTech 2.0

We are now seeing PropTech 2.0, a new explosive wave of innovation, investment and entrepreneurial activity. Its origins lie in frustrations concerning the large, unmoving, illiquid asset class and the vested interests of the business which control it, plus (according to Steve Weikal at MIT) unprecedented breakthroughs in technology – cloud computing, leaner coding, mobile devices, sensors – and much lower costs, plus ubiquitous connectivity driven by broadband, Wi-fi and 4G telephony. There is new demand from an increasingly tech knowledgeable and familiar mobile real estate workforce. Innovation appears to be inversely correlated to desktime, and the workforce is increasingly self-employed (40% by 2020) and mobile.

As the PC and later the internet facilitated the growth of PropTech 1.0, PropTech 2.0 has been released by e-commerce, social networking, open-source software and the multi-platform world. Taking these in order, Amazon has driven a revolution in commerce, diverting activity from shops to e-commerce in huge quantities. Why not sell real estate via an e-commerce platform using customer feedback as an alternative to professional advice? Facebook has created a system of networks that have a scale and global reach well beyond the capacity of any real estate broker. Why not capture online networks for the marketing of real estate? Open-source software has allowed cheap access to previously very expensive technology solutions (for example, on line payment processes). Why not build a website that acts as a hanger for these processes and data and build a portal for real estate services? And why not distribute these products and services via PCs, tablets and (given that there are as many cell-phone subscriptions as there are people on this earth) smartphones, and through a satellite culture of applications (apps)?

Accompanying these global earthquakes, trade bodies such as PISCES and later OSCRE set standards for the exchange of what had been idiosyncratic property data ledgers. Systems such as Yardi and Argus that were designed not to talk to each other (*“spaghetti balls of knots and tangles”*) began to allow collaboration and compatible applications to be built. Zoopla has launched an open application programming interfaces or API to allow developers to create applications using local data on their sale and rental listings, using 15 years of sold price data. (Application programming interfaces allow collaboration between sites, while driving traffic to your own website and not *‘losing that eyeball’*).

IPD developed from a UK business to a provider of information in all regions of the world. Such advances enabled the PropTech 2.0 innovator to move into an industry whose barriers were being slowly dismantled.

PropTech 2.0 is happening because the answers to these questions appear obvious, while the real estate industry continues to be characterised by its limits. Will the nature of the asset class ultimately frustrate the innovators?

In retrospect, PropTech 2.0 will be judged to have been a highly successful revolution only if it releases the asset class and the industry which surrounds it from its limits. Will PropTech be as enduring as the industry on which it has built its foundations? Can it make fundamental changes to the way property is held, traded or valued?

2.4 The limitations of real estate as an asset class

The following analysis of real estate's limits as an asset is taken from Andrew Baum's Real Estate Investment (Routledge, 2015).

As with all equity-type assets, the performance of property is ultimately linked to some extent to the performance of the economy, and like all assets its performance is linked to the capital markets. The economy is the basic driver of occupier demand, and, in the long term, investment returns are produced by occupiers who pay rent. However, in the shorter term - say up to 10 years - returns are much more likely to be explained by reference to changes in pricing, or capitalisation rates, which are in turn driven by required returns. Required returns do not exist in a property vacuum but are instead driven by available or expected returns in other asset classes. As required returns on bonds and stocks move, so will required returns for property, followed by property capitalisation rates and prices.

Nonetheless, history shows that property is a true third asset, distinctly different from equities and bonds. The direct implication of property being different is its diversification potential, and hence the justification for holding it, within a multi-asset portfolio. Generally, the impact of the real economy and the capital markets on the cash flow and value of real estate is different from the impact on stocks and bonds, and is distorted by several factors.

These are as follows.

1. Property is a real asset, and it wears out over time, suffering from physical deterioration and obsolescence, together creating depreciation.
2. The cash flow delivered by a property asset is controlled or distorted by the lease contract agreed between owner and occupier. US leases can be for 3 or 5 years, fixed or with pre-agreed annual uplifts. Leases in continental Europe may be 10 years long, with the rent indexed to an inflation measure. Leases in the UK for high quality offices are commonly for 10 years, with rents fixed for five-year periods after which they can only be revised upwards.
3. The supply side is controlled by planning or zoning regulations, and is highly price inelastic. This means that a boom in the demand for space may be followed by a supply response, but only if permission to build can be obtained and only after a significant lag, which will be governed by the time taken to obtain a permit, prepare a site and construct or refit a property.
4. The returns delivered by property are likely to be heavily influenced by appraisals rather than by marginal trading prices. This leads to the concept of smoothing.
5. Property is highly illiquid. It is expensive to trade property, there is a large risk of abortive expenditure, and the result can be a very wide bid-offer spread (a gap between what buyers will offer and sellers will accept).

6. Property assets are generally heterogeneous, and large in terms of capital price. This means that property portfolios cannot easily be diversified, and suffer hugely from specific risk. Research and due diligence costs are significant.
7. Leverage is used in the vast majority of property transactions. This distorts the return and risk of a property investment.
8. The risk of property appears low. Rent is paid before dividends, and as a real asset property will be a store of value even when it is vacant and produces no income. Its volatility of annual return also appears to be lower than that of bonds. This is distorted somewhat by appraisals, but the reported performance history of real estate suggests a medium return for a low risk, and an apparently mispriced asset class.
9. Unlike stocks and bonds, real estate returns appear to be controlled by cycles of eight to nine years.
10. Real estate is time-consuming and expensive to manage.

Looking into the future, there are opposite forces at work. The excesses of the lead-up to the credit crisis will create a reaction that values conservatism, low leverage, more modest fee structures and stricter – or better – governance. At the same time, we must continue to innovate.

An improvement in the liquidity of unlisted holdings can be expected. While real liquidity is neither possible nor clearly desirable in the private equity real estate market, we can expect to see secondary trading platforms that help investors to manage mixed portfolios of listed and unlisted property, particularly at the core end of the market.

To what extent will PropTech 2.0 be successful in attacking these limitations? And what exactly is going on within the PropTech boom? We examine the evidence in Chapter 3.

Chapter 3

PropTech 2.0: the new wave

In this chapter we attempt to estimate the scale of the PropTech 2.0, and by reference to the new startups we test, improve and finally establish our classification system for PropTech

3.1 Information sources – venture capital, accelerators, researchers and blogs

There is a plethora of information sources describing activity in the broader tech and PropTech sectors. These include trackers of venture capital such as Venture Scanner, Crunchbase, Pitchbook or Angellist; blogs and newsletters dedicated to the provision of news items concerning PropTech, including CRE Tech Daily in the US and Prop Tech News in the UK; research organisations such as CB Insights, a broader technology platform providing data, research and news; universities, in particular MIT, which hosts regular seminars devoted to PropTech (realdisruption.com); accelerators such as 500 StartUps or Y Combinator which have backed PropTech ventures, and pure play PropTech accelerators such as PiLabs (UK) and MetaProp NYC.

Of course, there is no agreed definition or standard regarding what constitutes a PropTech venture or a PropTech investment. Scaling and classifying the sector is therefore difficult. Every reference source has a different set of search variables; there is no agreed definition of real estate, let alone what constitutes a Real Estate Fintech firm. We can only estimate the likely scale of the sector.

In scaling the sector, venture capital (VC) should provide a fruitful starting place. The new PropTech companies are bootstrapping (using minimal financial resources); using seed funding; or raising more substantial venture capital through what are called Series A, B and C (etc) rounds. The purpose of the series seed funding is for the company to clarify the product it is building, the market it is in, and the user base. Typically, a seed round helps the company scale to a few employees past the founders and to build and launch an early product. The range of seed funding amounts is \$250K-\$2 million; angels and early stage venture capitalists both invest in seed rounds.

Series A funding is applicable when the business understands its product and user base and needs capital to scale its distribution or identify a more plausible and deliverable revenue model. Typical series A raises are in the order of \$2m-\$15million. The Series B and C raise typically aims to scale the business, often through acquisitions. Amounts raised vary from £5m upwards for series B and hundreds of millions for Series C.

Seed accelerators, also known as startup accelerators, are fixed-term, cohort-based programs that offer mentorship and education, and culminate the relationship in a public pitch event. Unlike business incubators, the application process for seed accelerators is open to anyone, but highly competitive.

500 Start Ups, a seed fund and accelerator, has (as the name suggests!) invested in over 500 startups and its website lists over 100 categories of businesses the firm has invested in. A search under the Real Estate category turns up 6 businesses; that puts real estate in the top 40% of sectors backed by the firm.

Meanwhile, London-based PiLabs is an accelerator focussed only on PropTech.

Property Innovation Labs (Pi Labs) is Europe's first venture capital platform to invest exclusively in early stage ventures in the property tech vertical. Pi Labs is based in London and invests in property tech companies globally. Pi Labs was founded to become the centre of the property innovation ecosystem with the vision to identify, mentor, invest in and accelerate high-calibre startup ventures which have the passion and ability to create scalable businesses that will disrupt the property industry. Its in-house property expertise assists entrepreneurs in the rapid scaling of tomorrow's tech-enabled property start-ups. Pi Labs invests in property tech companies both directly, investing in Seed to Series A stage businesses, and through its accelerator programme.

New York based MetaProp is also an accelerator:

We are the world's premier real estate technology nexus. We work with the smartest entrepreneurs, technologists, investors and partners to fund and help build up to 25 of the real estate tech industry's best ideas every year.

According to Venture Scanner, Accel Partners is the leading PropTech VC in the US, having invested in a total of 31 unique Real Estate Tech companies, followed by 500 Startups, which has invested in 27 unique Real Estate Tech companies. Meanwhile, the MIT Real Estate Innovation Lab holds a database of over 1,600 Real Estate Tech startups.

By 2017, there was clear evidence of PropTech funding going mainstream, spreading out to real estate professionals and traditional real estate organisations. Prominent examples of firms investing in PropTech ventures or even launching funds and in-house accelerators include Hines, LaSalle, Cushman, British Land, CBRE and others.

3.2 Sizing the market

Since 2012, CB Insights suggests that real estate tech companies have raised almost \$6.4 billion in funding across 817 deals (see Figure 3.1). They define real estate technology as the software tools and platforms used by different participants in the real estate industry, including brokers, investors, real estate-focused lenders, property owners and managers. The category includes online real estate rental and buying guides.

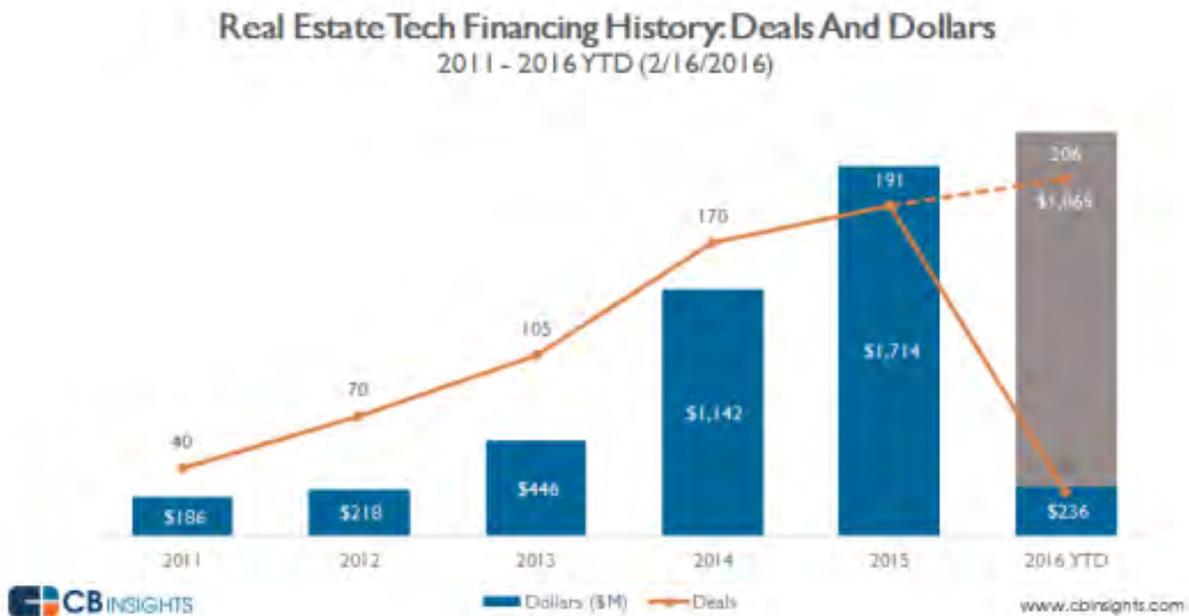
PropTech 2.0: the new wave

In early 2016, Venture Scanner announced that it “tracks 1,137 Real Estate Technology companies across 12 categories”, with a combined funding amount of \$16.99 bn. By late 2016, the same company is “currently tracking 1,258 Real Estate Technology companies in 12 categories across 61 countries, with a total of \$28 billion in funding”. Venture Scanner may have changed its measurement methods; it may have re-classified some ventures to its real estate category; or the growth in real estate funding is taking off and becoming as exponential as Moore’s Law. On the other hand, RE Tech reported in April 2017 that at that point venture capitalists had become extra cautious, preferring to back only established businesses. 90% of venture capital went to only 10 companies, including shared economy leader WeWork and leading Indian advisor PropTiger. Nevertheless, Crunchbase data suggests that venture firms deployed nearly \$3 billion in 70 real estate tech companies in Q1 2017.

Using these various data sources, we can tentatively suggest that there are likely to be over 2,000 PropTech startups of serious ambition; and that around 60% of these firms appear to have raised seed or better funding. Somewhere between \$30bn and \$50bn (an average \$25-40m per firm) has been raised and is being spent by these ventures.

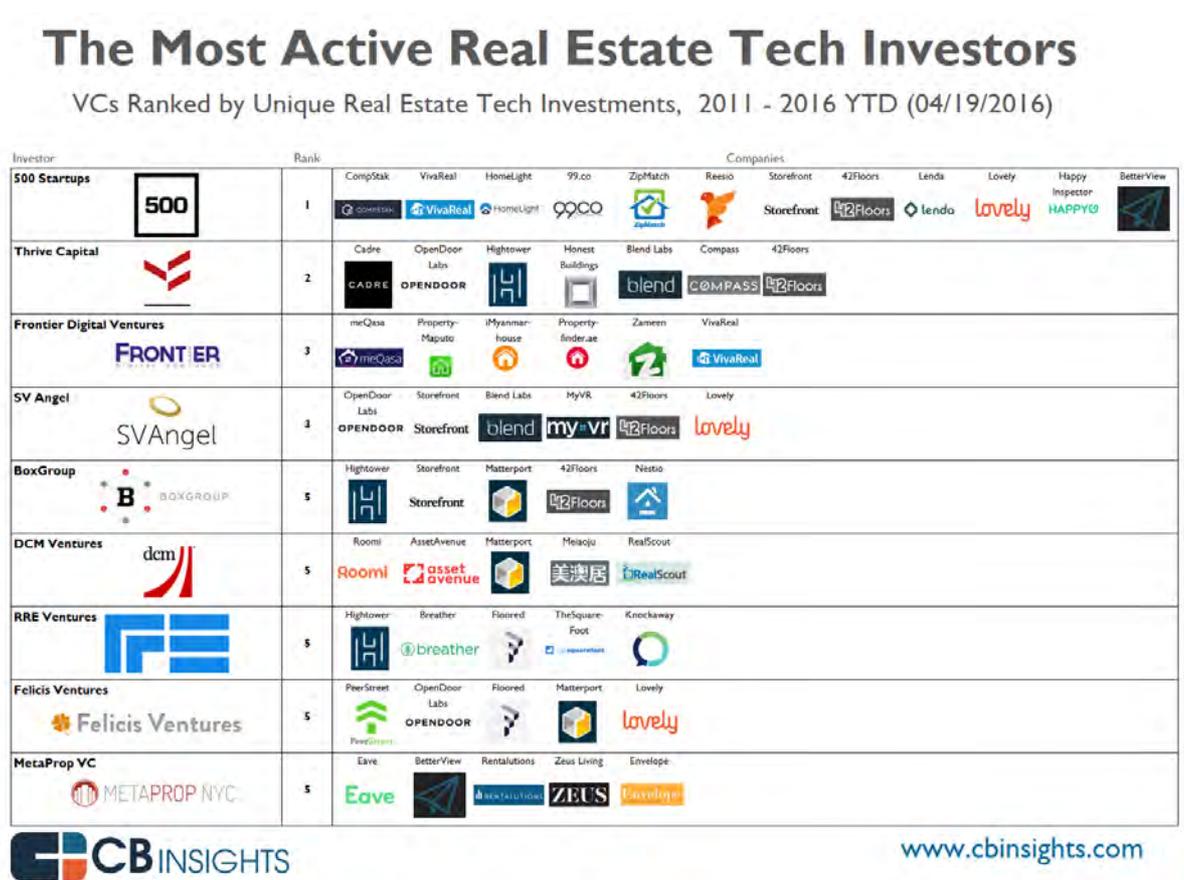
The venture capital industry has been raising capital at the rate of around \$10bn per quarter. If the PropTech sector has raised \$30bn since 2012, this would constitute around 15% of the market.

Figure 3.1: CB Insights - most active real estate tech investors



CB Insights (Figure 3.2) ranks the top VCs and accelerators over the 2011-6 period, omitting Accel, which Venture Scanner has identified as the leading US PropTech VC firm.

Figure 3.2: CB Insights - most active real estate tech investors



CB Insights have produced real estate tech market maps for commercial (Figure 3.3) and residential (Figure 3.4) sectors. Mortgage tech warrants its own infographic (25 companies, Figure 3.5).

For 53 commercial companies featured, the CB Insights categories are:

- Listing and search services (15)
- Leasing management software (2)
- Marketplaces (3)
- Investment/crowdfunding (7)
- Property information (4)
- Data, valuation and analytics (11)

PropTech 2.0: the new wave

- Occupier to occupier services (1)
- Mortgage tech (1)
- Tech-enabled brokerage (2)
- Property/building management (4)
- Virtual viewing (3)

Figure 3.3: CB Insights – commercial real estate tech market map



For residential, the categories inhabited by the 96 companies featured are:

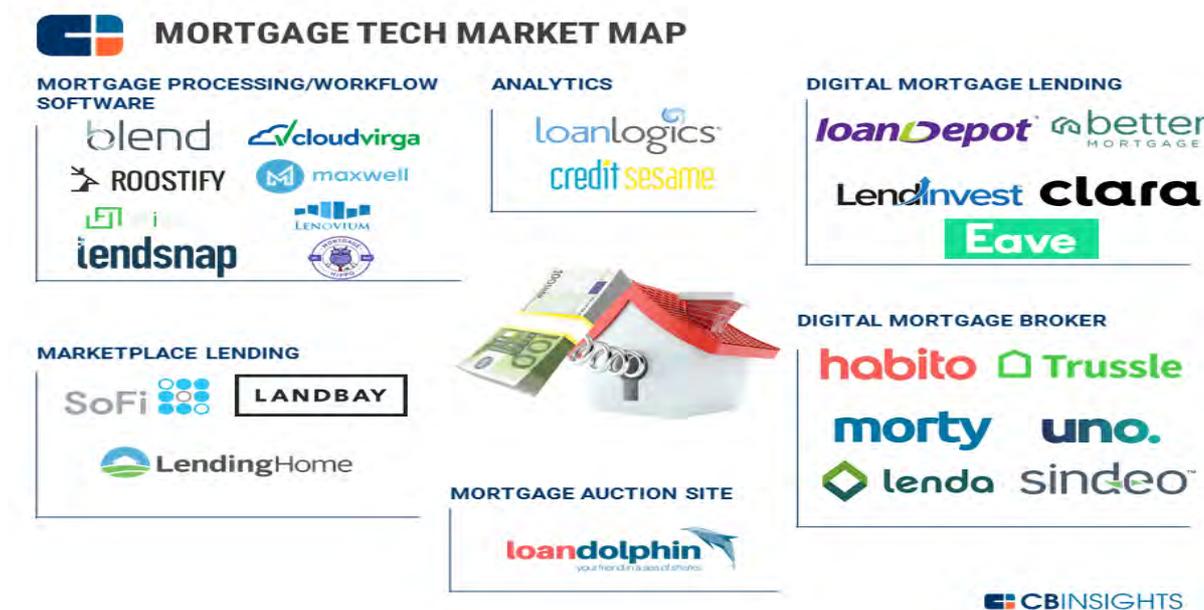
- Listing and search services (27)
- Agent matching (5)
- Marketplace (9)
- Broker-free list and search (3)
- Investment/crowdfunding (8)
- Property information (4)
- Data, valuation and analytics (1)
- Occupier to occupier services (3)
- Mortgage tech (10)
- Tech-enabled brokerage (4)

- Leasing management software (2)
- Property management (7)
- Virtual viewing (5)
- Sales and marketing (5)
- Agent services (3)

Figure 3.4: CB Insights – residential real estate tech market map



Figure 3.5: CB Insights – mortgage tech market map



PropTech 2.0: the new wave

From this evidence, we can discern more activity in the residential sector than the commercial sector. VCs interviewed confirm this: because the global residential market is estimated to be around five or six times the size of the global commercial market (Savills, 2017) – see Table 3.2 – the likely payoff for a successful residential tech firm is enough to justify serious funding, while commercial property solutions are less compelling.

Table 3.2: Savills market size estimates

	Investable	Non-investable	All	%
All real estate	81	136	217	58%
Residential	54	108	162	43%
Commercial	19	10	29	8%
Agricultural	8	18	26	7%
Other investments	150		156	42%
Equities	56		56	15%
Securitised debt	94		94	25%
Gold			6	2%
All Assets			373	100%

Source: Savills, 2016

We would all love to invest in a business that captured 1% of a £10bn market, or even better, 20%. Property is about as big as it gets. As the main store of wealth for most of the world's population, an industry generating 12.3% of the UK's GDP, property is almost second to none in terms of market size.

<http://techcitynews.com/2017/01/04/uk-proptech-venture-capital-love-affair/>

If we are right in our estimate that PropTech has captured around 15% of all VC investment since 2012, we can expect some growth.

3.3 Classifying the PropTech segments

MIPIM is a major property meeting held in Cannes in France every March. Recently, MIPIM introduced an innovation forum and competition promoting PropTech ventures. The MIPIM graphic, shown as Figure 3.6, lists the following tech categories:

- smart buildings/IoT (internet of things);
- smart city sustainability;
- market place;
- crowdfunding;
- ConTech;
- 3D/VR (virtual reality);
- data and research analytics

Figure 3.6: MIPIM innovation forum 2017



These categories map reasonably well onto our initial classification system (see Chapter 1), but they mix what we call verticals (smart buildings) and horizontals (information).

Venture Scanner claims to track over eleven hundred Real Estate Technology companies across 12 categories, with a combined funding amount of almost \$30 billion. They organize Real Estate Technology into the 12 categories listed below.

Property Management: Technologies that help in the day-to-day operation of real estate rentals. Examples include tenant management, electronic payments of rent, and tools for landlords and tenants to communicate.

Our category: smart buildings/management

Construction Management: Technologies that help teams manage the construction of new buildings.

PropTech 2.0: the new wave

Examples include construction visualizations tools, project management tools for construction teams, and platforms to manage blueprints.

Our category: ConTech

Facility Management: Technologies focused on the efficiency and long-term sustainability of large structures. Examples include tools to quantify a building's data (energy usage, water usage, etc.), tools to make buildings more efficient, and building inspection platforms.

Our category: smart buildings/management

Portfolio Management: Technologies that real estate investors use to make smarter investment decisions as well as platforms to make investments. Examples include listing data trackers, information on REITs, and real estate crowdfunding.

Our category: Real Estate FinTech/information and Real Estate FinTech/transactions

Home Services: Technologies that support consumers in the management of their homes. Examples include cleaning services, renovation management, and technology-forward postal services.

Our category: Smart Buildings/management

Commercial Real Estate Search: Tools that help consumers/businesses find commercial real estate for rent and/or sale. Examples include shared working space search engines as well as traditional commercial real estate search engines.

Our category: Real Estate FinTech/information and Shared Economy/information

Long-Term Rentals/Sale Search: Consumer tools that aid in the process of finding residences for sale and for long-term rent. Examples include traditional real estate search engines as well as mobile apps.

Our category: Real Estate Fintech/information

Short-Term Rental/Vacation Search: Consumer tools that aid in the process of finding residences for short-term rentals or vacation rentals. Examples include platforms for individuals to list their personal properties as well as traditional vacation lodging search engines.

Our category: Real Estate FinTech/information and Shared Economy/information

Life, Home, Property & Casualty Insurance: Companies that offer life, home, and property insurance, as well as other kinds of insurance such as renters, disability, and marriage insurance. Examples include websites that offer life, home, and P&C insurance in packages.

Our category: Real Estate FinTech/information

Real Estate Agent Tools: Technologies that help real estate agents do their job, as well as technologies that effectively automate it. Examples include real estate specific CRMs, real estate agent review platforms, and

marketing tools.

Our category: Real Estate FinTech/information

Indoor Mapping: Companies that help create indoor models for the real estate industry. Examples include cameras that produce 3D renderings and visualization platforms that allow users to interact with floor plans.

Our category: Real Estate FinTech/information

IoT Home: Internet of Things devices focused on the residential real estate segment. Solutions include home security, home automation, and energy management.

Our category: Smart Buildings/management

James Dearsley, in a well-known infographic (Figure 3.7), uses another set of categories. These, which recognise the different residential and commercial sectors with some overlap, include:

- Big data
- Software providers
- Lending/crowdfunding
- News/advice
- Lending: peer-to-peer
- Virtual and augmented reality
- Property management
- Lending – mortgages
- Co-working
- Internet of things
- Online agent - brokerage
- Online agent – sales
- Online agent – lettings
- Payment operations
- Blockchain
- Artificial intelligence (AI)
- Accelerators and VCs

This mixes verticals (co-working), horizontals (news/advice) and modes of operation (AI). Mapping these (omitting accelerators and VCs, and AI) onto our matrix, we might arrive at the following indicative classification (Table 3.3).

Table 3.3: Dearsley verticals and horizontals

	Real Estate FinTech	Shared Economy	Smart Buildings
Information	Software providers News/advice		Big data Virtual and AR
Transactions/marketplace	Lending/crowdfunding Lending/peer to peer Lending/mortgages Online agent – brokerage Online agent – sales Online agent – lettings Payment operations Blockchain	Co-working	
Management/control			Property management Internet of things

Finally, we examine the activities of PiLabs, a London-based accelerator. Now we set out to test how the companies which applied to PiLabs and the 3% of those applicants that were successful in raising investment backing from the accelerator fit into our matrix. In doing so, we left the PiLabs team to decide on the appropriate classification for each of the companies. We should point out that the horizontal and vertical classifications are not necessarily the ones Pi Labs uses.

In discussions between the author and PiLabs, the following clarifications were made.

All platforms that assist with finding a tenant or property are classified as FinTech - transactions/marketplace.

AR/VR tech for built environments is classified as FinTech - information. AR/VR tech for new builds is classified as Construction Tech - information.

All interior design and architecture platforms are classified under Construction Tech.

All property management software is classified under Smart Buildings - control/management.

PropTech 2.0: the new wave

Hospitality platforms (such as Airbnb) are classified as Real Estate FinTech - transactions/marketplace.

Property management including repair request platforms is classified under Smart Buildings – control/management, unless it connects the user with a repairer, in which case it is classified as Smart Building – transaction.

Tenant referencing technology is classified as FinTech – transactions/marketplace.

Construction Tech management platforms are under ConTech – control/management.

Other Smart Buildings - control companies include building access technology and companies that have built sensors to manage space better.

Smart applications which expand the shared economy space offering are classified under Shared Economy – control/management.

Figure 3.8 shows the breakdown of the PiLabs Accelerator applications over a four-year period. More than half of all (over 600) applications were in the Real Estate FinTech sector; around 20% were derived from each of the Sharing Economy and Smart Buildings verticals; and ConTech is the least active vertical, with under 10% of all applications.

Figure 3.8: Pi Labs applications – analysis by vertical

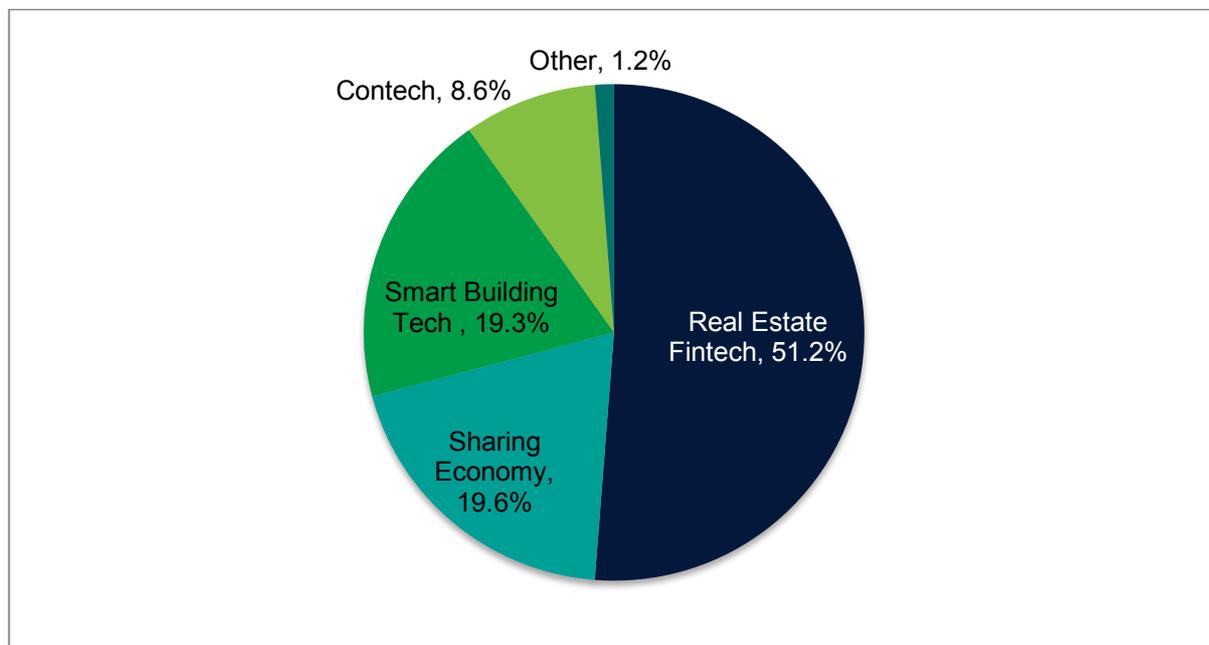


Table 3.4: Pi Labs applications – analysis by segment

	Real Estate FinTech	Sharing Economy	Smart Buildings	ConTech	Total
Information	12.9%	0.6%	0.9%	3.1%	17.5%
Transactions	38.3%	16.6%	3.4%	3.4%	61.7%
Control/management	0.0%	2.5%	15.0%	2.1%	19.7%
Total	51.2%	19.6%	19.3%	8.6%	98.8%

Table 3.4 shows that by far the most common orientation (or horizontal) is transactions or marketplace businesses, with over 60% of all applications, and information and management equally weighted at 17.5-20%. By sub-sector, Real Estate FinTech/transactions is by far the most populous. One of twelve sub-sectors, this captures 38% of all applications.

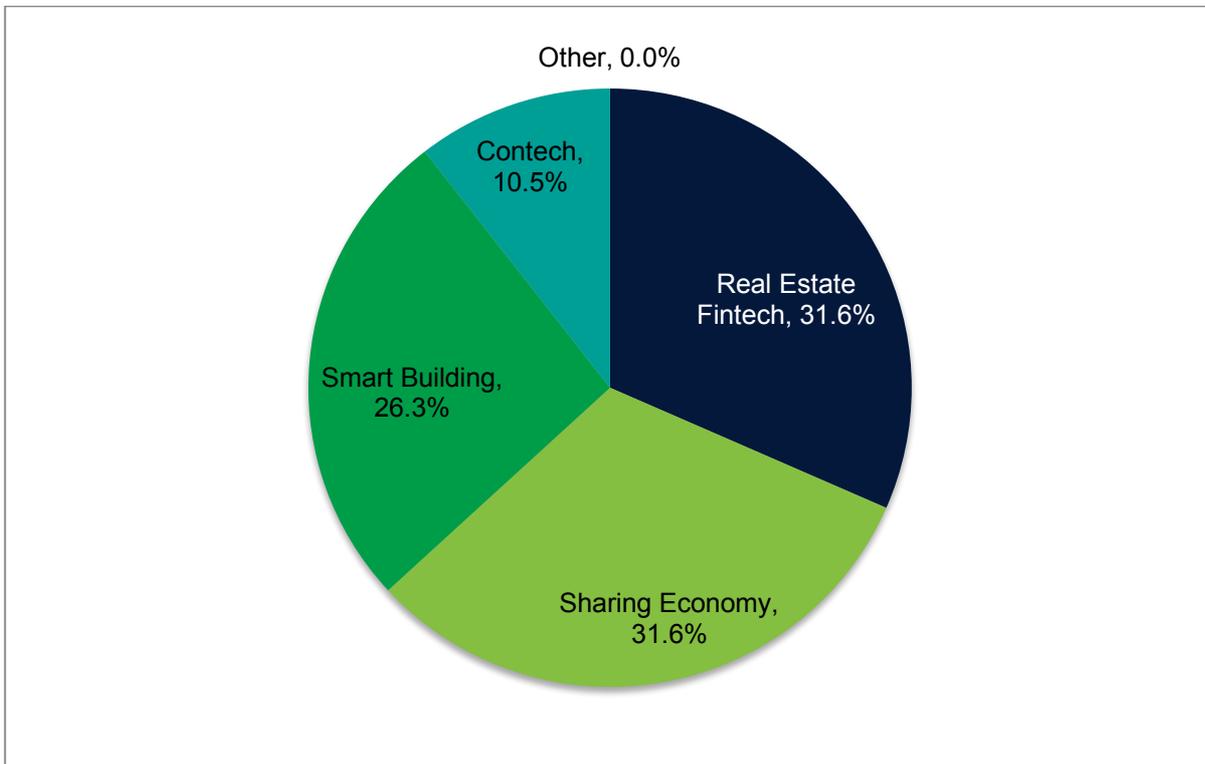
In Chapter 2, we imagined how the matrix would fill out, and did not expect to be able to populate the FinTech/control, Shared Economy/control and Smart Buildings/transactions sub-segments. These are non-existent or very scarce in the PiLabs data, as is Shared Economy/information and Smart Building/information.

Table 3.5: Pi Labs investments – analysis by segment

	Real Estate FinTech	Sharing Economy	Smart Buildings	ConTech	Total
Information	15.8%	0.0%	0.0%	0.0%	15.8%
Transactions	15.8%	21.1%	0.0%	5.3%	42.2%
Control/management	0%	10.5%	26.3%	5.3%	42.1%
Total	31.6%	31.6%	26.3%	10.5%	100.0%

Table 3.5 and Figure 3.9 show that the 19 businesses that were successful in getting PiLabs accelerator support (fewer than 3% of the total applications) are more evenly distributed between the three main verticals. ConTech captures 10%, roughly reflecting the weight of applications, while FinTech is down 20% to just over 30%. Sharing Economy and Smart Buildings businesses do very well by comparison.

Figure 3.9: Pi Labs applications – analysis by vertical

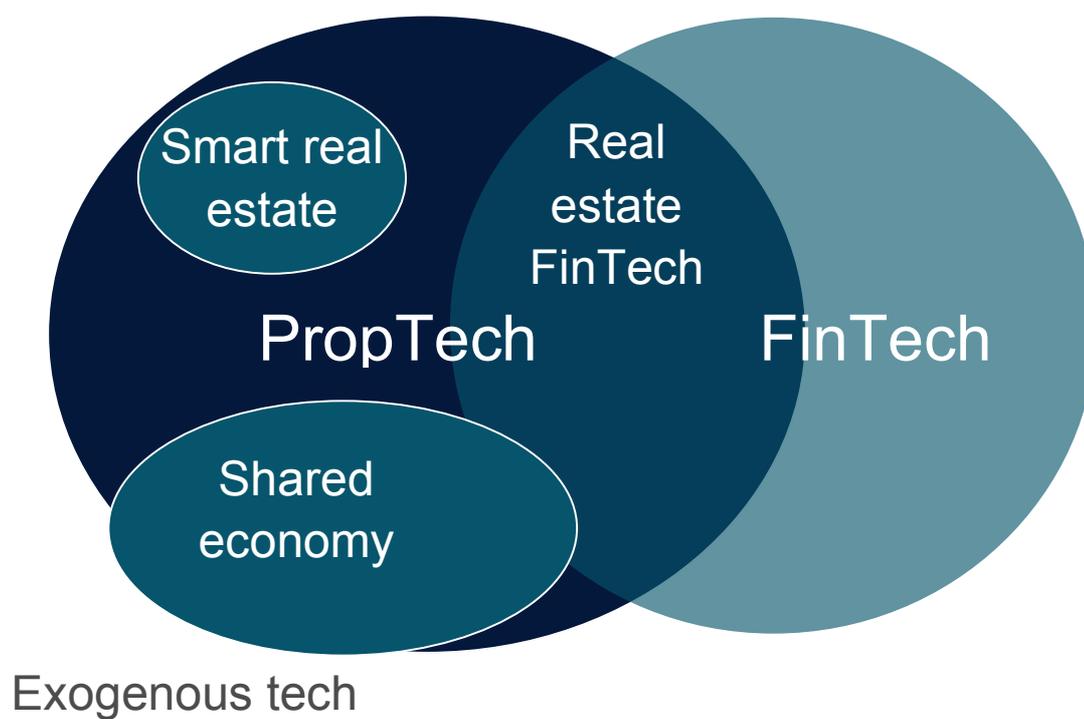


We believe that this process offers proof of concept regarding our verticals and horizontals. We will now focus on three of the four verticals, leaving ConTech to one side as a related but different non PropTech sector. We recognise the difference between endogenous PropTech (created by and for the property market) and exogenous tech (not created by and for the property market but impacting on it). Figure 3.10 summarises our analysis.

Real Estate FinTech is a sub-category of FinTech and a key PropTech segment. Smart Buildings Tech is related to ConTech, but as it affects the control and management of existing assets it becomes a second key PropTech segment. Shared economy is a third sub-category of PropTech, with some possible overlap with Fintech (as transactions may take place under this vertical). These are all endogenous PropTech segments; the external world of exogenous tech is also important.

In Chapters 4, 5 and 6 we will focus on each of our PropTech verticals: smart buildings (Chapter 4), shared economy (Chapter 5) and real estate FinTech (Chapters 6 and 7). Exogenous tech and its impact is briefly considered in Chapter 8.

Figure 3.10: The PropTech industry verticals



Chapter 4

Smart real estate

In this chapter we describe the smart real estate or smart buildings sector, meaning real estate which supports tech platforms and buildings that use tech platforms

Poster children: Nest, Digital Realty, Equinix, Aggreko

4.1 The smart building sector is founded on the control and efficient management of real estate

In our analysis of the companies which applied for PiLabs accelerator support in Chapter 3, 20% of all applications were in this vertical. The Smart Buildings vertical was active exclusively through the control horizontal. This chapter will focus on tech developments that facilitate the control and efficient management of space.

Pure information is the precursor to control and management. Businesses like TAP (Tenant Assistance Program) provide tenants with information about the buildings they are renting from energy consumption to insurance and health and safety compliance. Energy consumption, in particular, lies at the heart of the smart building concept.

4.2 Sustainability and energy – the background

The top five S&P 500 companies by market capitalisation in Q3 2016 were Apple, Alphabet (Google), Microsoft, Amazon and Facebook.

These companies have a huge appetite for power. The increasing dominance of cloud computing, for example, requires Facebook to build huge data centres on the fibre optic network powered by electricity. The data held by these companies is exploding in size – big data is valuable, and it needs to be stored. Where it is stored needs to be powered and climate controlled.

The baseline standard to deliver an asset now includes a commitment to sustainability. It now seems obvious that delivering a 'green' building is the modern normal, but this was not the case as recently as fifteen years

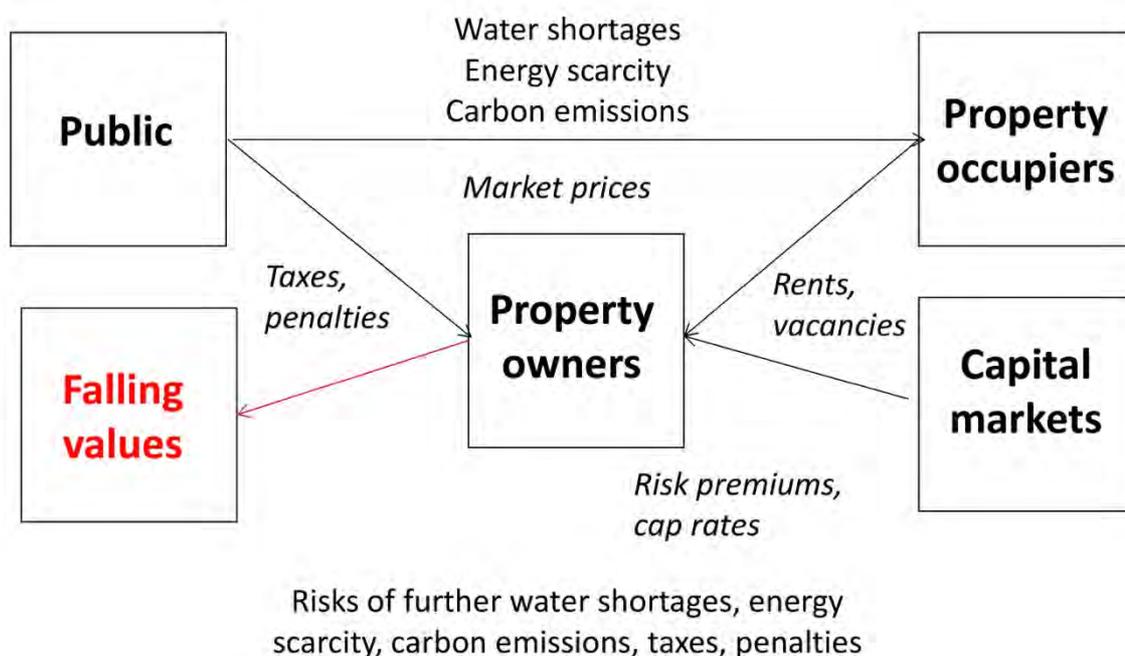
ago. Delivering sustainable assets is necessary as a minimum standard; it is no longer a marketing issue but something the marketplace demands.

In order for a building to be efficient, it needs to be in the right location and fit for purpose. This means that the basic building service inputs (air, water, power and transport) and outputs (emissions, sewerage and refuse) need to be consciously managed for the health and well-being of the building, its tenants and the local community. This applies to any development type within the broader real estate asset class (office, retail/commercial, leisure/hotel, residential, logistics, and so on).

There is an expectation from both users and investors that buildings will operate efficiently from both a cost and functional perspective. In theory, if operational costs are lower, then a more competitive total occupation price is offered to occupants, and better returns are available to investors.

This issue is slowly becoming incorporated in market pricing. Initially, the drive for sustainability and energy efficiency was a burden which was held by the public – it was a matter for public concern that was not transmitted into market pricing. This is because the traditional lease between a property owner and a tenant governed only space usage (and not the utilities). The utility bill was the responsibility of the tenant, and discovery of the issue of running costs by tenants was a gradual process not priced in the initial lease negotiation (see Figure 4.1).

Figure 4.1: Transferring the energy burden



Small buildings

We remember, for example, a presentation by DHL which discussed the stages of energy use consciousness. This began with the identification of a depot using too much electricity, explained by staff failing to switch off lights at night because the light switches were hidden and inaccessible; to the automatic switching off of lights when rooms are not in use; to information gathering and the subsequent automatic adjustment of energy use.

It took quite some time for consciousness about building energy efficiency and the subsequent costs in use to be incorporated into the corporate real estate decision process. When this began to be the case, landlords and developers had a motive for producing energy efficient buildings. Now a lower energy cost could be used to negotiate higher rents and deliver better returns for investors. The evidence for this has been patchy, perhaps because the connection between energy cost and rent is somewhat indirect, but it is accumulating (see, for example, Green Building Council, 2015).

A more powerful connection is made if and when energy costs and rent are bundled together in one payment. If the developer/owner supplies both space and energy and charges an energy-inclusive rent, his motivation to deliver an energy efficient building is direct.

If the developer/owner can also generate power within the building and cut out the middleman (the utility company) we will have a much more efficient market for space and energy. However, the landlord will now be concerned to limit the amount of energy used by the tenant. So we will need to be able to develop a system where the benefits of energy saving pass directly to the market participants. This requires intelligent monitoring of energy use through control and monitoring devices, and the efficient transmission of data between the user of the building and the supplier of space and energy. Sadly, according to interviewees, traditional office leases largely continue to fail to achieve the internalisation of energy saving in office management.

The development of intelligent leases, efficient energy supply and energy monitoring lies at the heart of smart building technology. The root driver of change – an increased need for energy and telecoms to supply the users of technology – will require developers to make buildings more energy efficient, to satiate the hunger for space to support the new tech world and to be much more creative in leasing practice.

4.3 Definitions

What are smart buildings? This term means buildings which combine space with technology. Given the recent growth of technology firms as tenants of buildings, this concept now has two dimensions. We need buildings that *use* tech platforms to be more efficient; and we also need buildings which *support* tech platforms (such as the Facebook HQ in California, any of the big five's data centres, or the Google European HQ in London's Kings Cross).

There are at least a dozen variants on the definition of a smart building, mostly tailored by big name consultants for their clients. In its simplest form, it refers to an asset which runs efficiently through automated technology in its building systems. This is to ensure the asset's optimal functionality. A building will only be as smart as its

programming, which still requires human input, so it is a misnomer that a smart building is an automated building. To be more precise, a smart building is an asset which optimizes the system design and automation to run efficiently.

There is a loose corollary that smart buildings are green buildings, and therefore sustainable. Efficiency has become a synonym for sustainability, hence the terms are used almost interchangeably. There is a continuing drive to ensure that buildings are performing with minimal waste to balance what is used and what is expelled. It is implicit that smart buildings are both clean and environmentally friendly, while supporting the long-term use of the asset for its occupants or purpose.

4.4 Buildings that use tech

Smart buildings describes technology-based platforms which facilitate the *operation* of real estate assets. The assets can be single property units or entire cities. The platforms may simply provide information about building or urban centre performance, or they may directly facilitate or control building services. This sector supports real estate asset, property and facilities management.

PCs, tablets and mobile phones are potential dashboards for controlling electronic functions. The Internet of Things (IoT) allows objects to be measured (information provision) but also sensed and/or controlled remotely across the existing network infrastructure, creating opportunities to adjust or turn systems on or off remotely. As an example, heating systems can be switched on remotely through a mobile phone app, and Google's 2014 acquisition of Nest (a producer of thermostats, sensors, lighting and other intelligent energy-saving home applications) to create a Google IoT division was seen at the time as a significant moment.

The instant popularity of the Nest thermostat, introduced in 2011, seemed to confirm hopes that this sector would take off. But those expectations were dashed in the coming years as the market for connected home devices stagnated. Nevertheless, many of the biggest consumer technology companies are now moving into the smart home market. For example, Apple recently released its self-installed smart home ecosystem, called Apple Home. Google launched the Google Home and its companion ecosystem in 2016, hoping to jump into the voice-activated smart home speaker market, which Amazon currently dominates. Google Home was set to be launched in the UK in April 2017. Like Amazon's Echo and Alexa, Home can answer basic queries as well as control smart home devices.

Many more companies (Distech Controls is an example) deliver innovative building automation and energy management systems that maximise comfort, environmental quality and sustainability requirements. As these advances continue, we are getting close to seeing unmanned, robotic buildings engaging in such activities as 3D printing or warehousing. The next generation of smart buildings will be able to run wholly remotely.

Companies such as CAME, Honeywell and Siemens have transformed themselves from traditional suppliers of mechanical goods into developers of home automation and intelligent systems. CAME, for example, develops

Small buildings

controls for large public facilities and the management of urban and public areas, offering integrated solutions to meet all needs of people-flow and access control controlling and monitoring.

The remote control of driverless cars and delivery vehicles, plus bots offering a range of services, are setting in motion many thought processes imagining the likely future of logistics and retail real estate. More can be expected. According to the CEO of a major UK business space developer, smart buildings will increasingly rely on smart transport. One of the key problems for developers and managers of office/workspace on business parks is parking - how much to provide and how to manage. So the firm is developing a smart app to facilitate car sharing, without yet having solved the economic benefits of sharing (see Chapter 5).

4.5 Smart cities

Smart cities encapsulate an urban development vision to integrate multiple information and communication technology and IoT solutions to manage a city's assets, including information systems, schools, libraries, transportation systems, hospitals, power plants, water supply networks, waste management, law enforcement and other community services. The goal of building a smart city is to improve quality of life by using urban informatics and technology to improve the efficiency of services and meet residents' needs. Through the use of sensors integrated with real-time monitoring systems, data are collected from citizens and devices, processed and analyzed (Smart Real Estate vertical; information horizontal). The information and knowledge gathered are keys to tackling inefficiency.

At the city level, firms such as Maalka have been working on district-level sustainability, developing an expertise in creating eco-districts and sustainable districts, including the Pearl District in Portland and Kashiwa-no-ha in the Chiba Prefecture of Japan.

4.6 Buildings which support tech platforms

The 1980s created a new property sector. High tech (or hi-tech) buildings were initially the mixed use office/industrial buildings which formed the component parts of a science park. Hi-tech described the operations carried on within the building rather than the building itself; but now the term has migrated to describe the building.

High tech – another variant of smart buildings - also describes new buildings (and whole new property types) which support technology-based platforms. These include data centres, specialised logistics such as on-line distribution hubs, click and collect stores, Amazon locker sites, co-working space designed for tech companies requiring very fast broadband, and other futures which we can imagine, such as autonomous car charging stations, drone hubs and others.

Mega data centres, typically also known as 'hyperscale data centres' and operated by large service providers,

are on the rise globally. According to Cisco, global data centre IP (internet protocol) traffic will grow threefold at a compound annual growth rate of 27 percent between 2015 and 2020. Traffic within hyperscale data centres will quintuple by 2020.

An industry tracking publication, Datacenter Knowledge, estimated that Facebook was running about 60,000 servers in 2010. Given the scale of Facebook's completed sites, thousands of new servers will come on-line each year. This is not surprising with the explosion of applications available from the cloud, and the expectation from users for any app to process any transaction instantaneously. For a company like Facebook, building its own cloud facility is essential.

Nearly two billion photos are currently shared on Facebook services. In addition to this vast stock, 350 million photographs are uploaded onto Facebook every day. This produces a huge demand for data storage or cloud facilities. In 2010, Facebook (by no means the most data hungry of the big five tech firms) announced plans to build its own data centre in Prineville (Oregon). Since then it has completed three other data centres in Forest City (North Carolina), Altoona (Iowa), and Lulea (Sweden). To support its growth from acquired platforms such as Instagram, WhatsApp and Messenger, Facebook has started construction in two new locations in the U.S. and two more in Europe in Clonee (Ireland) and Odense (Denmark). Facebook has commissioned a new build averaging a million square feet every year in the last seven years. In SEC filings Facebook reported capital expenditures related to data centre infrastructure, network equipment and office space of about \$4.5 billion in 2016, \$2.5 billion in 2015, and \$1.8 billion in 2014 – growth of 2.5x in three years. The company expects this expense to continue growing as its business (and its data centre footprint) expands.

Figure 4.2: The Facebook data centre at Altoona (Iowa)



<http://www.datacenterknowledge.com/archives/2015/06/04/third-facebook-data-center-coming-to-iowa/>

According to the Facebook Sustainability Page (sustainability.fb.com): *In 2004, one million people were using Facebook. Today, more than a billion people from around the world use our family of apps and services,*

Small buildings

including Facebook, Messenger, Groups, Instagram and WhatsApp. They're staying connected with friends and family, discovering what's going on in the world, and expressing what matters to them. We are committed to powering connectivity with the smallest footprint possible.

Connectivity is a main pillar for such mega data centres and their locations are useless without meeting the latency (the time interval between request and response) requirements of the applications they are serving. In the last year, Facebook has announced partnerships to help lay a trans-oceanic cable from the U.S. between the East Coast and Europe and similarly from the West Coast and Asia. It is interesting that the trading routes from several centuries ago mirror the fibre optic routes of the digital age. However, the changing nature of the internet's global information flow is challenging and taxing existing network points, so new ones must be built, sponsored by the likes of Microsoft, Alphabet and/or Facebook.

As another example, Amazon has developed its Amazon Web Services (AWS) data centres into one of the essential pillars of its business, not only serving Amazon's internal needs but also a source of external competitive advantage. These buildings will need to be connected to broadband services in order to be fit for purpose.

In response to this need, PropTech startup WiredScore's Wired Certification rating standard uses several metrics, including connectivity quality, infrastructure, and readiness, to rate buildings.

WiredScore provides property owners with official certification details and information about how to improve their connectivity levels. Wired Certified information is made publicly available for tenants, agents and the general public to identify commercial spaces that meet their connectivity needs.

There is a growing number of REITs and property companies specialising in data centres and other new-generation high-tech buildings.

For example, the CBRE Global Investors spin-off Digital Realty has 198 buildings in 14 countries across 5 continents. According to Wikipedia, Digital Realty held its initial public offering in November 2004. At the time, its portfolio of 24 properties consisted primarily of those contributed by a private equity fund (GI Partners Fund I) to which CalPERS provided a \$500 million equity commitment to invest in technology-related real estate and technology operating businesses. In addition, CB Richard Ellis Investors, a subsidiary of CB Richard Ellis, and members of GI Partners' management provided a commitment of \$26.3 million. Digital Realty has regularly delivered outstanding returns.

Equinix has 145 data centres in 40 markets on five continents. This is an American-origin multinational company that specializes in enabling global interconnection between organizations and their employees, customers, partners, data and clouds. The company is "*the leading global colocation data center provider by market share*". Equinix was founded in 1998 to provide a neutral place where the networks forming the early internet could exchange data traffic. It expanded to Asia-Pacific in 2002 and Europe in 2007. The company later began operating facilities in Latin America in 2011 and in the Middle East in 2012. Its purchase of TelecityGroup in early 2016 established the company as the largest colocation provider in Europe. In December 2016, Equinix

announced that it had agreed to purchase 29 Verizon data centres in a move to expand its presence across the U.S. and Latin America. The deal, expected to close in mid-2017, would bring Equinix's data centre count to 179 facilities in 44 markets.

4.7 On-site energy supply

Energy supply for data centres (and other large commercial buildings) is a growing business need and opportunity. Traditional electricity utilities cannot keep pace with the exploding demand for energy by big data centres. The energy challenge is exacerbated by high total expenditure on electricity by data centre operators; high volatility in electricity prices; and pressure to lower the carbon footprint. A possible solution is to develop cooling (and/or heating) systems and learning algorithms that enable customers to get the energy services they need at a lower cost.

For Facebook, energy use in its data centres requires a renewable energy partner to meet its sustainability targets. It has committed to power its owned and leased data centre operations with clean and renewable energy. Facebook is expected to announce a commitment to secure 100% clean and renewable energy in its future sites, as it has done for several of its existing centres and the ones currently under construction.

Aggreko plc is an example of a modern age energy supplier. Aggreko is a manufacturer of temporary power generation equipment and of temperature control equipment, headquartered in Glasgow, Scotland, listed on the London Stock Exchange and a constituent of the FTSE 250 Index.

We can expect partnerships between energy suppliers and energy users as the data centre market – and the smart real estate sector – continues to grow.

Chapter 5

The sharing economy

In this chapter we describe the sharing economy, which is a movement designed to enable the sharing of the use of real estate assets or space through tech platforms

Poster children: Airbnb, WeWork

5.1 The sharing economy is founded on transactions enabling the sharing of the use of space

In Chapter 3 we developed our classification system for PropTech and the major horizontal business activities: information provision, transaction or marketplace facilitation and control/management. In our analysis of the companies which applied for PiLabs accelerator support in Chapter 3, 20% of all applications were in the Shared Economy vertical. The Shared Economy vertical was primarily active through the transactions horizontal, which comprised 85% of all applications in this sector. This chapter will primarily focus on transactions enabling the sharing of the use of space.

5.2 Definitions

Your first space is hopefully your home. If you are a service industry worker, your second space is likely to be your company's office. You are now increasingly likely to do work in a third place, or a whole range of third places. This could be a coffee bar, a hotel, a park or a train – a shared, social space.

The 'Sharing Economy' - sometimes also referred to 'Collaborative Consumption', or 'the Access Economy' - represents an economic revolution built around an economic philosophy that space and capital goods are better shared. The concept of the sharing economy started to emerge in the early 2000s. Since then, probably encouraged by the search for new business formats in the aftermath of the global financial crisis of 2008, it has fostered seventeen unicorn companies with billion-dollar valuations, and impacted many industries by redefining their core business models (Tune, 2014). The best known examples are Uber and Lyft, Airbnb, WeWork and Zipcar. The assets being shared in these examples are cars, houses and offices, but the concept is not limited to these assets.

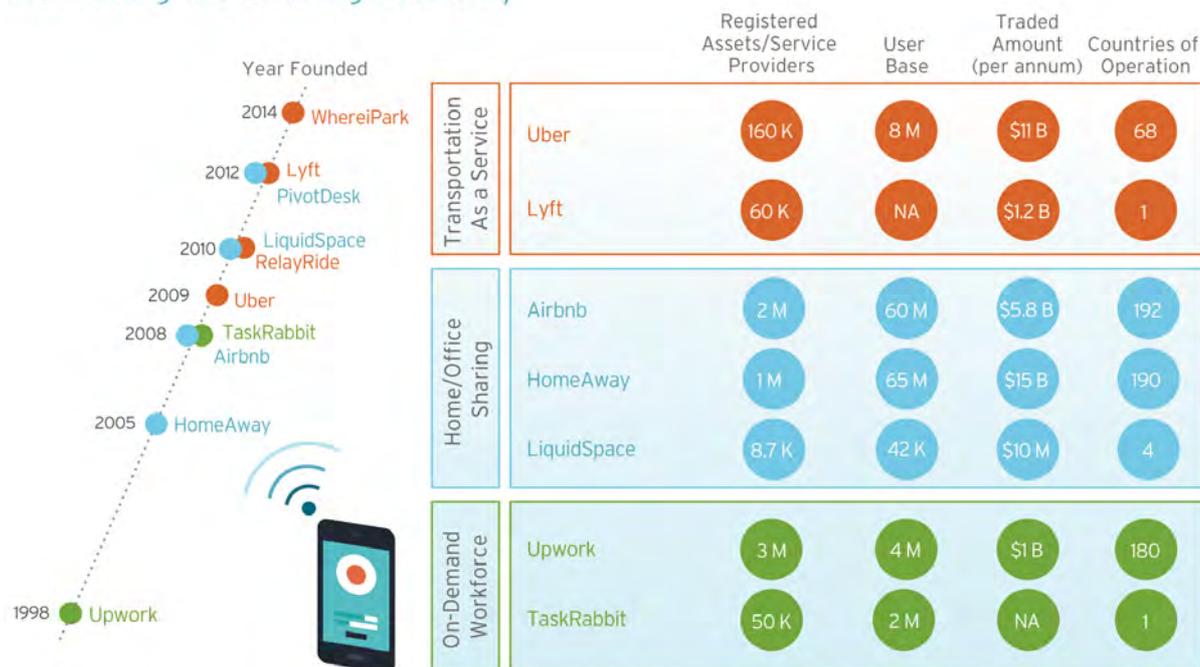
The industries that have been dramatically impacted are:

- Transportation: car rentals and taxis
- Real estate: residential, hospitality, retail, storage and office space
- Labour: the sharing economy model provides an online platform to share people’s skills and expertise for potential customers, leading to ‘the gig economy’. The self-employed US workforce is estimated to be about 53 million, which in 2014 equated to approximately 34% of the entire US workforce and was expected to grow to about 60 million by 2020 (Grothaus, 2015).

Figure 5.1 depicts milestones in the evolution of the sharing economy, and provides statistics for some of the industry’s key players.

Figure 5.1: milestones in the evolution of the sharing economy

Measuring the Sharing Economy



Source: Latest publicly available data
Figure 1

Source: Cognizant Business Consulting (2016)

Most of the successful Shared Economy companies emerged or gained significant motion during or after 2008 – and this is not by coincidence. Significant job loss and financial austerity has changed the way consumers access, buy and use products and services. Instead of aiming exclusively for traditional ownership, which carries with it the burden of expensive storage space, an increasing number of consumers are paying for temporary access or temporary ownership. This (signalled by the growth of offsite self-storage as anew property

The sharing economy

type) has become a cost saving mechanism that has commuted to an iconic modern lifestyle for millennials. While the sharing economy may be the result of the economic downturn, there has clearly been a shift in mindsets of millennials.

Significant technological, economic, political and social changes have also fostered this fast-growing iconic style of living. These are as follows:

- **Technological:** the internet has made it easier for companies to aggregate supply and demand and has transformed consumers' relationships with products and services. Smartphones have revolutionised both consumers' and producers' access to the marketplace. Satellite positioning functions help to find nearby markets, and social media networks and recommendation systems have helped to establish a bilateral trust system. Finally, internet billing systems such as Paypal have helped to build the foundation for e-commerce (the transactions/marketplace horizontal).
- **Economic:** austerity, crises, high house prices in global cities and the decline of stable full time employment have re-oriented people's consumption behaviour towards more cost efficient rental models.
- **Political:** increasing political instability, the promotion of the entrepreneur and the replacement of institutions by global businesses has created a shared channel for idealism and social enterprise.
- **Social:** a startling number of millennials have begun to question ownership as a necessity for security and a fulfilling life, and this is infectious.

The shared economy movement has built its roots and gained popularity by resolving and improving two important business and social problems. The first is the importance and increasing drive towards collaboration and the access economy. The second is the accessibility of goods and services.

Collaboration is defined as the share or exchange through peer-to-peer based platforms of such intangible assets as skills, expertise, innovation and user experience. In a recent JLL poll, 74% of respondents indicated that *"thinking, talking, and brainstorming create the most value for an organisation. In response, companies are turning to alternative workplace solutions such as co-working to encourage collaboration"* (Jones Lang LaSalle, 2016). Examples of available solutions quoted by JLL include WeWork (co-working); Ecomodo (skill sharing); and Good Neighbours (neighbourhood support). Collaborative consumption differs from standard commercial consumption in that the cost of purchasing the good or service is not borne by one individual, but instead is divided across a larger group and recouped through renting or exchanging. Major examples include Uber, Relayrides and Zipcar (transportation); Airbnb and Sharedesk (home and office space sharing); Roost, Sharemystorage and Storemates (storage and parking); and We Are Pop Up (retail).

Accessibility is a function of tech-driven information systems and marketplaces. Location is usually important in a shared economy proposition – think Airbnb or Uber – and in maximizing the value of a proposition it is essential that the information systems used aggregate all available offers to make the location choices as precise as possible. How flexible are you about where you would want to park your car or store your canoe? Micro-location and accessibility are closely related.

5.3 The shared economy and real estate

In the real estate space, we can gather examples of tech-driven propositions enabling the shared use of houses, rooms in houses, office buildings, restaurants, storage space, car parking and shops.

Millennials have been forced to assume that home renting, and not ownership, is the order of the day. This is because house purchase in increasingly densified urban centres is prohibitively expensive, requiring large capital down payments. Real estate has a high capital cost: even if debt is used, an initial equity payment of around 10-30% of the total outlay, including fees and transfer taxes, is needed. In London, despite over 30,000 new city apartments having been built since 2008, prices have increased by 60%. The average house price in London is around £660,000. Typical minimum deposits are at least 20% - or £135,000.

Affordability has forced millennials to reconsider the need for ownership in housing, yet there is extreme excess capacity in the real estate market. It is estimated that there are 700 million sq m of existing spare capacity in China alone as at 2016, with over 400 million sq m in residential and the rest in commercial (Jieman News, 2016). The English housing survey 2015 (DCLG 2016) suggested that *“The overall number and proportion of under-occupied households in England increased between 1995-1996 and 2014-2015 from 31% (6.2 million households) to 36% (8.2 million households). This was driven mainly by an increase in under-occupied households in the owner-occupied sector, from 39% in 1995 to 51% in 2015. Meanwhile, under-occupation in the rented sectors declined from 13% in 1996 to 9% now.”*

These statistics suggest a growing rich-poor divide; the decline in under-occupation in the rented market suggests that more and more millennials are being pushed or pulled into a shared renting lifestyle. The ever-growing demand for the rented sector has created a supply shortage. However, as more and more business startups begin to operate in the p2p (peer to peer) rental market, this shortage can easily be corrected by employing the sharply increasing number of spare bedrooms in the increasingly under-utilised owner-occupied sector: 8.2 million households in England have one or more bedrooms than they need.

In addition to its high capital cost, the asset is also highly illiquid and non-portable. The ownership exchange process is inefficient, slow and costly. The average time to complete a purchase in the UK is 3 months or more and the average in China is 6 to 12 months. In 2016, fewer than 2% of owner-occupied properties changed hands in China (Jieman News, 2016). The burdensome purchasing process and the high capital requirements of traditional real estate have deterred many people from owning their own properties.

5.4 Short term housing rental, co-living and hospitality

A clear expression of the asset-lite shared economy is now being expressed through co-living businesses such as OpenDoor Co-Living or The Collective, which create collaborative living spaces (a perfect example of collaborative consumption). These spaces (says OpenDoor) are targeted at urban creatives and millennials. *“Our homes are curated social environments that facilitate sharing, connections, and meaningful relationships.”*

The sharing economy

Where most landlords and property managers rent space, we provide a platform for a life well lived. We are a culture play with a real estate business model.”

Trulia and Zillow – both originally house sales intermediaries – have now expanded into shared economy propositions. They set out to make house purchase and renting more efficient, for example by finding a renter for a second bedroom to support house purchasers or rent to rent entrepreneurs. Splittable facilitates the shared use of living space by tracking expenses and facilitating the sharing of bills, spinning off so-called ‘big data’ which can be sold to traditional owners and offer another revenue stream.

A second form of expression of the shared economy in hospitality space is of course Airbnb, which was launched in the autumn of 2008 at the peak of the global financial crisis. Its founders, Brian Chesky and Joe Gebbia, who had both recently graduated from the Rhode Island School of Design, were unable to find a job. When an industrial design conference came to town, they realised a commercial opportunity to make extra money by taking in a few boarders who were coming to the conference but did not want to pay for an expensive hotel. So they built a website, bought some air mattresses, and played host to three people for the weekend.

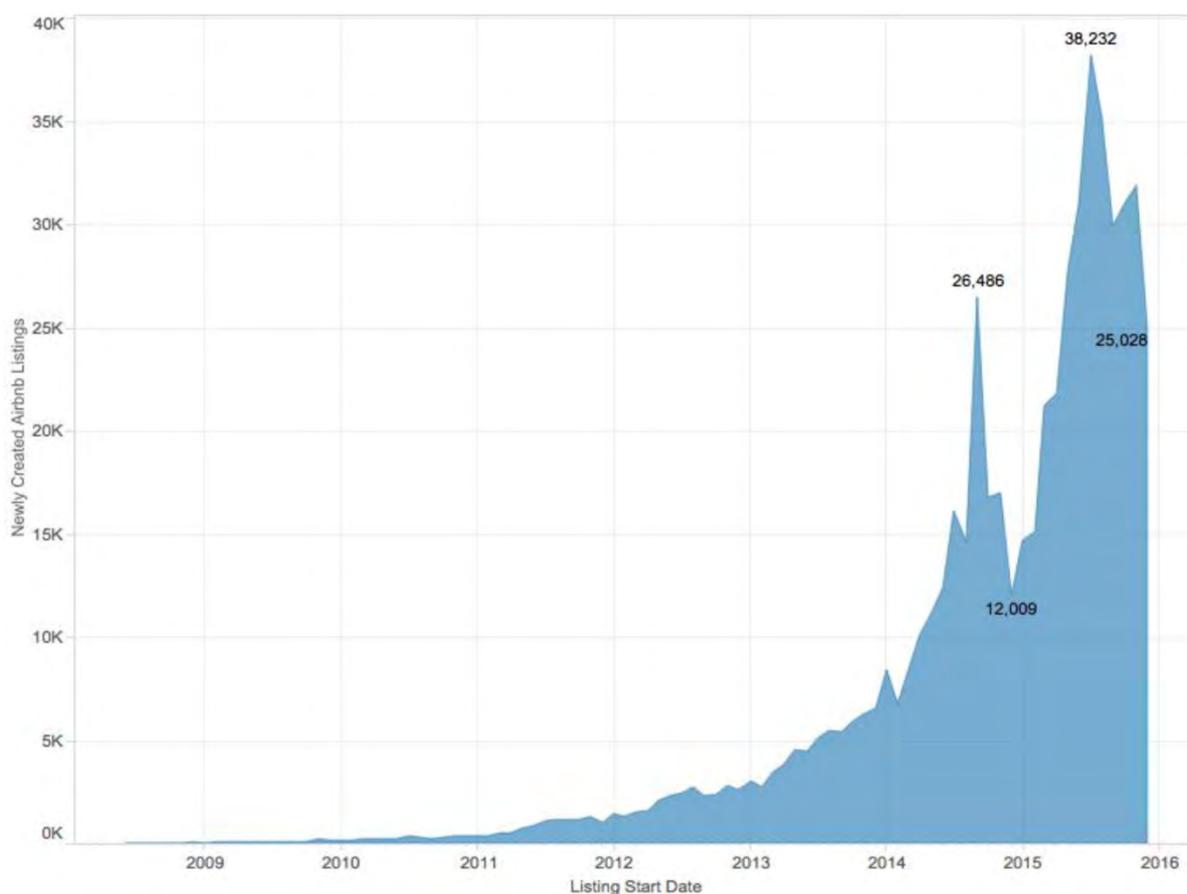
Today, Airbnb is an international phenomenon. It currently operates in 57,000 cities in 192 countries. In 2015, Airdna identified a total number of 550,000 Airbnb listings in the United States. HVS research suggests that over 2.8 million room nights were booked via Airbnb between September 2014 and August 2015. As a result, HVS estimated that hotels have lost over \$450 million in direct revenue per year to Airbnb (Mahmoud, 2016). Airbnb has more than 2.3 million house listings and a market capitalization exceeding \$30 billion (Newcomer, 2016; see Figure 5.2).

The key appeal of Airbnb is the classic PropTech proposition. The conditions are (i) a diverse, widely distributed source of demand (potential users of short stay hospitality); (ii) a diverse, widely distributed and heterogeneous source of supply (rooms); (iii) no dominant, efficient mechanism for bringing demand and supply together; (iv) potential financial gains to the demand side, the supply side and an intermediary; and (v) scalability.

The dominant efficient mechanism appears to be a very simple combination of a website and a brand. Traditional marketing and sales is by no means unimportant, but the value of brand, often associated with first or early mover advantage, is a huge factor in the automatic and low cost generation of volume. Shared economy businesses need ‘liquidity’ - lots of traffic. Small slices of supply revenue can be taken by the intermediary because potential volume is so large.

Airbnb is not the only force of change being applied to the hospitality market. The advent of Amazon-style customer feedback has driven businesses such as booking.com, Trivago and Trip Advisor in their journeys to extract revenue from the hospitality industry. These are in part classic PropTech businesses, part of the Real Estate FinTech vertical and the information and transaction horizontals. They have undermined or at least cannibalised the hotel and hotel chain website as a revenue source, as they offer much more choice. To travellers, location is the key variable driving demand, not brand; hence aggregators simply have a better proposition.

Figure 5.2: Growth in Airbnb listings



Source: *Newcomer, 2016*

To put the Airbnb scale into context, the Table 5.1 summarises the number of Airbnb bedrooms available and the number of traditional hotel rooms in the top 10 U.S. markets (CBRE, 2016). Airbnb appears to constitute around 10% of the total market in the top 10 US cities, but only 3.3% nationally, illustrating the self-reinforcing nature of densification. The value of a PropTech proposition is very likely to depend on the richness of the data it uses, as data richness will drive demand traffic to its site. Location is vital in real estate, so urban concentration is necessary to create that value.

As local urban data becomes richer, more people are pulled to that location, further driving concentration. This is the same river that makes Uber – particularly its car sharing service - highly successful in many big cities but absent from rural communities.

Table 5.1: Airbnb units as a proportion of hotel rooms, US

MARKET	ACTIVE AIRBNB UNITS	ACTIVE AIRBNB BEDROOMS	BEDROOMS PER UNIT	HOTEL ROOMS	AIRBNB UNITS/HOTEL ROOMS
New York	22,876	27,965	1.2	117,367	19.5%
Los Angeles	13,023	17,967	1.4	98,166	13.3%
San Francisco	6,428	8,790	1.4	51,561	12.5%
Miami	5,199	7,368	1.4	51,498	10.1%
Chicago	4,626	6,153	1.3	111,408	4.2%
Washington DC	4,443	5,784	1.3	107,776	4.1%
Boston	4,147	5,566	1.3	52,119	8.0%
Seattle	4,044	5,601	1.4	42,455	9.5%
San Diego	4,016	6,290	1.6	60,754	6.6%
Austin	3,357	6,024	1.8	33,877	9.9%
Top 10 U.S.	72,159	97,508	1.4	726,981	9.9%
Overall U.S.	173,057	277,256	1.6	5,031,645	3.4%

Sources: Airdna, STR, Inc., CBRE Hotels' Americas Research, Q4 2015

5.5 Shared workspace and co-working

The third place (or third space) is the social space separate from the two usual social environments of home ('first place') and the workplace ('second place'). Examples of third places are environments such as cafes, clubs, public libraries, or parks. In his influential book *The Great Good Place*, Ray Oldenburg (1989, 1991) argues that third places are important for civil society, democracy, civic engagement, and establishing feelings of a sense of place. According to Jones Lang LaSalle (2016), 25% of average worker time is now spent in third places.

Dennis Frenchman of MIT uses the term 'real estate fracking' to describe the fragmented and inefficient use of real estate space. Optimising workspace is a second example of the shared economy being applied to real property. Real estate workspace sharing platforms can be viable given the necessary conditions we presented above (a diverse, widely distributed source of demand (office-type workers); a diverse, widely distributed and heterogeneous source of supply (work rooms); no dominant, efficient mechanism for bringing demand and supply together; potential financial gains to the demand side, the supply side and an intermediary; and scalability. Workspace (offices, coffee bars and restaurants, public spaces) is less voluminous than bedrooms, but it offers sufficient scale for the disruptors to become interested.

Co-working is built on the opportunity to create third places which support collaboration by workers from different backgrounds to encourage knowledge sharing, innovation and the user experience. The demand for

co-working space has been driven by the growth of the creative and tech industries as well as the changing nature of work. The number of co-working club members using co-working spaces globally has been steadily increasing year on year to reach 1 million by 2017 (Huet, 2016).

Co-working - which has grown its market share from 1% to 14% of office space in central London over the period 2000-2016 - has three distinctly separate drivers. The first two colliding forces were the increasing demand from big businesses to be more flexible in a fast-moving world and the length and inflexibility of the traditional office lease. One result of this collision was Regus, a multinational corporation launched in 1989 that now operates 4,000 business centres supplying flexible quantities of space on short leases or licences across 120 countries. Regus, like WeWork, expanded rapidly during a dotcom boom, but Regus became bankrupt in 2003 after the telecom and dotcom bubbles burst and its tech customers reduced their more flexible workspace commitments. It has since diversified its tenants and now has a market capitalisation of \$2.5 billion.

Regus was not established by or for the benefit of millennials. When we add the third driver of co-working, the millennials' preference for the access economy, we provide the conditions for WeWork and many other co-working brands.

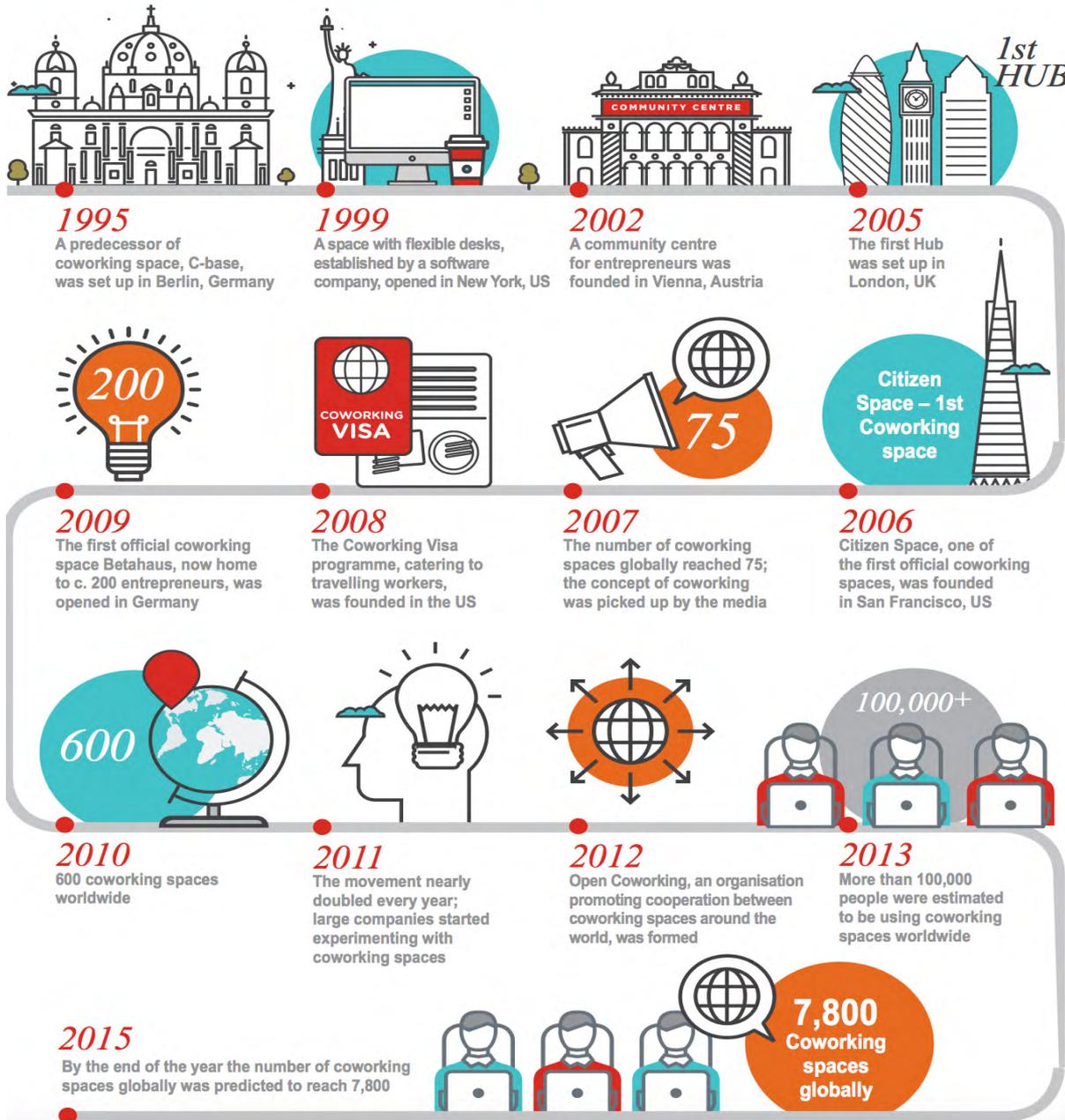
There are two co-working PropTech models. We can characterise one as the Uber or Airbnb concept, where the tech firm is simply an intermediary or broker of shorter term workspace. Brands active in this space include LiquidSpace, PivotDesk, Flexioffices, Spacious (brokering office space in restaurants) and Breather. These, like Airbnb, Uber, booking.com and many others rely on customer feedback and are as a result self-policing (although they face a regulation push back which we discuss in Chapter 8).

The second co-working model is characterised as the operator model, in which the business directly or indirectly controls the capital asset. This is the ZipCar model, used most famously in the co-working sector by WeWork, Workbar (which recently negotiated a tie up with retailer Staples to use redundant retail space), Spaces (from the Netherlands), Central Working, Grind, The Hub and others including Regus, scrambling to adapt. These business typically act as renters (and in future, owners?) of space and facilities managers rather than intermediaries between users and operators.

WeWork, the globe's leading shared office provider, opened the UK's largest shared space in London in 2016, with capacity to house 3,000 members. Its valuation reached a staggering \$16 billion after its 2016 round of investment funding. Its clients are diversified across multiple industries and the fastest growing segment is larger, more mature companies which have joined for the value proposition of more affordable space, community and network (Jones Lang LaSalle, 2016). The six-year-old New York start-up has also changed its revenue model from lease length arbitrage (buying long leases, selling short leases and realising a break-up value) into a management fee collection model for its services, including in some markets design, branding, software, and staff trading for its global network of members. In 2017, Japan-based SoftBank Group invested \$300 million in WeWork, thought to be the first installment of a multi-billion-dollar bet to make the brand truly global.

Figure 5.3: The co-working journey

The coworking journey



Source: Jones Lang LaSalle, 2016

Operators such as WeWork may continue to evolve as a management company – not a tenant, not a landlord but an operator like Marriott or Hilton. However, the probable emergence of a third model – the owner-operator – must also be considered (see Chapter 8). It would be surprising if a highly successful WeWork with a strong balance sheet did not in the longer term de-risk its operations by acquiring the real estate it operates – in which case it would probably become a REIT.

Meanwhile property companies are moving in the opposite direction. This temptation is neatly explained by the Harvard Business School Jamestown Case (Segel, Baum, Lietz and Wu, 2016). Should Jamestown, a developer/investor of mixed use workspace in Brooklyn, lease a key building to JP Morgan or WeWork? One has credit strength, supporting a high valuation for the income stream; the other a much weaker cash flow but a strong appeal to a valuable source of emerging tenants. Or should Jamestown launch its own co-working operation? Alstria, a German REIT, chose this latter route. British Land (initially through a joint venture with Central Working) is also beginning to operate its own co-working spaces.

Some co-working spaces focus on more deliberate collaboration, education and mentoring – The Hub and Central Working are examples. These operations may then be tempted to become accelerators by trading space for equity. Big companies know they need to be keep an eye on the disruptors, so we can also observe internal co-working, whereby established host companies invite investee companies and collaborators to share their workspace.

5.6 Other real estate shared economy sectors

The residential, office and hotel/hospitality sectors will bear the main brunt of the shared economy effect, and create an increased, more responsive and flexible supply that conventional real estate research and data fail to pick up. The next wave of workspace in a sharing economy is likely to further diversify third places as a way of facilitating mobile working, potentially with a social enterprise dimension. Meanwhile, other property sectors are also being fracked.

Internet-related over-supply in the retail sector is being matched with short term demand for what have become known as pop up shops through ventures such as Appear Here and We Are Pop Up, which claims to be “*the world’s largest network of retailers, space owners and brands collaborating on creative retail experiences*”.

Excess retail space is being made available for workspace in Staples stores in the US via a joint venture with Workbar, and Spacious is making restaurant space available to the same market in urban centres. Regus has a third place workspace proposition, building a series of partnerships with airports, railways stations, retail and roadside locations. Former managing director Phil Kemp said: “*We see an increasing number of mobile workers. There were 1.3 billion of them in 2013, enabled by the mobile technology. People find themselves working wherever they are. But physical space hasn’t caught up with the technology – people on the move don’t have professional places to work. So we are targeting high footfall locations that business people use, and*

The sharing economy

provide a professional workplace that's geared towards convenience and productivity”.

Roost is an online storage and parking marketplace that matches the demand side - renters who have cars to park or material to store – with the supply side, specifically neighbours who have unused space in their homes, garages, and driveways. The startup currently operates in over 22 cities in the US. Sharemystorage and Storemates are similar storage and parking ventures.

Next in line is likely to be municipal buildings, libraries, schools, universities, churches and other less obviously commercial spaces where the opportunity to maximise space use will be driven partly by social enterprises. Here we see all the necessary factors in place: a diverse, widely distributed source of demand (office-type workers); a diverse, widely distributed and heterogeneous source of supply (under-used community and municipal space); no dominant, efficient mechanism for bringing demand and supply together; potential financial gains to the demand side, the supply side and an intermediary; and scalability. However, achieving scale will be more difficult, as the supply side is not entirely focussed on revenue.

5.7 China – the emerging market

The total amount of investment made in real estate in China (1.5 trillion RMB) represents around 15% of the country's GDP (National Bureau of Statistics of China, 2015). Including other relevant businesses, the entire real estate and construction industry could contribute as much as 30-40% of China's total GDP. This is far larger than any other country in the world. On the other hand, the estimated total size of the shared economy in China is only 0.2 trillion RMB, with less than 5.5% of China's total workforce either directly or indirectly employed in the field (China State Information Centre, 2016). However, the Chinese central government predicted that this area of the economy will grow by over 40% annually and comprise well over 10% of China's total GDP by 2020 (China State Information Centre, 2016). This market presents an irresistible opportunity for shared economy enterprises.

Companies such as Airbnb, Xiaozhu and Mayi already dominate the traditional short renting market. Tujia and Youtianxia are pioneer companies in holiday renting; Soho 3Q, Urwork and Vanke Cloud Space are collaborative working space providers. Both traditional short letting and holiday renting sectors are growing rapidly. The entire online short renting market was worth only 140 million RMB in 2012, but by 2015 its size had multiplied 71.4 times to 10 billion RMB and the estimated size by 2016 is 30 billion (Zhou, 2015). However, unlike the bull market in residential markets, collaborative office sharing space has not appealed to Chinese companies. The extremely poor patent system in China has created distrust between corporates and discourages collaboration. Meanwhile, the Chinese government has built multiple incubators in each city to help facilitate central government's promotion of *'popular entrepreneurship and innovation propaganda'*. China may be lagging, but it is moving towards a solid and well established social trust system, which will eventually provide the support needed to capitalise on its huge shared economy potential.

Chapter 6

Real Estate FinTech

In this chapter we describe Real Estate FinTech, meaning the enterprise sector which supports (sale or leasing) transactions of real estate assets

Poster children: Zillow, Zoopla, LendInvest, OpenDoor

6.1 Real Estate FinTech facilitates transactions in the capital markets

In our analysis of the companies which applied for PiLabs accelerator support in Chapter 3, 51% of all applications were in this vertical. The Real Estate FinTech vertical was primarily active through the transactions horizontal, which comprised 75% of all applications in this sector. This chapter will therefore primarily focus on transactions of, and information enabling transactions of, real estate assets. Thus includes freehold or fee simple title, long leaseholds and shorter leases – any real estate asset with a capital value and capable of being transacted.

Given its size and the potential revenues attached to it, the residential sector is likely to feature heavily in any survey of Real Estate Fintech: see Chapter 3, and CB Insights, 2016b.

In Chapter 6, we set out the conditions that made a shared economy proposal attractive to tech investors and entrepreneurs. The conditions are (i) a diverse, widely distributed source of demand; (ii) a diverse, widely distributed and heterogeneous source of supply; (iii) no dominant, efficient mechanism for bringing demand and supply together; (iv) potential financial gains to the demand side, the supply side and an intermediary; and (v) scalability. These same conditions would seem to apply to the Real Estate Fintech sector in general; given that the residential sector is much larger in size than the commercial sector, much activity will be focused here.

The diverse, widely distributed source of demand in the broad Real Estate Fintech sector is homebuyers, home renters, and buyers and users of commercial and other non-residential real estate types; (ii) the diverse, widely distributed and heterogeneous source of supply is the same global real estate asset base; (iii) there is no dominant, efficient mechanism for bringing demand and supply together, instead of which we have a very large number of brokers by whom information is often keenly guarded and who can survive on a small number of large, remunerative transactions; (iv) potential financial gains to the demand side, the supply side and an

intermediary evidenced by very large round trip transaction costs; and (v) the same scalability based on the huge global real estate asset base.

I'd expect that technology will take all the offline real estate search and transaction processes online. Consumers will be armed with transparent market demand and supply information and will be able to take any actions they desire to easily buy, sell, or rent their homes. The home buying and selling process will become much shorter and homes can turn over at a higher rate. Moreover, more consumers will rent out their homes either as sublets, nightly lets or long-term rentals using online technology, like booking reservations on Open Table. Consumers will be incentivized to purchase larger homes so that they can easily rent out space; and roommates will easily find each other to live together either on a short-term basis until someone finds another place, or on a long-term basis. Trulia just launched rooms for rent; consumers can now easily post their rooms online in just a few steps.

Trulia and Zillow brought real estate information online so that consumers can have insightful information at their fingertips instead of solely relying on an agent, just to understand and see available listings. Both companies are still operating mainly as lead generating businesses for agents, focused on sending them highly qualified leads. In Q4 2016, on average more than 140 million monthly unique users visited Zillow Group's consumer brands, an increase of 13% year-over-year. Nearly 45% of people who visited Zillow and/or Trulia in the past 12 months are planning to buy and/or sell a home in the next 12 months.

Of the emerging technologies, I'd expect VR to play a huge role in real estate. With VR, buyers and renters can view homes remotely and secure a place. Potentially, there could be a service like TaskRabbit where consumers can hire people to go view a home for them. From my own perspective, I want to see everything currently done offline to be brought online with a heavy focus on mobile, so that the home buying and rental processes can be done on-the-go.

Yardley Ip, Trulia

6.2 Market size

According to Savills, 2016 and the World Bank, the global real estate market is worth \$217tr, 75% of which is residential property. Annual real estate trading has averaged \$683bn annually since 2007 and reached \$900bn in 2015. This represents turnover of around 0.3-4% of the capital stock. Inventory turnover in the S&P 500 company averages around 15 times; this is a multiple of approaching 5,000 compared to global real estate. The global real estate market is huge – making up more than half the value of all mainstream assets in the world - but it is horribly illiquid.

Ignoring taxes on property transactions, legal, valuation and structural due diligence, contracts, investment advisory fees and brokerage fees are likely to produce an average round trip trading cost of around 3-6% of the price of the real estate; and this estimate excludes abortive costs on transactions that do not complete. Annual

fees of 5% on \$1tr of property value (0.4% of the market) would provide income for built environment consultants, real estate professionals, lawyers and accountants of around \$50bn a year. Shaving 10% off that through greater efficiencies would release potential revenues of \$5bn. Reducing the illiquidity of real estate – from a five thousandth to only, say, a one thousandth of the average large companies – would mean that a 10% efficiency gain would reap a global revenue gain of \$50bn; and a 50% improvement would be worth \$250bn annually.

In 2015 the biggest global companies earned revenues as follows: Facebook \$17bn, Google \$70bn, Microsoft \$95bn, Amazon \$100bn, and Apple \$200bn. KPMG earned \$25bn and Deloitte \$35bn; CBRE earned \$10bn, and JLL \$6bn. A dominant platform reducing the inefficiencies of property trading and enhancing liquidity might not only command a large share of those \$50bn revenues but might also grow the size of the pie. The industry could certainly generate a unicorn (a \$1bn value company) or 10; there are currently around 25 global FinTech unicorns. Clearly, the focus of endeavour will be on improving the efficiency of the transaction process, and creating more liquidity or velocity. The relative scale of the market will encourage serious investment primarily in the residential market; commercial market applications are likely to follow behind.

The MIT innovation lab has conceived a ‘funnel’ of real estate tech, described by Steve Weikal. Imagining the real estate professional moving through a process of site location research, through finding a space, analysing the deal, managing the transaction process and finally managing the asset, MIT provided examples, to which our research has added, of new PropTech 2.0 entrants and the PropTech 1.0 defenders. These will be described in the following sections.

6.3 Research and information businesses

PropTech 1.0 created a large number of information and analytical businesses, which were then weakened by over-capacity, attacked by market leaders and subsequently swallowed. The end of this process was marked by Loopnet being sold to the big winner in the sector, CoStar (*“The industry’s most comprehensive database of commercial real estate information – with \$1bn invested in data collection”*). Alongside some newer PropTech1.0 spinoffs such as Real Estate Strategies/PACM in the UK we now have a new generation of challengers using cheaper and more advanced technology in combination with a greater availability of public data to produce what appear to be product-driven businesses. These include Datscha, Geophy, Kensee and Mashvisor, all offering (as the latter suggests) mashups of various data sources and hoping to persuade property investors to make sense of the combined result.

Datscha *“provides an online solution for faster and more accurate decisions by turning data from the best public and private sources.... Our core DNA is to collect, match, aggregate and visualise public and proprietary real estate data in the market’s most modern and easy to use web based service”*.

Kensee *“automatically collects and organizes mass amounts of global Real Estate data, cutting through the*

noise by bringing you only the relevant information, tailored to your interests and needs. We convert the bits and pieces of dispersed information into crystal clear market signals, sentiment trends and actionable insights, so you never miss rapid markets' changes."

Geophy is also representative of this group:

"In a world demanding ever-greater transparency, real estate remains incredibly opaque. GeoPhy was founded to change just that. On a daily basis, investors, banks, pension funds, consultants, governments and regulatory bodies make real estate decisions based on partial and inconsistent information. Right across the industry the lack of consistent and reliable data has undermined, devalued and destabilised short, medium and long term investment returns. We apply cutting-edge technology to an ever-growing amount of data from a wide variety of sources. Our semantic model for the real estate domain enables advanced analysis and research, combined with machine learning for predictions and forecasts."

Machine learning and artificial intelligence are important in Real Estate Fintech. Artificial intelligence (AI) is intelligence exhibited by machines. An intelligent agent is a device that takes actions that maximize its chance of success in achieving a specific goal; machine learning is a type of artificial intelligence that provides computers with the ability to learn without being explicitly programmed. Machine learning focuses on the development of computer programs that can change when exposed to new data. The process of machine learning is similar to that of data mining, as both systems search through data to look for patterns. However, instead of extracting data for human comprehension, machine learning uses patterns in data to adjust program actions automatically. This means that, for example, multiple regression models used to forecast rents can be constantly re-estimated in real time as new data enters the system.

Can machines out-advise experienced professionals? We will return to this question in Chapter 8.

ZoomProspector, Aerial Look, ESRI and StateBook are focussed on less ambitious site selection tools:

"StateBook is the first online marketplace for site selection and economic growth and development. Explore reliable information required for site selection decisions for every community in the country, from demographics, taxes and utility costs to quality of life data like museums and golf courses. Connect with economic developers from each location to learn more about their communities, and use our robust tools to search, create meaningful reports, and more. Welcome to the new online meeting place for site selection consultants, EDOs, business, academia and government."

Compstak (US-based) brings together leasing data for investors and occupiers; its India equivalent is Propstack. UK-based Infabode brings together reports on global real estate markets into one simple search engine.

A major component of the research and information sector is the commercial property search engine. Finding a space to rent or to buy has been or was unimaginably difficult pre PropTech 1.0. This involved magazine paper-based advertising media including publications such as Craigslist, Yellow Pages, Exchange and Mart and Gumtree leading to physical meetings, or (at the upper end of the market) phone calls with a disaggregated

selection of real estate brokers. In London, these brokers were 'retained' to sell or lease certain properties, meaning that they would receive a fee on sale from the seller of up to 1% of the price or, on a letting, say 10% of the initial rent. They often described themselves as 'advisors' to the vendors (and sometimes were). If they were not retained, they would look to the purchaser for a fee if they introduced a property on which another broker was retained. Of course, they would heavily promote the assets on which they were retained. Small brokerages or agencies could survive for a year and longer on one successful closing.

That world and business model is slowly being assigned to the past. Properties are searchable on the internet through individual brokers' sites. A diligent tech entrepreneur can imagine ways to aggregate this data and to motivate the brokers to share it. Alternatively, he or she might employ a web crawler which is a bot (software application) designed to systematically browse the web. These web crawlers can copy all the pages they visit for later processing by a search engine. Crawlers often visit sites without tacit approval. New sites, using both the aggregation and web crawler models, are in large supply in a winner-takes-all race for brand supremacy.

Examples include PropTech 1.0 survivors CoStar and LoopNet (owned by CoStar), plus startups RealMassive, TheSquareFoot, Hubble, Property.Works, SPD, Xceligent, REALLA and Real Capital Markets. Plainly, not all of these will survive to PropTech 3.0.

Analysing the deal requires comparables, or comps – what has been paid for similar buildings nearby? This process is facilitated again by CoStar but also by Compstak, Credi-Fi, Megalytics, Propstack, 42 Floors and Lucro, which neatly adds modelling software for would-be property investors.

However, the great majority of commercial real estate deals will continue to require expert legal and real estate advice. Brokers – who might now be better described as agents - will continue to charge fees for helping to sell buildings by direct contact with the purchaser (or his own agent). The revenue models for these businesses may be subscription-based (CoStar), or may instead rely upon taking a slice of the broker's fee. This process is now under pressure, and true advisors charging time-based fees will emerge in a world where much information is freely searchable and high brokerage fees are unsustainable.

This assumes that vendors of properties will wish to expose their assets to public inspection. Unless and until we have an active unitized market for shares in assets (see Section 6.8 below), this is not likely to be the case for larger transactions. It often suits both buyer and seller to transact 'off-market', to avoid the stigmatisation of an over-exposed asset that fails to transact rapidly through over-pricing. In March 2017, for example, British Land and Oxford Properties announced the sale of The Cheesegrater – 22 Leadenhall Street, London – for £1.15bn to Chinese buyer CC Land. Very few market professionals, let alone the public, knew that the building was up for sale. Then, of course, maybe it was never marketed for sale. In a world of open web-based information, would-be buyers are capable of using research engines to identify buildings and their owners and make a direct approach. It is no wonder that real estate agents worry about disintermediation – as Elizabeth Barrett Browning wrote: *"let me count the ways...."*. The development of open ownership data pursued by Datscha, for example, might by itself reduce transaction costs and improve liquidity and turnover from that tiny 0-3-4% of the capital stock.

6.4 Residential sales and letting engines

Online estate agents are grabbing market share from the traditional versions, with a reduction in the number of estate agents widely anticipated. Zillow, Trulia, Rightmove and Zoopla are all successful tech-enabled information providers in UK and US residential real estate, all late stage PropTech 1.0 players who are now relatively mature and with a straightforward information aggregation proposition (Real Estate FinTech/information). These businesses began with residential sales and have more recently moved into lettings: for example, Trulia launched its rental brand in 2017.

The PropTech 2.0 challengers are a mix of sophisticated machine-learning tech companies (we feature HouseCanary) and something of a reversion to a human interface (we feature Purple Bricks).

Sales

“Data science will continue to play an increasingly huge role in predicting home prices for companies like OpenDoor and Knock. Zillow already has a dominant brand - Zestimate - to help home sellers better understand their home values.”

Yardley Ip, Trulia

Jeremy Sicklick of US-based HouseCanary, which uses AI/machine learning to value residential property in real time, estimates that it takes on average over 100 days to sell or buy a house in the US, and a combined total of 11% of the price of the house is spent by both sides in fees and taxes. Their mission and opportunity is to take a slice of that 11% while reducing the total burden of cost.

In the UK, estate agents have traditionally operated on a ‘sole agency’ basis, and are reliant on instructions to sell properties on behalf of the owner for a fee of around 1%-3% of the purchase price. In the US, sole agency is less common than the pooling of instructions across groups of brokers through what is known as a multiple listing service. This is a collection of services that real estate brokers use to share information about properties with other brokers who may represent potential buyers, establish contractual offers of fee sharing, and accumulate and disseminate comp information to enable appraisals. The listing data stored in a multiple listing service's database is the proprietary information of the broker who has obtained a listing agreement with a property's seller. Broker fees can as a result of this sharing model be a huge 6% of the property price, although it should be said that the broker also facilitates exchange of contracts and legal professionals are less involved, saving fees elsewhere.

In most developed markets, where debt is used in the majority of house purchases, the bank or lending party commissions a valuation by a qualified professional. This inevitably takes time – form filling by the buyer, processing of the application by the lender, commissioning of the valuation, setting up the inspection, preparing, writing and returning the valuation and processing the information received – which can eat into a large proportion of the 100 days.

Uncertainty over the value of the property can also delay the initial sale process, risking gazumping (a potential buyer offering more to a seller after an agreement has been reached with another buyer at a lower price) and a long drawn out negotiation. The well-funded HouseCanary proprietors believe that they can develop intelligent AI algorithms which can be accurate for the vast majority of US homes (say 80%) to within a 2% error range. Given that in some markets (including the US, Australia and South Africa) on-line appraisals are legally acceptable, the acceptance of this thesis by market participants and lenders would mean that perhaps half of the 100-day lag can be taken out of the process in 80% of transactions. This would create a 40% efficiency gain.

We can imagine a world in which prospective house buyers can go to one site where all houses on the market – or, better, all houses - are listed, with an independent and public valuation discoverable by the seller, the buyer and lenders. The transaction process will be faster, and the liquidity of this huge asset class will be greatly improved. This one site, or a duopoly, is already in place or emerging in the developed and major developing markets, and the activity of venture capital investors described in Chapter 3 suggests a focus on increasing dominance by large brands. In the US, Zillow recently bought its close competitor Trulia; in the UK, Zoopla bought Hometrack; in China, Fang, Sina and Juwei (for international property) are dominant; in India it is PropTiger and Square Yard.

However, an interesting battle is emerging in the UK which might be an early sign of the likely PropTech 2.0 reaction that we will discuss in Chapter 8. Zoopla and Rightmove are information providers; Purple Bricks is a tech-enabled estate agent which puts sellers together with local experts. Since its launch in 2014 Purple Bricks has raised well over £100m in VC funding and through the listed markets. Its business model is shockingly simple – it simply cuts out the cost of running a chain of offices.

Purplebricks was conceived by brothers Michael and Kenny Bruce from their experience in running a successful traditional estate agency in the Midlands. The brothers realised that, with the proliferation of the internet and widespread acceptance of transacting online, customers were interacting much less with high street branches. This presented the opportunity for the development of a new lower cost model without the need for a branch network yet retaining the local expertise and personal service that an agent offers. As of April 2016 the Directors estimate that the Company has become the third largest estate agency in the UK by fee paying customers at its current run-rate of instructions. Purplebricks successfully floated on AIM in December 2015. Since then the Company has expanded its market share considerably and has announced its launch into the £3.3bn Australian estate agent market (and now the US market).

(From customer feedback in Australia): *“The process for a seller starts by booking a property appraisal. This can be done online. Using an online form, the seller can enter in their address, choose a day and time, and confirm an appointment with their “Local Property Expert”. A Local Property Expert is someone who works for Purple Bricks, basically like a franchisee or local office of any other real estate agency. One difference between Purple Bricks and a traditional real estate agency is that Purple Bricks Local Property Experts do not have an office; they work remotely and come to the seller’s home for any face to face interactions. The Local Expert will*

create a floorplan of the property and give the seller an idea of what the property may be able to sell for in the current local real estate market. If the seller chooses to go ahead and use Purple Bricks to sell their property, they will be charged \$4,500 for a sale by private treaty and \$5,325 for sale by auction. Another difference between Purple Bricks and a traditional real estate agent is that Purple Bricks will charge the fee to the seller whether the property sells or not; a traditional agent is only paid their fee if they sell the property, and the fee comes out of the proceeds of selling the property.”

The Purple Bricks model, which combines digital and human interfaces, and is replicated in the US by Triple Mint, could be a sign of the future. Traditional business formats capturing tech for their own benefit will hit back and compete with purely digital offerings. This appears to be the model in India; SquareYard and PropTiger are both tech-based advisory and sales businesses that are raising significant US venture capital.

Lettings

We believe that urbanization will accelerate the sharing economy (cars, bikes, etc.) and also create more efficient and liquid markets for residential and commercial spaces. Differences from one neighborhood to the next or one quadrant of the city to the next, in our view, have always been apparent to consumers and real estate professionals. We believe urbanization will make these differences more important, and thus generate increased demand for information and analytics about hyperlocal markets. As a result, we believe that residential and commercial brokers that are able to become hyperlocal market experts and use social media to brand themselves as such will take market share from peers that, in contrast, try to be a mile wide and an inch deep. Urbanization and the increase in residential development (rented and owned) will likely increase the impact technology has on apartment and condominium markets. Consumers will be able to use technology such as Matterport’s 3-D tour software to view prospective rentals virtually after using information from sites such as RentPath and CoStar to choose a neighborhood in which to live. While we would not declare that technology will commoditize the rental market, we believe the combination of urbanization and technology will dramatically increase the liquidity of the rental market and hasten the demise of rental intermediaries.

William Blair, 2015

Like the typical residential sale, the residential letting process is also characterised by risk and inefficiency. Landlords risk letting to inappropriate and untrustworthy tenants; tenants risk paying out deposits and rent to unsuitable landlords; and a disparate pool of available rentals is matched by a disparate pool of prospective renters. Many tech entrepreneurs believe this market is ripe for disruption.

In the UK, Goodlord is a rental market place while Houzen rates letting agents using customer feedback. NoAgent connects residential landlords and tenants directly via an app, with revenue derived from landlord subscription fees. Zumper is an online aggregator of apartments for rent.

Reposit intermediates tenant deposits by taking a fee from tenants and guaranteeing to pay for any damage shortfalls. Cozy incentivizes landlords to set up renter application processes and payments through their platform.

Plastiq and RadPad allow renters to initiate payments without landlords having to explicitly invite the renters, leaving the control in the renters' hands. (RadPad was acquired by LandlordStation after nearly shutting down despite having what was believed to be a good product.) Yapstone is essentially a service provider for businesses who want to accept payments.

6.5 Crowdfunding and equity raising platforms

“If there is one area ripe for FinTech innovation, it’s real estate investing. Why put 30% down just to gain massive management headaches when you can now invest in rental cashflow online with very similar returns? FinTech and Real Estate are like peanut butter and jelly, they just go together!”

Linda Schicktanz, Chief Advisor, CK Mack

Equity raising in the private markets remains a vital, difficult activity. Equity is generally more time consuming to raise than debt: Keith Breslauer of Patron Capital describes the €949m equity raise for Patron Fund V as a long process including 490 meetings with potential and eventual investors. Hence, we can observe tech-driven entrepreneurial activity in the raising of equity. The shared economy model – real estate crowdfunding – has captured the imagination of young entrepreneurs; the bigger inefficiency, as illustrated by Patron, would be in the institutional markets.

Up to 2016, real estate equity crowdfunding had raised \$3.5 billion for 125 companies in the US, around 10% of global crowdfunding capital raised (Esbaitah, 2016). Crowdfunding has the potential to resolve the capital requirement problem for less financially capable buyers, but also to remove geographical barriers. Reducing the minimum deal size for an investor should widen the potential buyer base and the pool of available capital.

Capital raisers – Brickvest, Property Partner, Capitalrise, Property Crowd, Property Moose, Piggyback and Mashvisor, in the somewhat patronising yet hopeful words of the latter, *“let average people become savvy individual investors to make profitable real estate investments and rental strategy decisions through an online platform that instantly aggregates real estate data”*.

Increasingly, new GP platforms (for example, Shojin) use their own crowdfunding solutions as a retail distribution channel. Single properties are unregulated, so the result of the collision of retail crowdfunding and regulated investment management business is yet to become clear. The mechanism used for more sophisticated investments involves retail investors being grouped into one LP, advised by the platform.

Piggyback “aims to source the best property deals so you don’t have to. All of the Piggyback investment properties have been handpicked by our team following extensive research and in accordance with our strict criteria, so you can be confident about the investment opportunities we offer and pick a property that is right for you. Your investment is completed through our secure platform and your money is safely held by a regulated third party custodian in a client account until the property is fully funded. We accept investments in increments of £1,000, in exchange for which you will receive shares in the property. You can check the performance of

your investment portfolio by logging into your Personal Property Portal at any time, day or night”.

Whether good advice is being proved by professionals in these platforms is at best unclear. We reflect on the risks in Chapter 8.

The disparate world of GPs (general partners, fund raisers) and LPs (limited partners, investors) requires intelligent GP and LP matching solutions. Tech-enabled information providers such as Property Funds Research and Indirex are being replaced by PropTech 2.0 solutions such as iCapitalNetwork (for private equity) and real estate-focussed Source Central, *which “modernizes how Institutional Investors and Fund Managers engage each other. As Real Assets become a larger part of Institutional portfolios, teams need tools that improve productivity and ease the intense operational demands of real asset investing. Source Central is designed exclusively for Institutional Investors and Real Asset Fund Managers: a secure two-sided network that provides Investors with an intuitive platform to source and organize investment opportunities and Fund Managers with a compliance-friendly distribution and engagement tool. Our mission is to improve how Real Asset Investors and Fund Managers do business through well-designed technology”.*

In addition to crowdfunding and GP/LP matching, we observe a truly innovative group of residential co-ownership sites including The Unmortgage and Stride Up, whose proposition is to help prospective homeowners without adequate deposits co-invest with equity-rich capital providers. These sites combine crowdfunding-sourced equity and secondary market exits for home occupiers and co-investors. Is this a revolution in train? Will real estate become a liquid, divisible, tradeable asset, like any security? See Section 6.8 and Chapter 8 for more on this issue.

6.6 Debt and mortgage tech platforms

“There is going to be an explosion in the use of data driving the mortgage process in 2017. Both Freddie Mac and Fannie Mae have announced their data initiatives toward the end of 2016, and lenders are starting to push consumer financial data aggregation into the core components of their customer experiences. This ties in nicely to the industry-wide push forward to a more digital, end-to-end process that started in 2016.”

Nima Ghamsari, co-founder and CEO, Blend

In addition to equity sources, debt crowdfunding and mortgage platforms are booming (see Chapter 3). Muhn (2017) distinguishes what she calls mortgage tech companies from digital mortgage lending companies. Mortgage Tech companies are mostly B2B companies specifically focused on facilitating part of all of the mortgage application process but which do not lend or service the loan. Within this category (and focusing on the US market) she lists Credit Sesame, Envestnet/Yodlee, Equifax, eveOpen, Habito, Kofax, Mortgagebot, Mortgage Harmony, Point, Roostify and Top Image Systems.

Digital mortgage lending companies are online lenders which both facilitate the mortgage application process and service the loan. Within this category she lists Better Mortgage, Guaranteed Rate, LendingHome,

LendingTree, Rocket Mortgage/Quicken Loans, Sindeo, SoFi and Zeus Mortgage.

Lender SoFi was at early 2017 about to close a \$500 million funding round. Its competitor LendingHome topped \$1 billion in mortgage loan originations in 2016, and peer-to-peer lender RealtyShares has seen over \$300 million raised on its platform. As a sign of deals to come, Roostify formed a partnership with conventional lender JP Morgan Chase; in the UK, Trussle and pioneer peer-to-peer real estate lending platform LendInvest are also very active.

6.7 Commercial property leasing and portfolio management

For building owners, leasing and portfolio management are the most pressing issues driving cash flow and return. Recognition of this has encouraged two different groups of tech-based businesses. First, the modelling of portfolio cash flows has always been a difficult challenge in real estate because of the complexity and risk of building very big datasets in Excel. The dominant portfolio modelling, property and asset management tools – all with their critics – are largely creatures of PropTech 1.0. Argus, Talliance and Yardi have swallowed competitors and compatible businesses en route (Argus swallowing The Realm, Circle and Voyanta being a good example) but are being joined by new offers such as Reoptimizer, and others are poised to use new and more efficient processes than the PropTech 1.0 “*spaghetti balls of knots and tangles*” to compete with these large and often unfriendly engines.

Second, management of the leasing process is often inefficient. Interviewees complained about letting agents using a variety of communication media, including paper, to report progress with viewings, offers made and recommendations regarding terms. VTS (View This Space), which recently acquired its competitor Hightower in a \$300m merger, is “*built to provide real-time portfolio analytics to the top landlords and brokerage firms in the world. VTS allows brokers and landlords to manage deal activity, identify trends and quantify portfolio performance from their desktop or mobile device. With 3.3 billion square feet under management, VTS is the driving force behind the industry's shift towards real-time data and is quickly becoming the market standard*”.

These firms enable owners and managers of commercial real estate to monitor the letting process in real time basis by sharing information through a common platform. At the same time, prospective tenants can view the space using virtual reality.

Leverton is another example of a tech firm creating efficiency in the leasing and portfolio management process.

Adding another critical element to its technology platform, JLL today (August 10, 2016) announced a global co-operation agreement with Leverton. This formalises the relationship between the two companies and enables more effective management of lease documents through the roll out of Leverton's machine learning technology globally. JLL, the leading global financial and professional services firm specialising in real estate, and Leverton, the leading global deep and machine learning company, had an existing relationship to automate and digitise key administrative processes in lease management. As part of the newly signed agreement, Leverton's

automated lease abstraction software will be deployed for JLL's clients in North America, Continental Europe and Asia Pacific. Leverton's machine and deep learning technology enables the identification, extraction and management of key terms and data from corporate documents, such as leases and contracts, in more than 20 languages. JLL will integrate these systems into its own global technology platforms to transform the way lease documents are reviewed, analysed and managed for its clients. JLL clients will benefit from optimised data management, more efficient processing of documentation, reduced operational risk and a more robust audit trail.

The efficient storage of lease data opens up possibilities for much greater liquidity of leasehold interests. Currently, leases may be assigned or properties may be sublet, often requiring the lessor's consent, in an old-fashioned paper-based process involving up to six parties (assignor, assignee, real estate advisors on both sides and two sets of lawyers). The efficient storage and summarisation of leasing documents will, in time, simplify this transfer. We may even be at the beginning of a new market for leases as tradeable securities, with blockchain (Chapter 7) playing a key role.

6.8 Disposal and secondary market exchanges

Is a revolution in real estate in progress? Will tech-based endeavour be the prince which transforms the real estate frog into a beautiful, liquid, divisible, tradeable asset, like any security?

UK residential real estate is now more unaffordable than it has ever been in recorded history, and the global illiquidity of the residential sales process has been another barrier to first time buyers. Will this issue be solved by on-line house sale sites? In the voluminous and tempting residential sector, the WeBuyAny Car.com model is already being applied to create what is intended to be a secondary market platform for homes. Opendoor raised \$210m in 2016 and \$320 million to date to expand its home buying and selling platform to 10 US cities. A UK equivalent, Nested, was launched in 2016.

Companies like Opendoor, OfferPad and Knock operate as pure market-makers, liquidity providers or middlemen, suggesting to sellers who are trying to liquidate fast that they can sell their homes more quickly and efficiently but for a service fee of around 6.5% and at a discount (said from some evidence to be around 6%). Opendoor buys the home from sellers outright, whereas Knock uses an underwriting model by guaranteeing a price and selling on the seller's behalf. If the house does not sell within six weeks, Knock will buy it.

Rezi takes long leases of residential property and rents out the space on shorter terms at a profit – again, pure market arbitrage facilitated by the greater reach of a tech platform. Ironically, perhaps, this tech solution suggests a belief in the inadequacy of tech-based rental sites. We will learn over time how sustainable this model is, how commoditised the sector can be, and whether homeowners will accept discounts for liquidity as the price of fundamental defects in the home sales and letting processes.

The commercial market, on the other hand, is less likely to offer such a service. Instead, we can see attempts

made to unitise assets and to trade units through platforms. For example, Global Alternatives is a holding company which has acquired crowdfunder Property Crowd and set up Prop-X, a secondary trading platform for selling and buying units in buildings. Prop-X will provide live real time prices, promising liquidity and (perhaps) real time price discovery.

IPsx, the International Property Securities Exchange, is a new exchange for the trading of shares in single asset property companies preparing to apply for fully regulated exchange status in mid 2017. IPSX says: “We will list single-asset companies holding buildings worth about £30m or more as a proxy for direct investment in property”. IPSX “will operate the first dedicated exchange globally to provide a public stock market solely for the admission and trading of shares in companies owning and managing individual commercial property assets. IPSX will provide property owners – both institutional investors and owner occupiers – with the option to progress an Initial Public Offering of their real estate assets in a corporate entity, which offers the unique assurances to investors of a fully regulated exchange.”

Will there be liquidity in the shares? This is not the first time that a wave of activity has been aimed at unitising real estate holdings. The 1980s saw Property Index Certificates, Single Property Ownership Trusts and Single Asset Property Companies; in 1988 the Billingsgate SAPCO disappointed as liquidity disappeared during a severe property downturn (Roche, 1995). The 1990s saw the Real Estate Index Market; the 2000s saw the emergence of the real estate derivatives market. All flattered to deceive; none gained irreversible momentum.

However, the widespread use of FinTech distribution platforms will make the potential marketplace bigger; and the decline of defined benefit pensions and, because defined contribution pension plans need daily valuations, the parallel growth of defined contribution plans may just create the right backdrop. A daily traded market in single assets could be the way in which these plans will access real estate. Maybe – just maybe – PropTech 2.0 will deliver the solution we have been waiting for. We consider this again in Chapter 8.

6.9 China – the emerging market

It is unlikely that we will see a truly global dominant platform for on-line real estate transactions anytime soon. Regulations differ, local cultures vary, the essential data does not always exist, and trade barriers are being maintained and enhanced.

Given its recent development from a communist state to big government with a pro-business stance, China has been able to leapfrog traditional western models of doing business and adapt immediately to the era of e-commerce. The Economist (2017) has suggested that China is the world's leader in FinTech with by far the biggest market for digital payments. Dominant businesses such as Alibaba and Tencent, protected by government-imposed trade barriers, are already in place, and China constitutes no less than 75% of the global market for on-line lending. The largest Chinese FinTech company, Ant Financial, is valued as highly as UBS. “When it comes to FinTech, the rest of the world will be studying China’s experience.” There is more

consolidation of web applications, with the result that phones are used as wallets by 425m Chinese (65% of all local mobile users).

However, a regulatory kickback is in motion. More than a third of all peer-to-peer lending platforms, which had captured a large part of the market, have been shut down. Banks and asset managers have responded and are entering the e-commerce market, sometimes in partnership with the interlopers. It appears that China offers an example for the rest. Where there are few barriers to entry, the brand of a well-capitalised and secure bank in an inherently risk-averse industry will see it beat any startup.

In the real estate sector, Chinese FinTech is slower moving, like the asset class. However, residential sales information engines are dominant, including Fang.com, previously known as Soufun, which is the largest domestic portal for new home builders. Sina Real Estate is one of the larger information conglomerates (similar to Google or Yahoo), with a subsidiary real estate information portal. Juwai is the largest international real estate portal. This is subscription based: sellers can upload property listings for a fee. Juwai also puts on sales events.

E-House Leju has a strategic partnership with Zillow, while the \$225 billion Chinese internet and social media group Tencent, which operates China's equivalents of WhatsApp, Facebook, Spotify, Kindle and ApplePay, has announced the creation of an international real estate marketplace with Juwai.

However, debt-financed property transactions are less straightforward in China because of an absence of credit histories. This may change. The emergence of e-commerce in China since the beginning of 2000 means that companies such as Tmall (a subsidiary of Alibaba) and JD.com have accumulated big data, and relevant technology improvements have enabled these platforms to use consumers' shopping patterns to build internal credit frameworks. Experienced companies such as Experian from the UK are expanding into China by creating joint ventures with local companies to help set up official credit rating systems. Several social media and rating platforms have been established and have gained tremendous popularity in recent years.

Can the latest technology developments jump over these international barriers? Asia (probably) was the birthplace of the most intriguing of all of these developments - blockchain. This – and its potential impact - will be covered in Chapter 7.

Chapter 7

PropTech 3.0: blockchain and artificial intelligence

In this chapter we explain the background to blockchain and distributed ledger technology, and why it might have a significant impact on global real estate trading

“Blockchain is coming - get ready. If you haven't heard of Blockchain yet, it's likely you will soon. It could drastically change the real estate industry if it takes off as proponents believe. It's a new technology, a way of doing business, and transformational if it plays out.”

(Ian Cameron, CIO OSCRE International)

7.1 Blockchain is coming – get ready

OSCRE (a collaboration of organizations and individuals focused on the development and implementation of real estate standards) is looking into the long-term potential for Blockchain, or distributed ledger technology, as a potential breakthrough that could restructure the way information is exchanged and business is conducted in real estate.

Explaining the blockchain for the first time is tricky because it borrows from so many disciplines, including game theory, economic and monetary theory, cryptology, the internet and computer sciences. The technology was introduced in only eight pages by Satoshi Nakamoto's famous 2008 white paper (Nakamoto, 2008). According to Simon Tucker: *“The increased level of available information and computational data, in conjunction with improved automation, may trigger a second information revolution, going beyond what internet and mobile technologies generated. Particularly for Blockchain, the potential is huge, and so is the threat to existent paradigms. The level of operational automation that you can generate brings an amazing edge over traditional processes. In addition, the digital certificates are easier to trade, opening possibilities for new trading venues and bringing secondary markets to traditionally illiquid assets”.*

A distributed ledger (also called shared ledger) is a consensus of replicated, shared, and synchronized digital data spread across multiple sites, countries, or institutions. There is no central administrator or middleman and no centralised data storage. Blockchain is: (i) a technology and a business practice built on peer-to-peer transactions; plus (ii) a packet of information (a block) with the ability to create an historical and permanent ledger of transaction details.

Its real value is in establishing trust-based interactions, thereby accelerating the transfer of governance from

centralised institutions to distributed networks of peer-to-peer collaboration. Blockchain currently works on self-regulation through self-interest and consensus. The information function – the ledger – is perfect for land registration. Will blockchain be used to transfer money overseas, the most clunky and inefficient of all banking processes, without a party to use or speak to? Will individuals and institutions use blockchain for a large real estate transaction without the protection of a human interface?

Blockchain gives service providers a means to collaborate and derive a greater share of the value for themselves. The technology's trust protocol allows autonomous associations to be formed and controlled by the same people who are creating the value. All revenues for services, minus overheads, would go to members, who also control the platform and make decisions. Trust is not established by third parties, but rather through an encrypted consensus enabled by smart coding. The differences between this approach and current internet-based transaction technologies are profound and difficult to comprehend, which is a problem for blockchain proponents. However, international banks, investment firms, technology companies and others are spending significant capital and resources to evaluate the benefits and potential impact of Blockchain.

The ability of blockchain-based processes to execute transactions without an intermediary or a clearinghouse very much suits a private market like real estate and provides a clear contrast and alternative to the IPSX model of providing a public market to trade shares in buildings. For those who prefer not to expose their assets to the glare of the market, this is a clear attraction. The distributed ledger holds a history of a transaction, a property, an asset, or a title; it develops a digital secure identifier for a proposed transaction; and it offers an ability to transfer funds in new ways, for example using a digital encrypted (or crypto-) currency such as Bitcoin. The bitcoin blockchain is the most robust and longest running form of distributed ledger technology, and this will be the focus of this chapter.

Data quality is one of the major benefits of a blockchain. The international scope of blockchain makes international data exchange standards even more important because of the diversity of assets and the geographies involved, and it is clear that data exchange standards such as those maintained by OSCRE will play a significant role in creating consistency, trust and a common ground for blockchain transactions.

Consulting companies are now setting up blockchain practices and advising clients to do their own due diligence and to get ready for the transition. Some firms have already stepped into blockchain around a specific focus, such as subleasing; others are undertaking research and exploring proof-of concept projects to help decide how Blockchain might benefit their organization.

Disintermediation, fraud prevention, the increased use of digital currency and smart contracts are some of the major impacts of blockchain. Transparency between transactors, along with faster transactions and lower costs, are potential benefits. However, security and fraud concerns are still to be resolved, as in Brazil recently, where according to CRE Tech Daily (January 2017) "*...hackers siphoned off \$50 million from the Ethereum blockchain, an online ledger behind smart contracts and cryptocurrency*".

7.2 An explanation of blockchain technology

Blockchain is a form of distributed ledger technology, a distributed ledger being a radical alternative to a centralised database. At its most abstract, its characteristics are:

- There is no centralised, ‘trusted’ version of the database or ledger; everyone on the network has an identical copy.
- There is no centralised, ‘trusted’ authority: any change or update to the database is by the agreement of everyone on the network.
- Communication (or the transfer of any data) is not through a centralised, ‘trusted’ exchange: it is ‘peer-to-peer’, from one user to another.
- It is (said to be) extremely secure. If one copy is hacked or corrupted, copies on the rest of the network remain intact.
- It is ‘data-agnostic’. Because there is no central organiser, anything can be stored as long as it is in digital form.

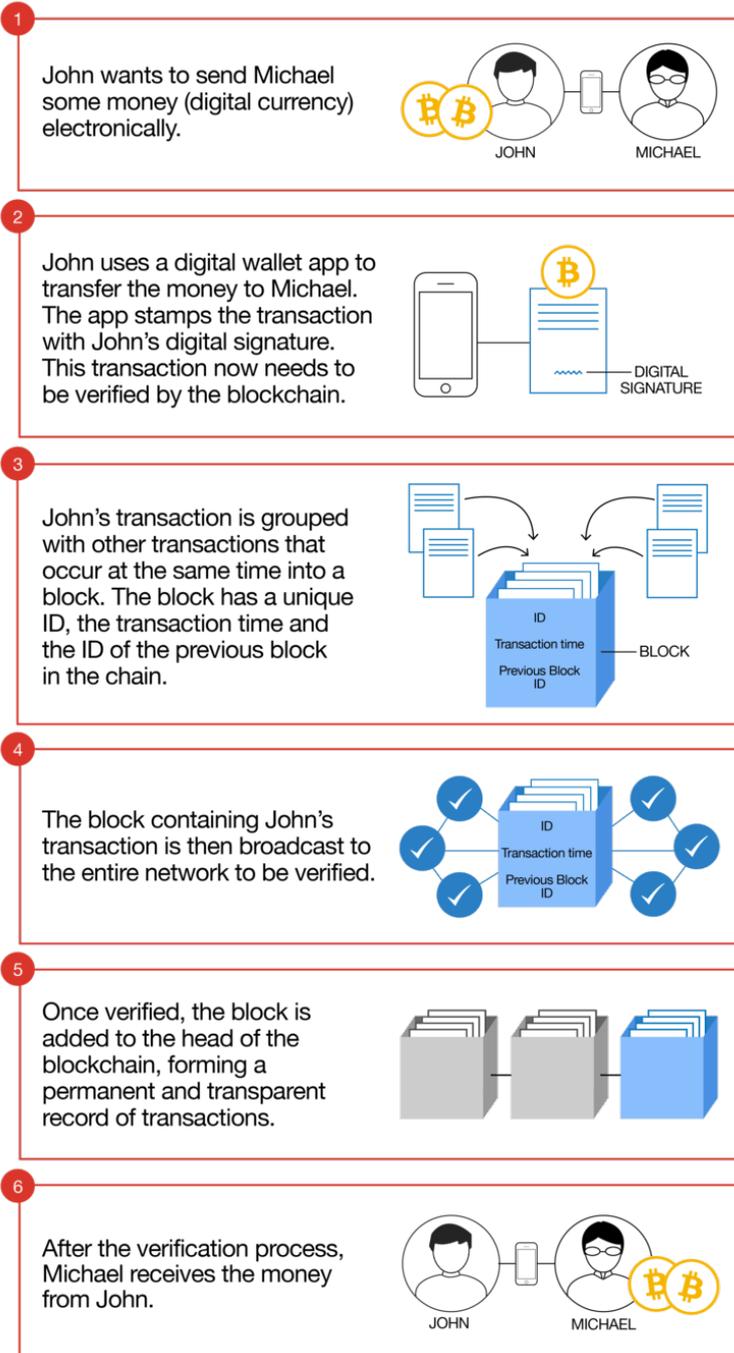
In summary, a distributed ledger looks like a centralised database because it accepts inputs from multiple parties and appears to present everything from one source. However, its distributed structure overcomes the centralised model’s vulnerability to attack. In decentralising and becoming ‘trustless’, distributed ledger technology disrupts large parts of the current infrastructure. We are used to the (costly) intermediation of ‘trusted’ central authorities, especially in finance where everything passes through a bank. Consider a simple asset transfer, in this case of money. You instruct your bank which alerts the recipient’s bank. The money passes from your account to the bank’s account in ‘clearing’ at the Central Bank. It goes through here into the recipient bank’s central bank account and from there, finally, into the recipient’s account. The two banks then exchange confirmations. This is time-consuming and expensive, and appears ridiculously archaic.

On a peer-to-peer (blockchain) network, the asset (bitcoin, a crypto- or digital currency) passes directly from one account to another. Transactions are anonymous. Everyone might see the entire transaction history of an address but can have no idea who uses that address. This anonymity protects users from identity-theft; nevertheless, it has given rise to criminal activity. Blockchain is secure: no bitcoin has been stolen from an address, but there have been thefts off-chain, either through accounting fraud or from websites that use bitcoin. As a result, the FBI is one of the largest holders of (recovered) bitcoin.

Blockchain’s innovative security protocol uses a (conceptually) simple mathematical tool to check for changes in every transaction, in every link between transactions, in every block into which linked transactions are bundled and in every link between blocks in the chain. It does this every time there is an update, creating a complex web of cross-references from transaction to block to chain. The smallest change anywhere will cascade through the web and become immediately apparent. Furthermore, it can check the transaction history of every bitcoin (or part thereof) back to its origin. This is analogous to following the ownership history of a bank note.

Figure 7.1: How a blockchain works

How a blockchain works



Transactions are made and secured with pairs of 'keys', which are strings of characters and numbers unique to a new address (or account). The Public Key can be used by anyone to view the address; the Private Key is known only to the user and enables access to the address. The keys work only in tandem to encrypt and decrypt a 'hash', which is a fixed-length, mathematical representation of a file's contents. The 'hash' ensures that a file (usually a bitcoin transaction) has not been hacked or changed when sent over the public network to the counterparty's address. The sender encrypts the file hash with her Private Key to create a digital signature" and transmits the file, signature and corresponding Public Key. The recipient decrypts the signature with the Public Key to confirm, with the 'hash', the integrity of the file's contents.

'Mining' is how the network is updated simultaneously and new bitcoin are created or 'mined'. Transactions are bundled together into a block, and the miner broadcasts the block to the rest of the network. A complex puzzle is attached to the block which must be solved to ensure the validity of the transactions in the block. Each miner is in competition to solve the puzzle first and is rewarded with bitcoin, creating an economic incentive for mining. Each block is tethered to the previous block, creating the blockchain. After a block is solved and has been broadcast to enough nodes, work begins on the next block. The process requires huge computing power, electricity and time (10 minutes for a confirmation). These are ongoing issues; however this is the required trade-off for a secure system that enables peer-to-peer transactions without a central authority.

In order to effect a transaction, it is not necessary to run the entire network which would require heavy downloading and constant synchronisation of the blockchain. Instead there is a process of Simplified Payment Verification (SPV) that allows users to make 'light' transactions. A user needs only the 'block header', around 80 bytes, of the most recent block to confirm that the transaction has entered the blockchain.

Smart Contracts are used for the automated movement of funds, data and agreements. They are contracts written in computer code which can react to information sent to them from a storage system, which can be the distributed ledger it is stored on. Smart contracts can be self-executing and self-enforcing, meaning that a contract can enforce a pre-determined outcome once the required criteria are met. They can be standard, multifaceted, multi-party or tailored to individual needs and can eliminate timing differences by making an exchange simultaneous. Currently, Smart Contracts do not have a legal status and are used as a guide to protocols of exchange. However, like eDocs and eSignatures, they will eventually acquire legal status and be able to enforce these protocols in the future, most likely working in tandem with traditional, paper-based legal practices where human judgement will still take precedence.

While the bitcoin blockchain itself has not been hacked, Blockchain is not, unfortunately, foolproof. Garbage can be maliciously uploaded – collaborative consensus is needed to push it out. The identity of the uploader of garbage is known, and any upload can be disputed and changed so that eventually there is a consensus, but there is no third party arbitration and the system relies on trust and collaboration. In practice, this may reduce to a reliance on professional advisors participating in the system and acting effectively as arbiters.

7.3 How could blockchain apply to real estate?

“Blockchain works with any transaction or interaction where property rights and timing matters.”

Kausik Rajgopal, McKinsey

In real estate, PropTech innovators have sped up the process of information exchange, but the market is still largely dependent on intermediaries. Transactions require time, proximity and relationships. By contrast, a distributed ledger such as blockchain has the capacity to send data, without friction, to all relevant parties.

Early assessments of the potential applications of blockchain in real estate include lease transactions arranged directly between lessor and lessee; land acquisitions and dispositions including title and parcel details; title, ownership and planning histories being available during the acquisition and due diligence process; and the exchange of maintenance records in buildings. Imagine also a world of digital asset management, which registers ownership and manages and distributes revenue rights directly.

Consider the minimum number of parties involved in a simple, UK residential transaction:

- Estate agents
- Conveyancing lawyers
- Structural surveyors
- The Land Registry (title deeds)
- Local authorities (multiple searches)
- The Environment Agency
- HMRC (Stamp Duty)
- Banks (financing and exchange of money)
- Credit Rating Agencies (on behalf of banks)
- Utilities (outstanding accounts)

Much of the data held by these parties, necessitating their participation in the process, is public but is stored in multiple private siloes. A lawyer is paid to collect all this information. Other data is gathered by the Credit Rating Agencies but is duplicated in the lawyer's searches. Payments are made to multiple parties through multiple banks.

Nearly all of this information can reside on a distributed ledger, referenced to the single asset (the property) and available almost instantaneously to every actor. Once agreed, the exchange of assets (ownership for money) and fees can also happen instantaneously. Of course, it is necessary that the parties put information into the distributed ledger rather than into their siloed databases. (No doubt lawyers will also keep files copies, but these will have less authority.) However, the huge savings in time and money might make it economically attractive - one day - to do so.

There are several property-based distributed ledger projects being pursued by a variety of sources. The initial focus of many projects has been to improve the efficiency and transparency of the registration and exchange of title deeds.

Securrency uses a “repeatabe process (which) makes it easy to trade value from a wide range of asset classes such as structured settlements, real estate leases, energy agreements, agricultural production, cloud IT services, etc. Securrency’s unique platform introduces an elastic securitization model that allows portfolios of assets to efficiently and securely expand/contract to meet market demands – something the mortgage-backed securities (MBS) markets desperately needed during the 2008 market collapse. By providing access to an investment grade instrument that carries with it the stability of a bond, the transferability of digital currency, and the exchangeability of the US dollar, Securrency will positively enable increased liquidity and access to both a dividend-producing asset and more affordable funding for capital improvements and investments.”

(Daniel Doney, CEO)

Ethereum, a not-for-profit, is “a decentralized platform that runs smart contracts: applications that run exactly as programmed without any possibility of downtime, censorship, fraud or third party interference. These apps run on a custom-built blockchain, an enormously powerful shared global infrastructure that can move value around and represent the ownership of property. This enables developers to create markets, store registries of debts or promises, move funds in accordance with instructions given long in the past (like a will or a futures contract) and many other things that have not been invented yet, all without a middle man or counterparty risk. On traditional server architectures, every application has to set up its own servers that run their own code in isolated silos, making sharing of data hard. If a single app is compromised or goes offline, many users and other apps are affected. On a blockchain, anyone can set up a node that replicates the necessary data for all nodes to reach an agreement and be compensated by users and app developers. This allows user data to remain private and apps to be decentralized like the Internet was supposed to work.”

The Swedish Land Registry, tech firm ChromaWay, Kairos Future and the Telia Company have investigated the possibilities for using blockchain technology for real estate transactions.

Through a partnership with real estate tech startup Velox.re, Chicago’s Cook County is testing the use of the Bitcoin blockchain for transferring and tracking property titles and other public records. The Cook County Recorder’s Office is the second largest such office in the United States, and it will be the first in the US to experiment with blockchain technology. Specifically, the office will be testing blockchain applications of property title transfer and a system for filing liens; the compatibility between a blockchain and a traditional, server-based setup; fraudulent use prevention; and conveyances of vacant property in Chicago.

Other projects include the following:

- BitFury and the Estonian government are working together to secure land titles over a private network, using the bitcoin blockchain for validation
- ConsenSys and the Dubai government are developing blockchain strategies for public services and smart

city connectivity

- Ubitquity, Velox.RE and Propy are developing the blockchain for title deed transparency and cross-border transactions of high end residential real estate
- Deloitte Netherlands, the City of Rotterdam and Cambridge Innovation Centre are developing a blockchain application for recording lease agreements
- ABN Amro and IBM have established a blockchain pilot for commercial real estate clients and services, making use of the 'Torch app' onto which details can be uploaded and spread to necessary parties
- RexMLS is a US-based multi-listing service that has developed a peer-to-peer proposition whereby information providers and validators can be paid in cryptocurrency

Tapscott and Tapscott (2016) cannot be accused of a lack of enthusiasm for blockchain's potential relevance to real estate. *"Spare residential space can list itself and negotiate through the Ledger of Everything to help tourists, students, managers of homeless shelter programs, and others find space that meets their needs."*

They also – more realistically – point to the problem of rampant title registration costs and corruption of this process in poor economies. Can poorer governments leapfrog the developed world and set up blockchain based title registry? The government of Honduras, working with Factom, are said to be engaged in a study of this type.

Could real estate transactions be blockchain-facilitated? The transaction time on the bitcoin blockchain is 10 minutes – the regular clearance period. This is not fast enough to clear stock market trades - but it is plenty fast enough for real estate.

7.4 Facing the future

These projects form only one stream of the much larger blockchain and distributed ledger ecosystem which encompasses every type of market and industry.

For the real estate industry, distributed ledgers represent a risk because new services and applications can appear from nowhere to threaten the market's architecture. At the same time, distributed ledger technology represents an intriguing opportunity to build a robust infrastructure for future use by the industry. It makes great sense for an industry consortium to explore blockchain technology and include associated sectors, including local and national government, the legal profession, finance (banks and insurance) and regulators. Although the implementation of blockchain seems distant today, the pace of technological change argues against complacency.

An open-source structure for the instant movement of assets is similar to the internet, which itself is an open-source structure for instant communication. In practice, the internet would not have scaled without commercialisation by industry: finance (banks, stock/commodity/bond/futures exchanges), retail (Amazon), media (Facebook), telecommunications (Google, Apple) and, more recently, transport (Uber), leisure

(TripAdvisor) and real estate (AirBnB). In the same way, blockchain and distributed ledger technology will develop and might scale as a result of its commercialisation by industry.

The real estate industry is able to use blockchain or distributed ledger technology to build applications, including smart contracts, and services that bring the benefits of a new technology both to itself and to the mainstream. Even if smart contracts do not radically transform leasing and sales, blockchain proponents claim that there will be:

- more information, available instantaneously;
- less error, less duplication, less human inefficiency leading to much lower costs;
- greater transparency (through consensus and distribution) of prices and contracts;
- potentially reduced transaction times; and
- greater market liquidity and turnover.

The blockchain is also argued to be the natural medium for feedback from the Internet of Things and, with advances in machine learning and AI, from big data-driven analytics.

The real estate industry uses both public sector and private, or proprietary, data. For the industry to incorporate a shared ledger, it needs a system that is, correspondingly, both public and private.

Simon Tucker argues: *“It should be a core objective of the industry, at the very least, to put public information onto a shared ledger. Currently, this freely-available information is siloed across different institutions, databases and/or websites, making the collection and analysis of data highly inefficient. Connecting all these public sources to a single, shared ledger system would give the industry instant access to all available information from a seemingly centralised source. The savings in time, money and increased collaborative capabilities would be enormous.”*

Yet, as we learn from Goodman (2015):

“The more we plug our devices and our lives into the global information grid – whether via mobile phones, social networks, elevators or self-driving cars – the more vulnerable we become to those who know how the underlying technologies work and how to exploit them to their advantage and to the detriment of the common man”.

Tapscott and Tapscott (2016), in *Blockchain Revolution* – highly positive blockchain evangelists – also list the risks, or the perceived risks, summarised as follows:

- *The technology is not ready for prime time*
- *The energy consumed is unsustainable*
- *Governments will stifle or twist it*
- *Powerful incumbents of the old paradigm will usurp it*
- *The incentives are inadequate for distributed mass collaboration*

- *The blockchain is a job killer*
- *Governing the protocols is like herding cats*
- *Distributed autonomous agents will form Skynet (a fictional neural net-based conscious group mind and artificial general intelligence (see also superintelligence) system that features centrally in the Terminator franchise and serves as the franchise's main antagonist)*
- *Big brother is still watching you*
- *Criminals will use it*

So the blockchain technology and ecosystem around it are evolving rapidly, and are probably raising more questions than answers. How do we establish a system of transparent governance to ensure the longevity of the blockchain? What about security, speed, cost and, more importantly, regulations?

As with other disruptive technologies, there will be winners and losers. If the technology is successfully managed for scalable growth, it could transform society. We have an opportunity to transform the digital platforms for tomorrow's cities. The blockchain becomes the city's operating system, improving citizens' access to services, goods and economic opportunities.

However, the technology is yet to mature. It remains to be seen if reality can live up to the idealist's imagination. In many ways, this point in blockchain time is quite reminiscent of the internet in the mid-1990s, but the same resulting adoption rate is by no means certain.

Will blockchain technology produce PropTech 3.0, the next wave of innovation in real estate? We consider our response to this and other questions uncovered over the course of this report in Chapter 8.

Chapter 8

Where is this going?

In this chapter, we summarise our findings. How will PropTech 2.0 shape the future of the real estate industry?

“Is PropTech creating a whole new industry or is it a more efficient way to create or extract money from a fat dinosaur that’s got bad knees and lost its agility?”

8.1 The PropTech 2.0 wave

Welcome to the Big Leagues, Rookie

“As is happening with many other industries, technology is beginning to disrupt how the traditional real estate industry operates. The introduction of technology generally creates process efficiencies through automation, scale, and uniformity, which we believe is occurring in the real estate industry after years of underinvestment. These new technologies are creating better consumer experiences and more productive agents, all while the real estate industry is being tasked with becoming more compliant as the regulatory spotlight brightens.

In our opinion, these new technologies will either improve or replace most value propositions that have long been the status quo in the real estate market. Therefore, we view the next few years as an opportune time for entrepreneurs, venture capitalists, private equity and corporations to reevaluate how they perceive that technological advancements and changing consumer behaviors will drive the outcome for the next real estate cycle.

We expect that the single-family, multifamily, and commercial real estate sectors will be materially affected by technology, each at different speeds and in different ways.”

William Blair, 2015

There is no denying the huge energy, creativity and optimism behind the 2015-2020 wave of activity that makes up PropTech 2.0. Thousands of extremely clever people backed by billions of dollars of often expert investment are working very hard to change an old-fashioned and inefficient industry that can be improved by idealism and which sucks out large fees for self-interested professional advisors. The heterogeneity and illiquidity of the industry goes some way to explaining those fees; advisory work is very often customized, because there is no velocity of repeat business. Hence much of the PropTech 2.0 activity is aimed at the way real estate is traded. Can it produce more velocity; more homogeneity; more commoditisation of processes; lower transaction fees; and a more tradeable liquid asset class?

Where is this going?

Underlying this huge capitalist and social endeavour is a clash of generations. Many of the startups are driven by, and aimed at, millennials, but they often look to babyboomers for money - and sometimes for advice.

PropTech 2.0 is also engineering a much-needed boost to property market diversity. Unlike many traditional real estate businesses, PropTech is attracting a diversified pool of talent that has a strong female component, representation from different regions of the world and entrepreneurs from highly diverse career and education backgrounds. Given the difference in background between the establishment and the drivers of the PropTech wave, it is not surprising that there is some disagreement about the level of disruption that PropTech 2.0 will create.

Idealism appears to infect the drive towards smart buildings, the shared economy movement and real estate FinTech. Are energy-efficient buildings a fad? Is the shared economy a social ideal with no future, or a capitalist drive for a classic entrepreneur-enabled revolution in the use of real estate space? Will houses be traded online, or is this asset class too important to risk taking out the traditional advisor?

Real estate is a slow moving asset class, and the real estate industry is highly conservative. No doubt many PropTech firms will fail and a lot of money will be lost. However, It would be surprising if this burst of activity does not lead to some significant change. There will be some very successful survivors who will in time have a radical impact on what has been a slow-moving, conservative industry. 2017 seems to mark a turning point, and PropTech 2.0 seems to be building such mass and momentum that it will change the world. How will this play out?

8.2 The context: big, or exogenous, tech

In Chapter 3 we identified four verticals defining technology development in the built environment. One of these – construction technology or ConTech - lies outside the scope of this report. We focus instead on Smart Real Estate (Chapter 4), The Shared Economy (Chapter 5) and Real Estate FinTech (Chapter 6). We can call each of these verticals endogenous or internal PropTech or Real Estate Tech sectors. In Sections 8.4, 8.5 and 8.6 we will summarise our views on the likely impact of activity in these sectors. Before doing so, if only in passing, we should consider the context of the bigger, exogenous tech movement and its potential impact on the real estate sector.

According to CBRE (2017), technology will play an ever greater role in how occupiers use and manage their office space. *“Growth in the use of sensors, big data techniques and predictive analytics to create strategies and manage portfolios more efficiently will sustain this trend. Underlying all of this is a desire on the part of corporations for greater operational flexibility in their real estate arrangements.”*

In the industrial sector: *“Automated warehousing technologies will mean that growth will increasingly be accommodated vertically in mezzanine floors, high bays or structural multi-layered warehouses.”*

In retail, *“The growth of multi-channel retailing will make retailers increasingly location sensitive. Virtual reality (VR) and augmented reality (AR) will benefit retailers by expanding the reach of their brand, driving additional traffic.”*

There are big forces at work. Driverless cars, airborne cars and drones will change the configuration and locational qualities of logistics space, retail space, parking and residential property. We can imagine a landscape of high rise high density urban buildings surrounded by low rise, low density agriculture, warehousing and parking sites.

Robotics and machine learning will lead to the automation of many office jobs, further driving change in the nature of work. Some worry that this will seriously damage the demand for office space. A 2013 Oxford University study concluded that 47% of US employees are at high risk of losing their jobs to robotic automation by 2023. There will be job growth in new sectors, if only for lawyers, salesman and programmers specialised in tech, robotics, drones, driverless cars and AI, but the two big changes - co-working and automation - are already having an impact on work style. Advances in voice-recognition, AI, and mixed reality will change the way office workers interact with technology and each other. Software and hardware will continue to become cheaper and faster, with cheaper sensors and devices, significantly more data and better transparency. There may be fewer office and factory jobs, but more likely is an ever-growing rich-poor divide.

According to IBM: *“90% of the data in the world today has been created in the last two years alone.”* We can expect to see more powerful analytics and predictive decision-making tools, decreased transactional friction and increased resource optimization which may mean fewer office jobs and/or a radical change in the front office/back office relationship. The suburban office park could stage a comeback as a centre for more automated activities, with a blurring between the data centre and the decentralised, automated office building. Facebook could become a huge property company – of which more later.

The growing confusion between retail and logistics space seems set to continue as drones and driverless cars facilitate last mile delivery. Again, the rebound of suburban development to hold warehousing and delivery functions alongside the automated office seems likely. Driverless and automated vehicles will change parking locations, which should move to the urban periphery.

Changing land use patterns will have a knock-on effect on residential locations. Continuing urbanisation and the vertical city dependent on rail transport for lateral connections will be encouraged by big tech, and it is those high rise vertical constructs that will lend themselves to smart building technology, the Internet of Things and flexible use – co-living, co-working and flexible rental/ownership. Rural areas will focus more on agriculture, energy production, leisure, second homes and retirement/senior living. We can expect a reaction against urbanisation and automation, and a second hippy movement focused on tiny homes, traditional crafts and rural life. There will more jobs for carers and social entrepreneurs.

Investable real estate will continue to migrate to new uses, mixed uses and social infrastructure. As offices, retail and logistics continue to evolve and mutate, the risk of these formats will rise, encouraging much greater

Where is this going?

investment in residential and social enterprise - sectors that will require large private investment in the face of reductions in government spending.

Student housing has already become a mainstream investment market; other emerging private real estate sectors will include schools, universities, hospitals and medical centres, prisons, data centres, a new generation of re-cycling plants creating energy and value from ever-increasing obsolescence and waste, parking for automated vehicles, fuel storage and generation facilities and senior housing parks. Co-working, co-living, vertical spaces and micro urban apartments will be supplemented by tiny rural homes.

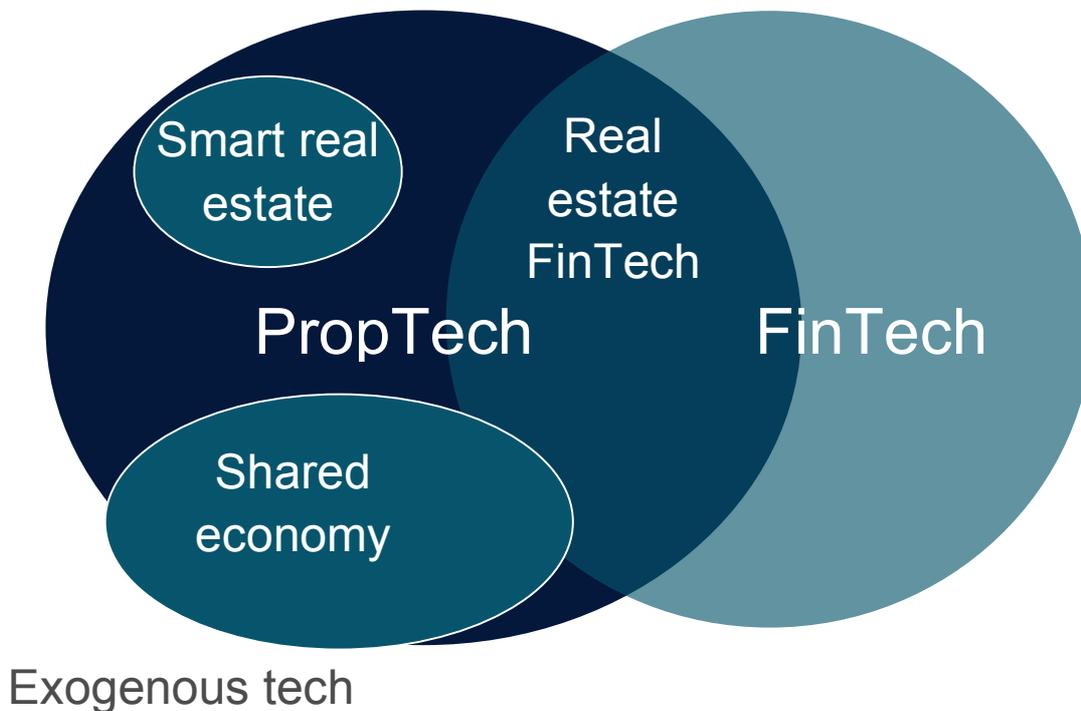
It seems highly likely that the sector definitions which we are currently familiar with – office, retail, industrial - will fade in importance as the multi-purpose high rise building (already evident in cities such as Hong Kong and New York) will grow in dominance. More clustering of urban centres and vertical travel between co-living space, co-working space, corporate HQ, hotel/gym, shopping centre, school and medical centre is a natural development requiring only more flexible planning regulations and inventive design.

8.3 A reminder: PropTech verticals and horizontals

“Many of the new propositions have unsustainable business models.”

Rupert Catell, OwnerSellers

Figure 8.1: PropTech, ConTech, FinTech and exogenous ‘big tech’



While facilitating the impact of ‘big tech’ on life and land use patterns, PropTech investment will also continue to shape the internal operation of the real estate finance and investment sector. As Figure 8.1 is designed to illustrate, big or exogenous tech will continue to be driven by forces outside the real estate sector, but will require the support of FinTech, ConTech and PropTech entrepreneurs.

Table 8.1: PropTech verticals and horizontals

	Real Estate FinTech	Shared Economy	Smart Real Estate
Information	yes	yes	yes
Transactions/marketplace	yes	yes	
Management/control			yes

For example, in Table 8.1 the smart building vertical will continue to attract capital and drive innovations which will facilitate the operation of new property types and cities, and the management/control horizontal will be vital in this endeavour. The efficient use of space and continuing shifts in land use will be promoted by shared economy real estate development, requiring continued information to facilitate transactions. Meanwhile, companies in the Real Estate FinTech vertical will attempt to push the real estate market towards the flexible and liquid sector it will need to be to accelerate the pace of change.

Over 150 PropTech firms are mentioned in this report. We refer in passing to 10 ConTech firms. The PropTech industry verticals – smart buildings (c.15 companies), the shared economy (c.35 companies) and real estate Fintech (c.100 companies) – are the subjects of review in the next three sections.

8.4 Smart real estate

Smart real estate, smart cities and smart buildings are terms in common use which describe technology-based platforms which facilitate the operation of real estate assets. The assets can be single property units or entire cities. The platforms may simply provide information about building or urban centre performance, or they may directly facilitate or control building services. This sector supports real estate asset, property and facilities management. We discussed this vertical in Chapter 4.

Smart building tech supports the efficient use of buildings and urban environments, and facilitates control and sustainable management, which is a powerful driver of change. There is a huge appetite for power by tech firms, and energy costs are now becoming internalised in property rents and pricing. New property sectors, including data centres, are emerging. Based on our expectations about the big tech impact on city form, there is a huge demand for growth in this sector. This is a natural growth area for PropTech, with the ConTech sector also playing a vital role, and requires much more focus by real estate professionals.

8.5 The shared economy

Plenty of micro entrepreneurs are now entering the shared economy to make profits. It would be difficult to find individuals that own more than five properties on Airbnb's listings. Like Janelle Oris, the sharing lawyer, has pointed out: "I am disappointed in the structure and financing of most sharing-economy companies. Because they're mostly VC-funded, there's a great deal of incentive for their founders, and for their funders, to sell out to a larger company." This has already become reality in multiple markets. Avis, the existing traditional car renting incumbent, splashed our \$500 million in acquiring Zipcar. It wouldn't be crazy to imagine that in the near future Marriot will acquire Airbnb.

To me the ultimate future should be the shared community, where real estate developers will build entire mini-cities or towns. Within these communities, we will share resources such as schools and utilities with those who live in the same area. Co-working spaces, community sports facilities, public transportation facilities and other infrastructure should be shared within the community. Consequently, people will not need to travel out of the community.

Utilising new financing technology, the developer will no longer sell each housing unit to property buyers or investors. Instead, the developer will create a portfolio of such communities, and then securitise the portfolio to make it virtual currency friendly, so that it can be purchased through blockchain, bitcoin or any other form of virtual currency. This will not only improve the current burdensome purchasing process, but also remove current geographical barriers to house buyers. Securitised investment will be come in two forms: the traditional whole property unit and shared property based on a minimum living space – for example, a single room in a multi-bedroom house or apartment. This set up will enable people who can only afford a single bedroom to buy a single bedroom, while other people can buy a double bedroom or small studio,

Finally, all property within the community will be supplied with smart tech features and fully powered by many mini solar power farms.

Oxford MBA student

The Shared Economy describes technology-based platforms which facilitate the use of real estate assets. The assets can be land or buildings, including offices, shops, storage, housing and other property types. The platforms may simply provide information for prospective users and sellers of space, or they may more directly facilitate or effect rent- or fee-based transactions. This sector supports the real estate occupier markets. We discussed this vertical in Chapter 5.

The shared economy could be a popular movement which is part way through a process of radically altering concepts of private property, health and safety regulation and public liability. Airbnb and WeWork (like Uber) are immensely successful unicorns. In this report we are not short of examples – we refer to 35 real estate shared economy ventures. Is this an irreversible revolution? If so, will the discovery and utilisation of huge volumes of previously hidden space create a supply tsunami that will kill any growth in rents for the traditional owner?

The net impact of the sharing economy on the world consumers and economy is expected to be overwhelmingly positive. Consultancy Europe Economics (2016) has estimated the potential welfare gain from reductions in the under-utilisation of assets and labour across the EU at €572 billion, which translates to over €1,000 per EU citizen (Zuluaga, 2016). Airbnb has not only had 150 million guests but drives other start-ups, such as Proprly (a cleaning and key delivery service for Airbnb hosts); Guesthop (a company which provides support services for home sharers from check-ins, to key management and cleaning); and Pillow (which handles all the details of hosting, including marketing, guest communications, booking and pricing optimization, cleaning, repairs and troubleshooting).

However, an unlimited shared economy boom is very unlikely. While a continued increase in the use and supply of co-working spaces in more and more inventive locations (public facilities like schools and libraries, and shopping centres in particular) is to be desired and expected, and co-living propositions will cater for some slices of society, there are natural limits to this movement, which many see as a temporary fad. Co-living and co-working are economic necessities in the post-recession age but have a limited appeal for many of us. There are natural limits to sharing – collaborative consumption might be a long term millennial preference but it is likely to be age-related. As families and responsibilities grow, a desire for more control is natural. The millennial generation for whom Uber, Airbnb and the shared use of space are natural may be youthful idealists who will mutate into conservative property-owning and non-sharing parents. We have also seen that cultural differences reduce the appeal of sharing space in countries like China where there is weak copyright control.

Sharing will have a limited appeal for users of real estate, and it will have even less appeal for operators. We can foresee a day in the not-too-distant future when WeWork will announce that it wants to own and control buildings. Asset-lite has not proved to be a sustainable model for successful operators of space, who usually demonstrate conservatism and a desire to protect wealth by moving up the food chain and becoming property companies. And, coming at this issue from the opposite direction, there are no barriers preventing traditional property companies from offering flexible WeWork-style space to their tenants.

Regulatory pushback may also inhibit the growth of this sector (CNN, 2016). We can imagine all sorts of disputes involving unprofessional lessors of not fit-for-purpose space and damaged renters. Because of concerns about its market impact and the potential misuse of residential property as quasi-hotels, Airbnb has already faced pushback in places like Barcelona and Berlin, and it has sued other cities, including its hometown of San Francisco, which recently passed a law requiring anyone who wants to rent out their home on Airbnb or similar platforms to register their property with the city authority.

Pushback is happening partly because Airbnb has caused incumbent businesses (hotels and b&bs) a loss of revenue and jobs. Over 2,800 jobs have been directly lost to Airbnb, a loss of over \$200 million in income for hotel employees (Mahmoud, 2016). In San Francisco, Airbnb's home ground, the first ever lawsuit was filed on behalf of tenants who have been damaged by the illegal conversion of residential housing into short term letting properties. New York state law bars most urban apartment-dwellers from renting out their units for less than 30 days if they are not present. In Berlin, the city enforced a new law imposing fines up to \$110,000 on people

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renting out more than 50% of their homes for less than 2 months. In Barcelona, Airbnb's third-largest market in Europe, the city is imposing fines of over \$65,000 for listings without proper licenses.

Sharing economy businesses have all entered markets where existing companies are subject to regulation. Regulators believe that large chunks of Airbnb's business are illegal. Should Airbnb be responsible for all hosts having proper insurance? Micro entrepreneurs who own more than one property are essentially running a mini hotel business but without any proper licenses. Federal, state and local tax administrators have not directly addressed many of the tax implications of shareable transactions. As micro entrepreneurs get savvy on Airbnb, they are buying or converting more properties into short term letting properties. This causes house shortages for the poor and can push up house prices to an unaffordable level.

There is a limit to the idealism of collaborative consumption and the shared access economy. The discovery and utilisation of huge volumes of previously hidden space is very unlikely to create the supply boom that will kill any growth in rents.

8.6 Real Estate FinTech

Looking into the future, there are opposite forces at work. The excesses of the lead-up to the credit crisis will create a reaction that values conservatism, low leverage, more modest fee structures and stricter – or better – governance. At the same time, we must continue to innovate. An improvement in the liquidity of unlisted holdings can be expected. While real liquidity is neither possible nor clearly desirable in the private equity real estate market, we can expect to see secondary trading platforms that help investors to manage mixed portfolios of listed and unlisted property, particularly at the core end of the market.

Baum and Hartzell (2012)

Real Estate Fintech describes technology-based platforms which facilitate the trading of real estate asset ownership and leasing. The assets can be buildings, shares or funds, debt or equity, freehold or leasehold, but must have a (negative or positive) capital value. The platforms may simply provide information for prospective buyers and sellers, or they may more directly facilitate or effect transactions. This sector supports the real estate capital markets. We discussed this vertical in Chapter 6.

We discovered from our discussions that the residential sector is more compelling (bigger and more liquid) for investors than the commercial market. The greater the size of the capital stock, and the greater the velocity of turnover of assets in both sectors, the greater the volume of fee savings that will be made available for more investment in process improvements. The key question is therefore this: can and will Real Estate FinTech improve liquidity and grow velocity?

In our discussions, the preponderance of Real Estate FinTech firms (70 of our population of 120 firms) is interesting and also a matter for some concern. As one interviewee said: *“There is too much of a get-rich-quick goldrush mentality among innovators – and some very poor propositions.”*

We know that a significant financial benefit will flow to the innovators who can introduce more velocity and liquidity into real estate, and more efficient distribution. There is no doubt that information platforms are already helpful in lubricating the market. While there appear to be too many purely product-driven research businesses appearing, some will hit the target: *"Simply being able to discover the identity of surrounding landowners via Datscha rather than a Land Registry search in the UK can unlock deals that would otherwise take much longer to arrange – or never happen."* The main area of doubt is the potential for the transactions segment, populated largely by crowdfunding/distribution and secondary market platforms, to make a real impact; and, related to this, the blockchain factor.

There appears to be little doubt among outsiders that the inefficiency of property trading means that brokers richly deserve to be disintermediated. However, the disintermediation process will be long and slow, the product of many small process improvements, with no silver bullet or big bang. The accumulation of lots of small contributions may create a small revolution, but this depends on the attitude of banks and professional institutions.

Will banks accept the machine learning founded appraisals of House Canary? Is the peer review process capable of replacing the professional advisor and promoting real estate investment to the masses via a crowdfunding platform? Or is this a disaster waiting to happen? What will happen in a market crash? Can IPSX or Prop-X create a successful secondary market for units in commercial real estate?

Scepticism would be very natural, given the various failed attempts to introduce such liquidity and unitisation in precious decades, particularly when it is not obvious that technology has changed the nature of the required solution (a heterogeneous offering, through an efficient platform, and a large pool of qualified buyers).

Consolidation is certainly on the way, and we can expect to see traditional broking and advisory businesses cherry-picking the best ideas and moving into the space currently occupied by the more thoughtful startups. Meanwhile, blockchain has a very long way to go before it will penetrate the mainstream of legal real estate transactions - trusted professional advisers are still needed to keep the system clean.

8.7 Reaction

The new dinosaurs

PropTech 1.0 led to a very large number of start-up failures and takeovers driven by over-optimism. We were left with a small number of dominant survivors with market share but struggling with an outdated tech infrastructure. As technological improvements gather pace, the same process is sadly inevitable.

Regulation

Equally inevitable is a reaction from protective governments and big business. We have already described Airbnb's problems; other successful FinTech will run into similar issues. Unauthorised deposit holding,

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unregulated investment advice, unprofessional governance, inaccurate advertising and misrepresentation are all charges against Real Estate Fintech startups that we heard in interviews. *“Processing rental recurring payments exposes companies to legal liabilities like a money transmitters which will cause many companies to be unwillingly and unwittingly considered a bank.”* Even more concerning for some, some success by crowdfunding platforms in what is the currently unregulated property market plus some secondary market liquidity might force regulators to regulate direct property investment.

While a clear loss of confidence in banks and finance professionals has been in evidence post 2007, it is difficult to see the risk management offered by experienced advisors being over-ridden by peer review and blockchain, unless the blockchain movement is itself monitored and administered by those professionals. This will slow the pace of change.

The human factor

The notion that qualified, experienced professional advisors can be replaced by customer feedback is fanciful. The human factor will re-assert itself in a variety of ways. As an example, the relatively unadventurous Purple Bricks model, which combines digital and human interfaces and is replicated in the US by Triple Mint, could be a sign of the future. Traditional business formats capturing tech for their own benefit will hit back and compete with purely digital offerings.

Asset-lite?

Asset-lite businesses quite reasonably point out that their return on equity is enhanced as all available capital gets put to work in highly profitable operations and not in low-return assets like real estate. Yet Google owns its own HQ buildings and Facebook owns its data centres and HQ. It has been suggested that Facebook might use its customer base to offer loans and become a bank with a balance sheet. Deliveroo is taking on property research staff and Amazon has begun to open shops and sub-lease data centre space. It will certainly mutate into a property-owning business.

The death of the asset-lite model is inevitable as firms accumulate cash and profit, become more risk averse and buy real estate assets. Coming from the opposite direction, property owners will Hoover up tech firms and combine high return service operations with low risk ownership.

8.8 What problems will be solved?

In this report, we have discussed the product-driven businesses which characterise much of PropTech 2.0. A product-driven environment involves the business developing a product first, then searching for a market for it. Such a business operates under the assumption that with great products come great customers which, in turn, bring in revenue and profit. When, on the other hand, a business goes out and gets information from its customers, and subsequently develops a product based on the information gathered, then it falls under the customer-driven category. How do you make the customer happy? What can your business do to address their

needs? How can you meet and exceed their expectations?

Tech business like Apple are classic product-driven platforms. Clearly, they can be immensely successful. But there are not many Apples, and the safer bets are customer- or market-driven. How can PropTech make the customer happy?

In Chapter 2, we listed the perceived problems associated with real estate as an asset class.

1 Property is a real asset, and it wears out over time, suffering from physical deterioration and obsolescence, together creating depreciation.

Can technology remove this problem? No: the limitations of physical space designed for a specific purpose will clash with shared economy and multi-use re-purposing. The increased pace of change will likely increase obsolescence, especially of energy-inefficient buildings that are incapable of becoming smart buildings. Some buildings will be re-imagined, but we will need more urban high rises and some property types will find themselves in the wrong locations, too far from the front office, the communications network and power. Obsolescence is more likely to accelerate than to disappear.

2 The cash flow delivered by a property asset is controlled or distorted by the lease contract agreed between owner and occupier. US leases can be for 3 or 5 years, fixed or with pre-agreed annual uplifts. Leases in continental Europe may be 10 years long, with the rent indexed to an inflation measure. Leases in the UK for high quality offices are commonly for 10 years, with rents fixed for five-year periods after which they can only be revised upwards.

The shared economy and the increasing pace of change both point to the need for shorter and more flexible leases, a development which is already in motion. We can expect to see more owner-operator landlords, characterised by the student housing and multi-family PRS sectors, as co-working and co-living operators merge with traditional property owners in their joint mission to create, own and operate multi-purpose, energy efficient, flexible space. Leases will be shorter. Much of the real estate market will become more like an equity asset and less like a bond.

3 The supply side is controlled by planning or zoning regulations, and is highly price inelastic. This means that a boom in the demand for space may be followed by a supply response, but only if permission to build can be obtained and only after a significant lag, which will be governed by the time taken to obtain a permit, prepare a site and construct or refit a property.

Can tech disrupt the real estate cycle? The much greater availability of information might just help to regulate and smooth away the boom and bust nature of the office market, as may the multi-purpose design of new space.

4 The returns delivered by property are likely to be heavily influenced by appraisals rather than by marginal trading prices. This leads to the concept of smoothing.

Appraisals of unitised property may become machine-generated in real time, but this is unlikely to affect large,

Where is this going?

complex assets. Shorter, more flexible leases may make real estate harder to value, as it will take on more equity-like qualities and look less like a bond. More liquid and unitised secondary markets might just begin to provide real time transaction evidence and the much-needed velocity/liquidity, but this is not likely to happen quickly.

5 Property is highly illiquid. It is expensive to trade property, there is a large risk of abortive expenditure, and the result can be a very wide bid-offer spread (a gap between what buyers will offer and sellers will accept).

This is the key issue. Crowdfunding platforms, on line secondary market platforms and blockchain make this the most intriguing of FinTech questions.

It seems very likely that the many tech-based contributions to the residential sales process will bear fruit. If investor protection issues can be solved, tech platforms will enable smaller residential assets to transact on platforms and exchanges in reasonable quantity, leading to exponential growth and radical change.

In the less homogeneous and less well-funded commercial or institutional investment sector, the experience of the last 30 years suggests that more liquidity will be very hard to effect. Can PropTech 2.0 make the difference?

While many small forward steps in the provision of data will reduce the risk of abortive expenses, the conservatism of institutional investors, the heterogeneity of the assets and leases and the size of the transactions put together mean that radical change is much less likely. Unless and until the market and processes become very well established, larger investors are unlikely to want to automate larger transactions due to the sums and risks involved.

However, greater unitisation and liquidity is something of a holy grail. The trading of shares in single assets by platforms such as IPSX may create small scale liquidity very soon, while PropTech 3.0 – blockchain - could just provide the key to mass market change. Unfortunately, this is many years away.

Note that unitisation and liquidity could change the nature of the asset class – not always for the best, as more volatility and equity market correlation is likely. Anticipating the speed and scale of this movement is one of the most challenging PropTech issues.

6 Property assets are generally large in terms of capital price. This means that property portfolios cannot easily be diversified, and suffer hugely from specific risk.

Again, unitisation is possible through the primary and secondary market platforms now being established. However, investors, both high net worth and institutional, will wish to settle large capital sums in single transactions, and are unlikely to automate this type of transaction for a long time due to the sums and risks involved. On the other hand, defined contribution pension plans may be an exception and single urban property assets will get bigger, so we can expect to see the further development of a listed market for single assets. If this happens, real estate portfolios will become easier to diversify.

7 Leverage is used in the vast majority of property transactions. This distorts the return and risk of a property investment.

Nothing is likely to change, as peer-to-peer lending platforms and online mortgage apps may make leverage easier to obtain.

8 *The risk of property appears low. Rent is paid before dividends, and as a real asset property will be a store of value even when it is vacant and produces no income. Its volatility of annual return also appears to be lower than that of bonds. This is distorted somewhat by appraisals, but the reported performance history of real estate suggests a medium return for a low risk, and an apparently mispriced asset class.*

Online marketplaces, if successful, will allow real time pricing and introduce more volatility. If active secondary platforms begin to capture real scale, real time pricing of assets becomes inevitable and (while this has many benefits) the risk of the asset will rise. Shorter leases and more operational real estate will make property more like a risky equity and less like a bond. For the first time, investors (and banks) will know when they are out of the money, and lender and borrower balance sheets will both become more unstable. It is to be hoped that the pace of this change is sufficiently moderate to allow lending banks to sort out their balance sheets in advance of this development.

8.9 Final thoughts

The real estate sector is ripe for change, being famous for its lack of capacity for deep and continuing innovation. We need to be make sure that we do not under-estimate the capacity of the real estate industry to resist change, and we need to be aware of the generally uncritical positive spin put out by those tech businesses with vested interests. Some exist because technology makes some things possible, but do not serve an obvious need.

However, the majority of PropTech activity is creating building blocks towards a more efficient property market, and the sums invested mean that FinTech and PropTech is here for the long term. PropTech businesses will survive if they solve problems without duplication.

“The majority of PropTech firms that will succeed are not those that are trying to be disruptive; they are the ones focussed on delivering products that bring efficiency and alignment to the market.”

Ryan Masilello, VTS

PropTech appears to be capturing only around 15% of all VC funding. Real estate is a huge sector, but has little or no velocity. If and as this problem is solved, more and more funding will be attracted. This issue means that Real Estate FinTech is where the money is, and is probably attracting at least half of all PropTech funding. At the same time, it should be recognised that the smart building sector is the least challenged PropTech segment – the demand is clear, the market huge, the technology increasingly available, and vested interests aligned.

A truly transformative PropTech movement is under construction. These firms will eventually bring efficiency and alignment to the market, but they will encounter behavioural obstacles, establishment reaction, and often

Where is this going?

financial calamity. There is an oversupply of activity in Real Estate FinTech, an excess of optimism in shared economy real estate, but a real need for smart buildings. PropTech 2.0 startups needs to respond to these economics before PropTech 3.0 comes along and makes them as obsolete as many of the buildings they rely upon.

References

- Baum, A and Hartzell, D (2012): **Global Property Investment**, Wiley Blackwell
- William Blair Equity Research (2015): **Real Estate Services and Technology**
- Carbon War Room (2015): **Building Returns with Sustainability Programs**
http://carbonwarroom.com/sites/default/files/reports/Green_REITs_FINAL.pdf
- CB Insights (2016): **The Pulse of Fintech Report**
- CB Insights (2016): **Home, Sweet Home: 96 Tech Startups Reshaping Residential Real Estate**, May. <https://www.cbinsights.com/blog/residential-real-estate-tech-market-map-company-list/>
- CBRE (2016): **The sharing economy checks in: An analysis of Airbnb in the United States**, <http://www.cbrehotels.com/EN/Research/Pages>
- CBRE (2017): **Global Real Estate Market Outlook**
<http://insights.pickeverard.co.uk/post/102dexes/what-is-proptech-this-post-includes-a-video>
- CNN (2017): <http://money.cnn.com/2016/06/22/technology/airbnb-regulations/>
- Coffman, K.G. and Odlyzk, A.M. (2001): **Growth of the Internet**, A T & T Labs - Research
- Cognizant Business Consulting (2016): **The Sharing Economy: Implications for Property and Casualty Insurers**, <https://www.cognizant.com>
- CRE (various): **CRE Tech Daily**
- Goodman, M (2015): **Future Crimes**, Corgi
- Esbaitah, W. (2016): **Growth of Real Estate Crowdfunding in 2016**, <http://crowdfundbeat.com/2016/04/05>
- Frey, C. and Osborne, M. (2013): **The Future of Employment: How Susceptible are Jobs to Computerisation?** Oxford Martin School
- Green Building Council (2015): **The Business Case for Green Buildings**, <http://www.usgbc.org/articles/business-case-green-building>
- Green, D. (2015): **Inside NYC's First 'Micro Apartment' Building**, December 28
- Grothaus, M. (2015, May 21): **Four Things Freelancers Wish You Understood**, <http://www.fastcompany.com/3046387/the-new-rules-of-work/4-thingsfreelancers-wish-you-understood>
- Huet, E. (2016, September 26): **WeWork Turns to New Business Model for India Expansion**, <https://www.bloomberg.com/news/articles/2016-09-26>
- Inman (2017): <http://www.inman.com/2017/01/31/knock-another-opendoor-competitorraises-12m/>
- International Blockchain Real Estate Association (various): <http://www.ibtcrea.org/>
- <http://www.jamesdearsley.co.uk/uk>
- Jiemian News (2016): **An interview with Mr. Ren Zhiqiang**, <http://www.jiemian.com/article/441619.html>

Appendix

Jones Lang LaSalle (2016): **A New Era of Co-working**, <http://www.jll.co.uk/united-kingdom/en-gb/research/339>

KPMG (2015): **The Future**, World Economic Forum

Market tracker, May 2016: **Proptech Business Models: is the Real Estate Sector Facing a Paradigm Shift?**
<https://www.venturescanner.com/blog/real-estate-technology-q2-update>

Mahmoud, A. (2016): **The impact of AirBnb on the Hotel and Hospitality Industry**,
<http://www.hospitalitynet.org/news/4074708.html>, March 7

Muhn, J (2017): **Why PropTech and MortgageTech Are the Future of Fintech**, @julieschick Tanz, February 23

Nakamoto, S (2008): **Bitcoin: A Peer-to-Peer Electronic Cash System**, White Paper, 31 October

Nanos, J. (2013): **The End of Ownership: America's New Sharing Economy**,
<http://www.bostonmagazine.com/news/article/2013/04/30/end-ownership-sharing-economy/May>

National Data (2016): **National Bureau of Statistics of China**,
<http://data.stats.gov.cn/easyquery.htm?cn=C01&zb=A0201&sj=2015>

Newcomer, E. (2016): **Airbnb Seeks New Funding at \$30 Billion Valuation**,
<https://www.bloomberg.com/news/articles/2016-06-28>, June 28.

Oldenburg, R (1989, 1991): **The Great Good Place**

Prop Tech News (various)

RealWealthNetwork (2017): <https://www.realwealthnetwork.com/learn/news/look-whos-knockingopendoor-offerpad/>

REIT Bond Pricing (2016): <https://www.fitchratings.com/gws/en/fitchwire/fitchwirearticle/REIT-Bond-Pricing>

REN 21 (2015): **Renewable Energy Production Comparison from 2004 and 2014**,
<http://www.ren21.net/Portals/0/documents/activities>

Roche, J (1995): **Property Futures and Securitisation – the Way Ahead**, Woodhead Publishing, Cambridge

Savills (2017): **Around the World in Dollars and Cents**

Segel, A., Baum, A., Lietz N., and Wu, C. (2016): **The Jamestown case**, Harvard Business School

Tapscott, D. and Tapscott, A. (2016): **Blockchain Revolution**, Portfolio Penguin

Tune, J. K. (2015.): **The Sharing Economy Has Created 17 Billion-Dollar companies and 10 Unicorns**,
<http://venturebeat.com/2015/06/04>

Venture Scanner (various), including <https://www.venturescanner.com/blog/real-estate-technology-q2-update>, April 26 2016

Zhou H.T. (2016): **The Last Corner of the Sharing Economy: Are There Prospects for Online Short Term Renting?**, <http://www.kejilie.com/baidu/article/RFr6F3.html>

Zuluaga, D. (2016): **Regulatory Approaches to the Sharing Economy: A briefing**,
<https://iea.org.uk/wpcontent/uploads/2016/07>, February

Interviewees

Seb Abigail, VTS
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Richard Batten, Jones Lang LaSalle
Darren Bechtel, Brick and Mortar Ventures
Alice Breheny, TH Real Estate
Keith Breslauer, Patron Capital
Marc Bruno, Datscha
Faisal Butt, PI Labs
Roberto Charvel, Vander
Mary Criebardis, PI Labs
Ian Currie, TH Real Estate
Drew DeWalt, Rhumbix
James Dipple, MEPC
Jack Elton, DN Capital
Jane Fear, Property Funds Research
Malcolm Frodsham, Real Estate Strategies
Yair Ginor, Lipton Rogers
Adam Hyde, Keepsite
Yardley Ip, Trulia
Ragnar Jongen, DN Capital
Natalia Karayaneva, Propy
Phil Kemp, Regus
Rachel Kisler, Kensee
Hugo Llewelyn, Newcore Capital Management
Dan Madrigal, Facebook
Andy Miles, REALLA
Rohin Modasia, Global Alternatives
Allie Morse, Lamudi
Richard Newton, Thomson Reuters
Rayhan Rafiq Omar, Unmortgage
John Partridge, Cording
Matt Partridge, Infabode
Jacob Philipson, Datscha
Sandeep Puri, Shojin Property Partners
Curtis Rodgers, Brick and Mortar Ventures
Rajeev Ranade, Source Central
Neil Sarkhel, Newcore Capital
Bryan Saxby, Oairo
Lisa Shaforostova, CBRE
Jack Sibley, TH Real Estate
Jeremy Sicklick, House Canary
Charles Tan, Global Alternatives
Cyril Theret, IPSX
Rohan Trivedi, Stride Up
Simon Tucker, consultant
Steve Weikal, MIT
Kristina Wirt, Pitchbook
Andy Wishart, Thomson Reuters
Sakeeb Zaman, StrideUp
Bob Zerbst, Digital Realty
Yue Zhang, University of Oxford

PropTech companies featured

ConTech

Autodesk
ConstructConnect
Holobuilder
Iron Planet
Micello
Kahua
Plangrid
ProCore
Rhumbix
Textura

Smart Buildings

Aggreko
CAME Digital Realty
Distech
Equinix
Honeywell
Maalka
Matterport
Nest
Siemens
TaskRabbit
WiredScore

Shared Economy

Airbnb
Appear Here
Breather
Central Working
Flexioffices
Grind
LiquidSpace
Love Home Swap
Mayi
Open Door Co-Living
PivotDesk
Regus
Rentpath
Roost
Sharedesk
Sharemystorage
Soho 3Q
Splittable
Spaces
Spacious
Storemates
The Collective

The Hub
Tujia
Urwork
Vanke Cloud Space
We Are Pop Up
Wework
Workbar
Xiaozhu
Youtianxia

Real Estate FinTech

42 floors
Aerial Look
Argus
Better Mortgage
Brickvest
Capitalrise
Compstak
CoStar
Cozy
Credi-Fi
Credit Sesame
Datscha
Envestnet/Yodlee
Equifax
ESRI
EyeOpen
Fang
Geophy
Guaranteed Rate
Habito
HouseCanary
Houzen
Hubble
Infabode
IPSX
Juwei
Kensee
Knock
Kofax
LandlordStation
LendingHome
LendingTree
Lendinvest
Leverton
LoopNet
Lucro
Mashvisor
Megalytics
Mortgagebot
Mortgage Harmony
NoAgent
OfferPad
OnTheMarket
OpenDoor

Appendix

Piggyback
Placester
Plastiq
Point
Property Crowd
Property Moose
Property Partner
Property.Works
Propstack
PropTiger
Propy
Purple Bricks
RadPad
Real Capital Markets
Real Estate Strategies
REALLA
RealMassive
RealtyShares
Reoptimizer
Reposit
RexMLS
Rezi
Rightmove
Rocket Mortgage/Quicken Loans
Roomi
Roostify
Shojin
Sina
Sindeo
SquareYard
Statebook
SoFi
Source Central
StrideUp
SPD
Talliance
TheSquareFoot
The Unmortgage
Top Image Systems
Triple Mint
Trulia
Trussle
VTS/Hightower
Xceligent
Yapstone
Yardi
Zeus Mortgage
Zillow
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Zoopla
Zumper



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Saïd Business School at the University of Oxford blends the best of new and old. We are a vibrant and innovative business school, but yet deeply embedded in an 800-year-old world-class university. We create programmes and ideas that have global impact. We educate people for successful business careers, and as a community seek to tackle world-scale problems. We deliver cutting-edge programmes and ground-breaking research that transform individuals, organisations, business practice, and society. We seek to be a world-class business school community, embedded in a world-class university, tackling world-scale problems.