Cambridge Centre for Housing & Planning Research

Housing Digital Built Britain Network

Position Paper 3: How will the UK govern, maintain and manage housing stock in a Digital Built Britain?

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October 2018

UNIVERSITY OF CAMBRIDGE

Cambridge Centre for Housing & Planning Research

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This project was funded by the Centre for Digital Built Britain.

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1. The question

How will the UK govern, maintain and manage housing stock in a Digital Built Britain?

2. What are the key issues and why is this important?

Housing sits at the heart of many social, economic and environmental issues, and a large variety of stakeholders are involved in the governance, maintenance and facilities management of different tenures and types of housing, across the existing and newly-built housing stock.

Housing **governance** covers housing allocation policies and defines the rules of property ownership and tenancy agreements. It also defines the goals and standards for housing policies which ensure effective management and maintenance of the housing stock through a set of policies and regulations. Housing management is complex given the wide diversity of UK housing stock, regardless of whether it is managed by a public or a private entity, by a single individual or by a group.

Housing **maintenance** involves all the technical activities of servicing or repairing the housing stock, as well as ensuring equipment and building components meet required legislative and regulatory standards. In the field of housing, where the housing stock is seen as a component of the built environment, maintenance is associated with Facilities Management (FM). Facilities Management is an interdisciplinary activity which can include asset management, space management, quality and safety assessment, supervision and delivery of technical services such as repairs, refurbishment, renovation, and day-to-day operation and maintenance of the housing stock. Depending on housing tenure and type, FM services can be operated either by internal managing agents or by external FM contractors.

Governance, management, maintenance and facilities management are key when it comes to issues such as housing safety standards and housing quality regulation, and they can have considerable effect on the delivery of sustainable housing capable of meeting peoples' needs. The emergence of new digital tools and technologies have the potential for impact upon the construction industry, and it may also affect the way we govern, manage and maintain housing stock. This report intends to disentangle the complexity of the regulatory

frameworks that surround housing, as well as to inform of the potential barriers to and solutions offered by the uptake of digital tools.

2.1. Why is housing important?

2.1.1. It is a **large-scale** issue

Efficient housing governance, management and maintenance of housing stock has an impact on all households, regardless of the housing type, tenure, geographic location or household composition. There are approximately 66 million people living in the UK, living in 28.7 million homes (ONS, 2018; NHBC, 2018).

2.1.2. It has an impact on **safety**

The Grenfell Tower tragedy shed light on the dramatic consequences of poor safety conditions, regulation and maintenance, particularly in the prevention of fire hazards. Grenfell is not an isolated case, and it has been revealed that across the UK, 470 buildings are still using the same defective aluminium cladding (Building Safety Programme, 2018). In 2016-2017, 332,000 households had experienced a fire at home in the previous few years, and only a quarter of them were put out by the fire and rescue services. 75% of dwelling fires attended by rescue services were in houses, bungalows and converted flats, and a quarter were in purpose-built flats (Home Office, 2017). In the year 2016-2017, 346 fire-related fatalities were recorded in the UK. The English Housing Survey showed that in 2016 more than a million dwellings were assessed as having a significantly higher than average risk of fire.

2.1.3. Housing quality has an impact on **health and wellbeing**

There are currently large inequalities in terms of housing quality, with a higher proportion of non-decent homes in the private rented sector, and a much lower proportion in new build housing stock. Furthermore, around 98% of homes which failed to meet the Decent Homes Standard were built before 1990. These disparities in housing quality have an impact on residents' health and wellbeing.

Nearly 15 million people in England are currently living in poor housing - a figure made up of 3.6 million children, 9.2 million working age adults and 2 million pensioners (Natcen, 2013). Poor housing is defined as either overcrowded housing, or housing that does not meet the Government's Decent Homes Standards. Poor housing quality has a considerable impact on health and wellbeing. Children living in poor housing are twice as likely to suffer from fair, bad or very bad health than children in good housing, and are particularly more exposed to poorer respiratory health when the house is cold or damp. A report published in

2013 by Natcen shows that 26% of adults living in poor housing report bad or very bad health issues, compared to 17% of those who live in decent housing. Poor housing also impacts mental health, with adults living in poor housing being 26% more likely to suffer from mental health issues, compared to those who live in good housing (Natcen, 2013).

2.1.4. Housing governance affects **energy efficiency**

Data from the Energy & Climate Intelligence Unit revealed that the "residential sector" accounted for 13% of the UK's greenhouse gas emissions in 2015. Despite an overall decrease in emissions in the last decades, the share has remained the same: the residential sector accounted for 10% of overall emissions in 1990 (BEIS, 2018). In terms of final energy consumption, the housing sector accounts for more than 29% of total energy consumption- that is more than road transport or industry (DECC, 2013).

Efficient management of housing stock and the delivery of well-maintained housing has an impact on energy efficiency, and on environmental issues more generally. The housing stock in the UK is generally inefficient, particularly non-recent built stock: while 82% of the new built stock was rated A or B in the last Energy Performance of Buildings report, 68% of existing dwellings were rated D or lower (MHCLG, 2018).
The type of housing impacts on CO_2 emissions. Compared to houses, flats tend to produce fewer carbon emissions as they have lower lighting and heating costs (MHCLG, 2018). Energy efficiency is also influenced by tenure. The English Housing Survey (2017) revealed high levels of inequality between the owner-occupied sector (68% of the homes with the worst energy efficiency, ranked band F or G, were owner-occupied), the PRS (28%) and the social-rented sector (4%). Data also revealed that UK homes are among the most expensive to heat in Europe because of poor maintenance and insulation. UK homes also have the highest level of fuel poverty and energy deprivation. In 2011, 2.39 million households (representing 10.9% of total households) suffered from fuel poverty (DECC, 2013).

2.1.5. Housing impacts the **economy**

Lack of governance and poor maintenance of the housing stock are very costly, particularly when it impacts on new-build defects and existing stock repairs. Health and safety issues generated by poor quality housing are among the biggest housing-related cost for the NHS, indeed, Category 1 hazards[1] relating to poor housing conditions are the source of 70% of NHS costs (NHBC, 2018). Poor building standards and inefficient regulation affect both the existing housing stock and new-build stock. Existing research suggests that remedying defects that occur during the construction period or during the builder's liability period will

[1] Category 1 hazards pose a serious and immediate risk to a person's health and safety. Examples include damp and mould growth, excessive cold, overcrowding and dangerous electrics.

cost the builder on average between 2.3% and 9.4% of the production cost. In the UK, the NHBC offers a ten-year warranty against construction defects for 80% of new homes. Hopkin (2017) explains that "in the UK in 2015, the NHBC spent £87 million on resolving warranty claims, and most of these claims are for repairs to the external structure and rendering of properties". There are various types of costs which are borne either by house builders, warranty providers or building inspectors: investigating defects, repairing, resolving complaints or ensuring regulatory compliance with the Building Regulations Requirements. Across all buildings and structures, the Repair, Maintenance and Improvement (RMI) sector was valued around £28 billion in 2009 (Killip, 2009).

Such costs are particularly important when it comes to energy inefficiency. An estimate from WWF (2010) revealed that fuel savings for the UK population following a large programme of retrofit would be estimated at between £76 billion and £131 billion. Such programmes would have a major impact in the economy: it has been estimated that major investment in energy efficiency in the housing industry could almost double the number of jobs in the sector to 260,000 (Cambridge Econometrics and Consumer Futures, 2012). In the long term, improving energy efficiency in the housing and construction industry would increase GDP by 0.6% by 2030, which represents £13.9 billion (ibid).

3. What does current research and evidence tell us?

3.1. UK housing stock

In England, housing represents 80% of the total built floor space (DCLG 2016). The housing market suffers from chronic shortages, an issue that has become particularly acute in the recent decade. In the coming years, residential developments will need to provide accommodation for an estimated population growth of 9.7 million by 2040. While it has been estimated that the current need for housing completions is around 300,000 dwellings per annum, completions in 2016/2017 only reached 217,000 dwellings, as per Figure 1. A large majority of this new housing stock is provided by private speculative house building firms (78%), while Housing Associations and local authorities provided 21% and 1.3% of new housing stock, respectively (2015, DCLG).

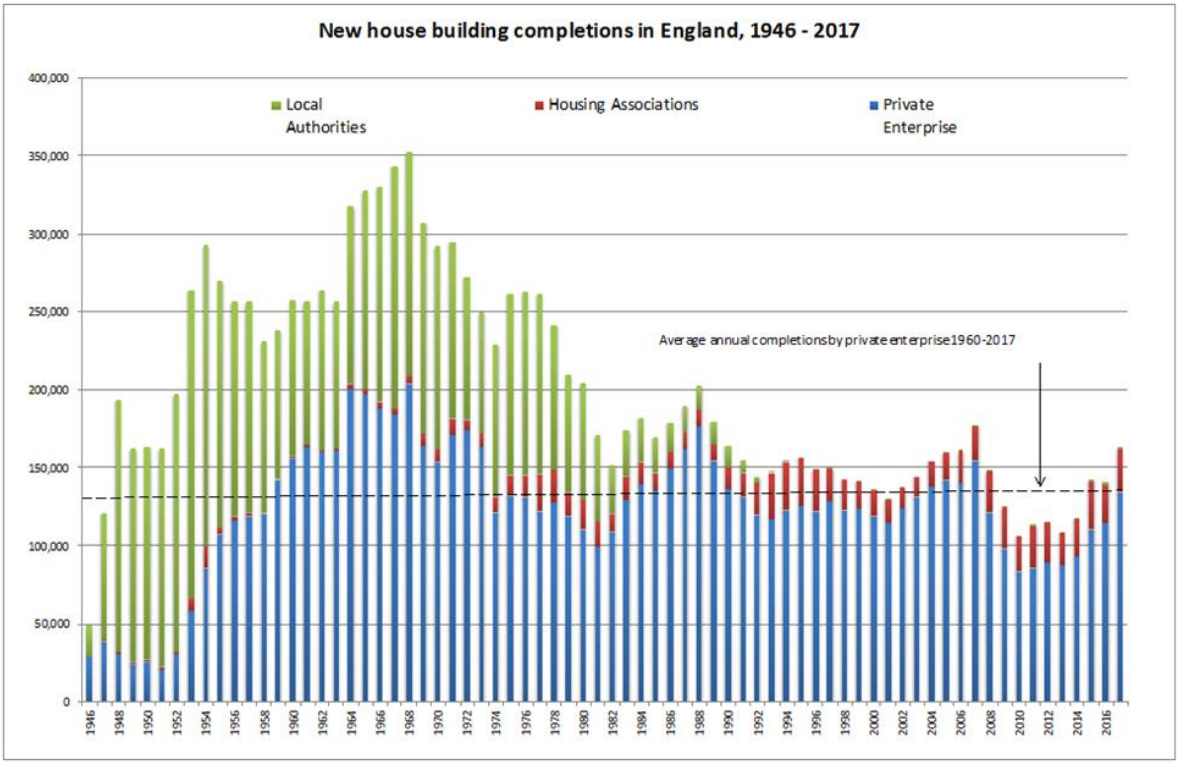

Figure 1 House building completions 1946-2017 (Source: MHCLG Live Table 244)

Of the estimated 23.5 million homes in England, 62% are owner-occupied, 20% are privately rented, and 17% are socially rented. Although owner-occupation is still by far the largest tenure, the private rented sector (PRS) has expanded considerably in the last decade, and is expected to overtake owner-occupancy in places like London in the next decade. Research

suggests that more than a quarter of households in Britain will live in the PRS by 2021 (Knight Frank, 2017).

While a large proportion of dwellings in the UK were built in the post-war period, and construction reached a peak in the 1970s in order to address a drastic lack of housing, 20% of the current housing stock was built before 1919, and 24% was built after 1980. With the smallest proportion built after the 1970s and the second largest proportion built before 1919, the UK has one of the oldest housing stocks in Europe (DCLG, 2017). The age of the housing stock varies very much depending on tenure. A third of private-rented dwellings were built before 1919, which makes the PRS the "oldest" tenure. The social-rented housing stock is more recent, but there are large disparities between council housing (7% was built after 1980) and Housing Associations' housing stock (37% was built after 1980).

These disparities in terms of age also affect the quality of the housing stock, particularly in the private-rented sector. Data extracted from the English Housing Survey (2017) showed that in the PRS, 47% of dwellings built before 1919 have been judged to be non-decent in 2017 (Ruggs & Rhodes, 2018). However, poor quality housing also affects the newly-built stock. A recent Shelter survey (2017) found that 51% of owners of recent new builds "experience problems including construction, fittings and utilities". This raises major management and maintenance issues, particularly in the private-rented sector where a third of homes have been considered non-decent (DCLG, 2017).

According to the Decent Homes Standard and the Housing Health and Safety Rating System (see below), a home is considered decent if:

- It is free from any hazard that poses a serious threat to health or safety
- It is in a reasonable state of repair
- It has reasonably modern facilities
- It has efficient heating and insulation

In England, houses are the most common type of dwellings: they still represent around 80% of the stock, while flats account for approximately 20% (DCLG, 2017). Flats are largely concentrated in urban areas. The type of housing also largely depends on tenure. While a large majority of owner-occupied dwellings are semi-detached and detached houses, 37% of the private-rented stock is composed of flats (DCLG, 2017). However, in 2017, with all tenures combined, the most common type of new-build housing was detached houses, and the proportion of new flats decreased by 20% between 2007 and 2017 (NHBC, 2018). Housing

type in the new-build stock varies between location. In London, more than 90% of the new stock were apartments, whilst in the North-East, 49% were detached houses (NHBC, 2018).

3.2. Tenure and housing governance

The governance, safety, maintenance and management of housing are particularly important in certain types of housing (both new build and existing stock) and they depend very much on housing tenure.

3.2.1. Private rented sector

Overview of the private rented sector in the UK

Although private renting was by far the biggest tenure in the UK at the turn of the twentieth century (in 1910, it housed almost 90% of the population), the significant increase in the number and proportion of private tenants in the UK is quite recent (DCLG, 2016). It is often explained as the consequence of a growing hardship for many households willing to buy, and a sharp decrease in the provision of socially-rented housing by local authorities: in 1979, 42% of households lived in council housing, this figure dropped to 8% in 2015 (DCLG 2016). Consequently, the PRS is now characterised by an increasing diversity of socio-economic situations, acting as a "stopgap" option for deprived households who are on waiting list for social housing, or as a temporary tenure for those saving in order to access homeownership. The English Housing Survey (2017) revealed that among private renters, 42% indicated they were privately renting because of affordability issues that precluded them from purchasing a property, and 15% were saving for a deposit, particularly among young renters aged 25-34. On the other side of the spectrum, more than 1.15 million households are on waiting list for social housing (Shelter, 2018). This diversity of situation, combined with a variety in housing types, raise complex management issues that need to be addressed in the PRS. Furthermore, the PRS is characterised by growing sub-markets such as the student housing market; 'young professionals' who constitute a large demand group within the PRS; but also in some areas a growing proportion of Housing Benefit recipients (Rugg & Rhodes, 2018).

Governance of the PRS

Currently, most PRS dwellings are owned by individual landlords rather than institutional investors, making it a highly fragmented market: single-property owners account for 40% of the whole PRS stock, while landlords with more than 100 properties account for less than 10% of that stock. The PRS is often described as a 'cottage industry'.

Scanlon et al. (2016) estimate that 2.49m individuals in the UK were private landlords, representing approximately 5% of the adult population. 90% of private landlords were

owner-occupiers, and 1% were social tenants. In terms of portfolio size, the Review Omnibus reports that 70% of landlords in the UK have only one property to let, 16% have two, 8% have three or four and the remaining 6% have more than four. In terms of evolution, in the past decade, the number of landlords with a single letting property increased significantly. The type of landlord also changed. While in 1993, 61% of landlords were individuals, couples or partnerships, and 20% were companies, in 2010, these figures were 89% and 5%, respectively. Such figures reveal that landlordism is now less professionalised, and this has an impact on how housing stock is governed, managed and maintained.

In England, landlords do not have to register with an official body, and it is not possible to access a centralised file which lists information on landlords. However, in Scotland, Wales and Northern Ireland, renting out a property without being registered is a criminal offence. This is not the case in England, where landlords may sign up to a registration scheme such as the National Landlord Association or the Residential Landlords Association on a voluntary basis. There is no national landlord or letting agent register, and rules vary depending on the local authority. There are, however, some rules for multi-occupancy: in England and Wales, landlords must have a licence if they are renting out a large House in Multiple Occupation (HMO)[2].

In many cases, particularly for individual landlords who own a single property, the PRS stock is managed directly by the landlord. The individual landlord is in charge of putting the dwelling on the market, allocating it and setting the rent. In some cases, management is operated by a letting agency. However, there are no precise data on the number of letting agents who currently operate in the market nationwide. According to the Review Omnibus, letting agents are involved in two fifths of lettings, but there is no register of letting agents. There seems to be no comprehensive research on the topic, but the landscape would appear to be fragmented between independent agents, branded letting agents and agents who operate independently but under franchise (Rugg and Rhodes, 2018). Letting and management services can also be part of large estate agencies. Just like individual landlords, letting agents can be accredited within organisations such as the National Approved Letting Scheme, but they are not compelled to do so.

Maintenance of housing stock

Lack of compulsory registration has major implications for the maintenance of housing stock, particularly in terms of housing safety and housing quality issues. For registered HMOs, local councils have to carry out a Housing Health and Safety Rating System (HHSRS, see below) within five years of receiving a licence application. For unregistered landlords, they are

[2] Large house in multiple occupation: a house rented to five or more people who form more than one household.

obligated to keep properties safe, make sure gas and electrical equipment are safely maintained, provide an Energy Performance Certificate (EPC) and follow fire safety regulations, but there is no mandatory HHSRS inspection, and no minimum standard of accommodation to be reached prior to letting a property. Similarly, there is no obligation for local authorities to pursue landlords for poor management practices. This is an area which is beginning to show signs of evolution: Newham Council in East London is the first local authority to introduce a system of landlord registration for every property, regardless of its size, in order to combat 'rogue' landlords.

When it comes to regulating the PRS, a number of issues emerge, particularly because the sector is associated with low property standards compared to other tenures, a perceived lack of professionalism in property management, and insecure tenancies (Rugg and Rhodes, 2018). The proportion of non-decent homes is higher in the PRS than in any other tenure. Between 2006 and 2016, there was an increase in the number of non-decent dwellings in the PRS from 1.29m to 1.35m (Rugg and Rhodes, 2018). 27% of properties were judged to be non-decent in 2017, particularly converted flats (52%) and old dwellings (47% of dwellings built before 1919). However, another 12% of new dwellings (built since 1980) were also considered non-decent, which is much higher than in the social-rented sector and owner-occupied dwellings, where non-decent homes do not exceed 7% of the stock (ibid). In their report, Rugg and Rhodes (2018) list potential reasons contributing to the incidence of non-decent properties in the PRS. The property type (poorly built, listed property where improvement is expensive), landlord characteristics (inexperienced, unable or unwilling to invest in improvement), local authorities (low level of proactive engagement in property improvement), or the local market are the main reasons listed in the report.

Much is unknown about the evaluation of enforcement measures in terms of housing quality and safety, because of a lack of both data and evidence. The DCLG 2010 report concluded that "the exact number of properties where landlords have carried out improvement to the physical condition of the property as a direct result of licensing is unknown. There is currently no monitoring outside properties which are under a licensing regime".

Overall, in terms of the regulatory and governance framework, Rugg and Rhodes (2018) explain that "the effective regulation of the sector is undermined by the nature of the broad, overarching regulatory and governance framework" and "the legal enactments framing letting activity fail at multiple levels".

The emergence of the BTR market: new challenges for the governance, management and maintenance of housing stock

Several factors have led the PRS to become the fastest-rising tenure, whether through tenure conversion or new-build residential developments. The Buy-to-Let mortgage, launched in the UK in 1996, and build-to-rent (BTR) schemes, designed for multi-unit blocks of purpose-built private rented housing and introduced in 2012, contributed to the rise of the PRS. BTR schemes are partly intended to address the complex management and governance issues caused by the high fragmentation of the rental market. They target the whole residential spectrum, from high-rise buildings to low-rise flats or houses. A specificity of new BTR schemes is that they are often large-scale investments, where the stock is owned and professionally managed as a single entity. BTR schemes are said to address the issue of "patchwork management arrangements" that the PRS often suffers from (British Property Federation, 2015).

According to research led by the British Property Foundation (2018), there are currently 95,918 BTR homes complete or under construction/planning application in the UK. In terms of housing types, BTR developments scheme are becoming increasingly diversified: 17% of schemes currently in the pipeline include houses, and not solely high-rise flats.

Between 2016 and 2017, the total of completed BTR homes increased by 45% (BPF, 2018). This is expected to grow further in future years. According to Savills, "At this rate of growth, we expect that the build to rent pipeline could double to around 200,000 within the next two years" (BPF, 2018). However, BTR completions are not equally distributed geographically. While London constituted a major ground for early BTR developments in Stratford and Wembley, in the year 2016-2017, 62% of the BTR house completions took place outside London, with a particular concentration in the northwest of the country (BPF, 2018).

Recent research on BTR developments emphasises many advantages, such as longer tenancies, flexibility for tenants and better management and maintenance services. In its *Build-to-Rent Best Practice Guide on design, management and construction*, the Urban Land Institute specifies that BTR developments are built "with the customer in mind" with a "typically incorporated dedicated staff (potentially on site)" (Future of London, 2017).

The development of this new build private rented stock triggered new governance and management arrangements, with local authorities and private companies working together in innovative ways. In particular, more Housing Associations are extending their portfolios to include private rented stock (either through transfer or new build), and are now playing a bigger role in the funding, delivery and management of PRS dwellings. Research led by Clarion and the Centre for Analysis of Social Exclusion (CASE) in 2018 shows that this new PRS portfolio "offers an opportunity to be innovative" in adopting different management approaches, centred on customer wellbeing and effective management and maintenance

services. The British Property Federation reported that, in 2017, registered providers (i.e. Housing Associations) had completed 21% of all BTR schemes.

An example of a new BTR residential development is located in East London. Named "East Village" because it is located in the former Olympic Village in Stratford, it is one of the first BTR developments characterised by single management for the whole block (also known as an "integrated management model"). These new PRS units are owned and managed by Get Living London, an organisation which acts both as a residential owner and a rental management company. East Village illustrates the shifts currently operating in the PRS, while emphasising flexibility and security for tenants in an area where the demand for private renting is particularly high. Get Living London brands "new ways of private-renting", offers "dedicated on-site concierges and a management team" in charge of managing and maintaining the stock. This integrated management model allows Get Living London to deal directly with the tenants, whether allocating dwellings or ensuring repairs and maintenance, "with no agent or middle-men". East Village now comprises 2818 apartments, most of them in the PRS, but with some under shared ownership.

Although some Housing Associations own their PRS stock through leasehold or freehold, others only partly own their stock, sharing with another Housing Associations or as a joint venture with an investment fund. Given the diversity of options in terms of management (joint venture, subsidiary, delegated to an external agency, separate in-house team), there is a lack of uniformity and clarity in the way maintenance services are provided to tenants.

3.2.2. Social housing stock

Governance

In the UK, social housing refers to the housing stock where rents are determined through a national rent regime, by definition below market levels. It has been traditionally associated with council housing owned by local authorities, but is increasingly applied to properties owned and managed by private registered providers known as Housing Associations (HA). These new types of social landlords are independent, not for profit organisations. Currently, among social renting households, 59% rent from Housing Associations and 41% from local authorities (English Housing Survey, 2017). Unlike private rented housing, social housing is allocated on the basis of need, according to the local council's allocation scheme.

The key purpose of social housing is to secure affordable accommodation for people on low incomes. Registered providers are financially regulated and funded by the Regulator of Social Housing (RSH), which, along with Homes England, replaced the Homes and Communities Agency in October 2018. Oversight for the social housing sector remains with

the Ministry of Housing, Communities and Local Government (MHCLG). However, social rented stock is governed differently depending on the type of social landlord (local authority or Housing Association).

The primary difference lies in the regulatory framework to which social landlords are subject. Central government decides how social rents are set, and what type of leases must be used, but there is a lack of clarity concerning the status of Housing Associations, which are, in theory, private bodies but have been classified by the Office for National Statistics in 2015 as public sector organisations. However, in the 2017 Housing White Paper, the government asserted that "housing associations belong in the private sector and we are committed to implementing the necessary deregulatory measures to allow them to be classified as private sector bodies".

All social housing providers are regulated by a list of standards containing specific expectations and the outcomes providers must achieve. These standards, published by the RSH, are as follows:

Economic regulation standards (which only apply to private registered providers)

- governance and financial viability
- value for money
- rent standard

Consumer regulation standards (which apply to private registered providers and local authorities)

- home standard
- tenancy standard
- neighbourhood and community standard
- tenant involvement and empowerment

The management arrangements of the social rented-stock were radically altered by the Large Scale Voluntary Transfers (LSVTs) which took place in the previous two decades, transferring a large part of housing stockand management control from the hands of local authorities to HAs. The management of social housing became even more complex after the abolition of the Tenant Services Authority (TSA), which was a single regulator between local authorities and private providers. In the past few years, that transfer of power and ownership out of the

hands of local authorities has been followed by new models of corporate governance and commercially styled models of management and finance (Hutchinson and Ward, 2012)

There are approximately 1700 housing associations in the country. Unlike private landlords or letting agencies for whom there is no public national register, the government publishes a list of registered providers on a monthly basis.

Housing associations can be registered charities (most of them are, but they do not have to be) and they may target specific social groups, such as the elderly or disabled people. Housing associations have varied types of activities. They can either build new stock that is specifically designed for the PRS, re-designate social rented stock, purchase housing and let it, or manage properties on behalf of private landlords (see above). Recent trends suggest that housing associations play an increasing role in the provision of housing in the country, sometimes establishing partnerships with large commercial developers on regeneration projects. Housing associations operate a wide range of housing types, from low-rent social housing to intermediate housing and, in some cases, market-rent lettings. In the UK, there is a wide diversity of housing associations in terms of size, portfolio management and geographic implantation. The largest housing association in the UK is Clarion, which has 125,000 dwellings in England, while L&Q (merged with East Thames) own 90,000 (most of them located in London; source: Scanlon et al., 2017).

Maintenance of housing stock

The 2016-2017 English Housing Survey revealed that more than a half million social homes fail to meet basic safety and housing quality standards - this corresponds to almost one in seven social homes in England (DCLG, 2017). However, housing quality is far better in the social rented sector than in the PRS. The English Housing Survey revealed that, in 2014, the social rented sector had the lowest proportion of non-decent homes (14%) while the PRS had the largest.

The home regulation standards set out by the RSH ensure the quality of accommodation, repairs and maintenance services. Registered providers have to ensure that homes meet the standards set out in the Government's Decent Homes Guidance, they must provide "cost-effective repairs and maintenance services to homes and communal areas", as well as "meet all applicable statutory requirements that provide for the health and safety of the occupants in their homes".

Many housing associations have property-maintenance arms, known as Direct Labour Organisations (DLOs). Some HAs also hire private firms (e.g. Kier) to maintain their properties. A report published in March 2013 by the Chartered Institute for Housing analyses

the role of outsourcing (i.e. allocating a specific business process to a specialist external housing provider) and the use of shared services (defined as "a collaborative strategy in which a set of functions are concentrated into a semi-autonomous business unit"). The report says that while maintenance and repairs may constitute up to 60% of the expenditure of some landlords, these activities are very often outsourced. HouseMark benchmarking data (2011/2012) showed that 44% of housing associations have a Direct Labour Organisation. Interestingly, most of the HAs that have a DLO are those which came from transfers of local authority stocks (LSVT) compared to more traditional housing associations.

3.2.3. Owner-occupied housing stock

There is less regulation and legislation on how owner-occupied housing stock is governed, managed and maintained: the majority of these activities are operated by the landlord for their own property. However, a fundamental distinction - which considerably affects the way housing stock is governed, managed and maintained - lies in the different types of property ownership, which is very specific to the UK context.

Property ownership legislation: freehold and leasehold

The housing landscape in the UK is made even more complex by the differences in terms of legal property ownership.

Freehold and leasehold are two fundamentally different forms of legal property ownership. Owning the freehold for a property means that the owners own the building, and the land on which it stands, outright and in perpetuity. Leasehold means the owner just has a lease from the freeholder to use the home for a number of years - which can go from short term to a very long period of time. The leaseholder has a contract with the freeholder, which defines the legal rights and responsibilities of both parties.

The distinction between leasehold and freehold largely echoes and overlaps the distinction by housing type. Traditionally in the UK, houses are freehold and flats are leasehold. However, the proportion of leasehold dwellings is growing in the UK: partly because flat construction is growing in cities, but also because a significant number of houses are sold leasehold. The DLCG (2017) reports that in 2015-2016, there were 4.2 million leasehold dwellings in England, which corresponds to 18% of housing stock: 1.4 million are leasehold houses, and 2.9 million are leasehold flats, representing 32% and 68% of the total number of leasehold dwellings respectively (DCLG 2017). Leasehold properties represented 43% of all new-build registrations with the Land Registry in England and Wales in 2015, and 3,000 of these were detached houses (FT, 2016).

Managing and maintaining the owner-occupied stock

This distinction between freehold and leasehold ownership has major implications in terms of management and maintenance of the stock. Freeholders are responsible for maintaining the fabric of the building (roof, outside walls) as well as the common parts of the buildings. Leaseholders have to pay maintenance fees and annual service charges, and they have to obtain permission before carrying out any major work to the property. In case of a leasehold, management and maintenance services can be carried either by the landlord directly (or the residents' management company) or alternatively a managing agent can be appointed to ensure good management and maintenance of the building on behalf of the landlord.

It is difficult to access information on maintenance of the stock, housing quality and safety based on the type of ownership. The English Housing Survey produces reports and releases data on housing stock condition, energy efficiency or fire safety between the different tenures, but it does not provide any detail on the type of ownership. The only data available concerns the whole owner-occupied housing stock, regardless of the difference in terms of lease.

In 2016-2017, a quarter of owner-occupiers lived in poor housing ("defined as a home that has serious damp or mould, a Category 1 HHSRS hazard, is non-decent, or has substantial disrepair"[3]) which sets owner-occupied housing stock between the PRS (38% of private renters live in poor housing) and social housing (22%). However, owner-occupied stock is poorly equipped in terms of electrical safety: 41% of owners lived in homes that do not meet all five electrical safety requirements.

It is also very difficult to access information on the cost of repair and maintenance for owned, freehold residential housing, as well as data on owner self-management. Every two months, the Office for National Statistics (ONS) publishes a measure of owner-occupied housing costs (OOH) in the UK: these are defined as the cost of housing services associated with owning, maintaining and living in one's own home. Between April and June 20018, repairs and maintenance accounted for 0.2 percentage points of the quarterly growth rate of OOH (ONS, 2018).

As underlined by Rugg and Rhodes in their report *The evolving private-rented sector. Its contribution and potential* (2018), another element that deserves to be mentioned here is the increasingly blurred differentiation between each tenure, entailing complex governance challenges. While management policies and housing policy regulation still vary by tenure, the

[3] House of Commons Report (2018): Homes (Fitness for Human Habitation, Bill 2017-2019).

rise of shared ownership, property guardianship or other types of temporary accommodation will make it "increasingly difficult to arrive at fixed definition of private-renting" (ibid).

3.3. Governance and maintenance challenges

The complex nature of the UK housing stock clearly creates challenges for the good governance and maintenance of housing. In addition to fragmentation and complexity, there are other drivers leading to a lack of governance.

3.3.1. Lack of regulation

Following the Grenfell Tower tragedy, the Government commissioned the Hackitt Review, an independent review of building regulations and fire, published in May 2018. It placed a spotlight on the failures of the existing system, particularly due to a lack of clarity on roles and responsibilities when it comes to safety issues, as well as inadequate regulatory oversight and enforcement tools. It argued that safety principles must cover the whole process - from design to construction and maintenance of a building - in an integrated and comprehensive way. There is also an urgent need to adopt a new approach where actors involved in the whole process (i.e., client, designer, contractor and owner) own and share risks. In the case of the Grenfell Tower tragedy, responsibility has been put on the complex contracting chain: lead contractor, distinct project manager, engineering firm, cladding manufacturer, ventilation and insulation supplier. This considerable fragmentation between various stakeholders implies that responsibilities were never clearly determined, and that no specific body had overall ownership and supervision of the global process. The report also highlights the lack of transparency and clarity at all stage of the building life-cycle: poor record keeping for building safety requirements, an opaque product-testing regime, unclear labelling and product traceability, and an ambiguous package of safety regulations and guidance. In the specific case of fire and safety regulation, and for Grenfell specifically, the main problem came from the lack of complete, up-to-date and accurate information on the building. Easy access to that information is necessary in order to properly evaluate fire and safety conditions and requirements.

3.3.2. Lack of incentive

The Landlords Energy Savings Allowance (LESA) was abolished in 2015 and there are currently no incentives to encourage landlords to improve the energy efficiency of their dwelling (CCHPR, 2017). LESA had been designed to encourage landlords to improve the energy efficiency of their properties and allowed landlords to claim up to £1,500 per year on expenditure relating to insulation and draft proofing. In contrast, in Scotland, there are grants and loans available to landlords to improve the energy efficiency of their housing,

including the Home Energy Scotland Loan4, the HEEPS Equality Loan5 and the Resource Efficient Scotland SME Loan" (CCHPR, 2017, p11).

Private landlords lack incentives to invest in the repair and maintenance of their properties, particularly in high-demand areas (Shelter, 2014). In an unprofessionalised market, where individual landlords dominate, there is no clear delimitation of landlord rights, duties or responsibilities. Nationwide, only 5% of landlords are members of an accreditation scheme which would require them to meet quality and safety standards, and there are few incentives for landlords to join such schemes.

The Government review on building regulation and fire safety highlights the fact that a lack of incentives is a significant weakness in the current structure of building control, particularly as building control bodies might be wary of using enforcement methods for fear of losing long-term business.

3.3.3. Lack of means and technology

In an environment where building technology evolves quickly, there is a need for a better understanding of the opportunities and barriers to the uptake of digitalisation processes in the UK housing sector, whether this is for new builds or existing housing stock. The landscaping is changing quickly, and the uptake of digital tools as well as the generalisation of data use are progressing: for instance, in May 2018, the Mayor of London introduced a new website where tenants can complain against their landlord or agent, therefore creating a wide 'rogue landlord database' (Rugg and Rhodes, 2018).

4. Potential benefits of use of data and digital technologies

The use of data and digital technologies has many benefits, whether used for addressing a lack of governance or improving management and maintenance of the housing stock, or for improving quality, safety or energy efficiency. They may help to reduce costs: research led in the US proved that using digital records might help to save 5% in the cost of the construction of newly built projects.

In Hackitt Report (2018), Dame Judith Hackitt advocates the use of new digital records for buildings in which all safety-related information is gathered, throughout the building life-cycle, from design to construction and during occupation of the building. This would help creating a "golden thread of building information", and would efficiently address the problematic fragmentation of stakeholders' activities and responsibilities. These digital records would gather information such as the size and height of the building, construction methodology, full material and manufacturer product information, escape routes and fire compartmentation information, as well as a track record of inspections, reviews and consultations.

The use of data and technology could also help to reduce the burden of excessive documentation. For instance, "Persistent Digital Identifiers for Construction Products", a recent UK Research and Innovation project, evaluated the feasibility of using an innovative identification system whereby every component in a building would have a unique identification code. The use of such a digital record in which each product is captured, stored and checked at any time would enable easy, transparent and shared access to any information needed.

4.1. What data do we already collect about housing?

Currently, a large part of data already collected about housing is related to environmental issues and energy-efficiency measurement. An example of that is the use of smart meters, described by BEIS as "the building blocks of a smarter energy system fit for the 21st century". Smart meters are gas and electricity meters which offer a range of intelligent, 'smart' functions, allowing households to easily access and control information on their energy consumption. There are potential benefits associated with the use of smart meters: they put consumers in control of their energy use, and can help save money on energy bills. BEIS estimates that, by 2030, those savings will be worth more than £1.2 billion a year. They allow consumers to choose a better tariff or switch supplier and communicate directly with energy suppliers in order to generate accurate bills which are not based on estimates. There are

approximately 12 million smart meters currently installed across Great Britain, with 400,000 new meters benefitting homes and businesses every month.

More generally, BEIS and the MHCLG also collect and publish live tables on Energy Performance and Buildings Certificates, which are free to access since 2008. They include data on the Energy Performance of Building registers, average efficiency ratings, energy use, carbon dioxide emissions or fuel costs.

In an attempt to tackle housing quality and safety-related issues, MHCLG launched a Building Safety Programme following the Grenfell Tower fire. It collects information on high-rise residential buildings over 18 metres. The Building Safety Programme ensures that "where this includes personal data, MHCLG is the data controller". Based on aggregate data on the results of Building Regulation Guidance tests, MHCLG publishes a monthly data release with a focus on buildings identified with Aluminium Composite Material (ACM) cladding by tenure and remediation progress. The Building Safety Programme published in August 2018 a privacy notice concerning data collection, protection and sharing. The data collected will not be accessible to the general public. It will be shared with other departments and agencies, local authorities and housing associations. When necessary, data received from local authorities can be shared with building owners, developers of high-rise buildings and in limited circumstances with agents or services providers.

Another type of data collected is the Building Control data. Building control services ensure that buildings are designed and constructed in accordance with the Building Regulations and associated legislation (in particular regarding the production of energy efficient, safe and good-quality buildings). The MHCLG sub-committee in charge of making building regulations and setting standards (called the Building Control Performance Standards Advisory Group) produces a "Building Control Performance Standards" annual report, which provides guidance on such standards and ensures consistent application of building control functions between building control bodies. There is no collection of data on a national scale, since each local authority is individually responsible for its own building control department. Some LABC (Local Authority Building Control) services do publish their datasets and a building control register which contains details about building control applications; however, there seem to be no national obligation to do so.

The Internet of Things (IoT) is the name given to computing devices embedded in everyday objects that are interconnected via the internet. There are more and more devices which are entering people's homes. According to the inaugural annual State of the Connected Home report, published in 2017 by techUK, the connected home is "where multiple devices and services across a variety of sectors are integrated to offer greater convenience and peace of

mind in the domestic environment". Devices such as smart alarm systems, motion sensors, security cameras, smart locks, but also smart thermostats or smart lighting have already entered people's homes. However, we have little information about the collection and use of such data.

4.2. How is digital governance already used?

4.2.1. Digitalising the building and construction industry

In the building and construction industry, the current form of ongoing transformation of the built environment through the use of digital tools is known as Building Information Modelling (BIM). BIM is a process of "designing, constructing or operating a building or infrastructure asset using electronic, object-orientated information". Autodesk (2018) defines it as "an intelligent 3D model-based process that gives architecture, engineering and construction (AEC) professionals the insights and tools to more efficiently plan, design, construct and manage buildings and infrastructure".

The use of BIM Level 2 on centrally procured public projects was a target set by the 2011 Government Construction Strategy, and, since April 2016 the government has required the use of Level 2 BIM on all centrally procured projects. Groups such as BIM4Housing have been established in order to ensure and facilitate the use of digital facilities and tools in the construction industry, and in the housing sector more generally. The NBS carries out an annual "National Built Survey" in the construction industry, which has revealed that the use of BIM has widely expanded over the past few years. In 2012, only 31% of respondents were using BIM (NBS, 2012) and that proportion had doubled by 2017, reaching 62% of respondents. This is expected to increase further in the upcoming years, since 95% of respondents believe they will use BIM in the next three years.

4.2.2. BIM and Digital Facilities Management (DFM)

Facilities Management (FM) designates the proper operation of all aspects of a building (security, cleaning, landscaping, health and safety, fire safety, maintenance or asset management) and these processes are increasingly digitalising. Demand for technology is increasing, digital tools are becoming less expensive and the construction industry as a whole is increasingly digitalising. In the design, site management or delivery of housing, technological solutions are now readily provided, and intelligent data can be used and shared for the automatic generation of inspection plans, maintenance plans or digital life cycle scenarios.

Digital facilities management is not only used for housing purposes. It has been widely used in other sectors and types of buildings, including hospitals (see also Lucas, 2012) and

schools. Companies such as BAM FM develop, design, build and manage facilities through the application of BIM. Using the data extracted by BIM technology, it becomes much easier to understand the built asset, transform management capabilities during the whole life-cycle of the building, and therefore reduce the costs involved in managing the asset and the risks associated with decision-making. This is particularly useful where such costs and risks are borne by different actors, such as technicians, internal managers and third party companies.

There has already been research on how the use of BIM could "revolutionise conventional practices in facilities management processes" (Olatunji and Sher, 2010). According to Araszkiewicz (2017), "advanced digital technologies is a source of numerous solutions that facilitate acquisition, processing, redundancy and compression of information utilised about building, making it easier to develop cause and effect models, draw conclusions and make forecasts."

According to FM Systems[4], the benefits of using BIM for facilities management can be summed up as follows:

- Improved space management
- Streamlined maintenance
- Efficient use of energy
- Economical retrofits and renovations
- Enhanced lifecycle management

[4] https://fmsystems.com/blog/the-benefits-of-lifecycle-bim-for-facility-management/

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Case study 1: London Heathrow Airport

Construction and facilities management: the use of digital tools

London Heathrow Airport provides two landmark examples of the use of BIM, for the development of Terminal 5 in 2008, and of Terminal 2B in 2014. Design and construction were supported 3D modelling for the design and production stages, and by the creation of a 4D construction planning and modelling environment that supported actual construction delivery.

According to a report published by Balfour Beatty, the infrastructure group in charge of operating and constructing the Heathrow redevelopment, off-site pre-fabrication of components and 4D planning simulations allowed savings of approximately £10 million and saved five weeks in the planned schedule.

Heathrow is also an example of the use of digital tools in facilities management. The airport currently uses Maximo, part of the Enterprise Asset Management (EAM) system. BIM for the airport is integrated into Maximo, which uses "immersive technology" to identify problems and reduce onsite maintenance costs. When a problem is identified (heating, cooling, lighting etc.), an alert is sent to the control centre system, which uses immersive 3D integration in the Maximo system to establish a response to the problem and can directly alert the relevant contractors in charge using Maximo Service Provider.

Heathrow's 2013 Business Plan Objectives state that the use of the new Maximo system would bring "a technology solution that supports the airfield in delivering an enhanced and compliant inspection and maintenance process, an automated customer feedback solution, a consolidated system for asset integration, efficient tools for the production of management information and a sustainable training environment for on-going system training requirements". Other benefits such as the mitigation of risk disruption to the business from system downtime, improved asset performance or efficient performance management through the use of an automated reporting system are also mentioned.

See also:
https://www.balfourbeatty.com/media/28595/bim-realising-the-benefits.pdf
https://www.heathrow.com/file_source/Company/Static/PDF/Investorcentre/strategic-capital-business-plan-2013_full-document_LHR.pdf
https://www.heathrow.com/file_source/Company/Static/PDF/Investorcentre/SCBP2013_appendix-G.pdf

4.2.3. Digital services for tenants

Some initiatives have already been implemented in order to improve maintenance services in the housing sector, particularly for social rented housing. As part of the new Digital Inclusion Strategy, specific companies have been created in order to support housing associations and social landlords in the digitalisation of their management and maintenance services, guiding both social tenants and housing providers.

Many housing associations have developed customer service websites or apps where tenants can pay their rent or request repairs. Halton Housing Association launched its Digital First Strategy which aims to get 90% of customer-led transactions online by the end of 2018 (Future Shape of the Sector Report, 2018). They have already put in place a customer app, a proactive LiveChat, automated payment lines and intelligent voice queues. Companies such as the Tinder Foundation work with social housing providers across the UK in order to guide their digital inclusion. For instance, they helped develop online platforms for tenants to directly report on safety or maintenance issues. Digital consultancy groups such as Reading Room work with housing associations in order to guide their digital development. They are also working on the implementation of sensors in 'smart buildings' which would be able to detect any safety or material defect and notify the repair company directly.

Digital Facilities Management (DFM) can help with the management of safety related issues by generating scenarios, risk assessments or emergency responses in the event of a disaster.

DFM and BIM can also have energy-efficiency purposes: through the use of platforms to receive and monitor sensor information on various elements (temperature, pressure, consumption of thermal energy and electricity, light intensity and needs).

Case study 2: Chimni

The Future of Home Management?

Innovations in the field of Digital Facilities Management have found an application in the field of social housing or private-rented housing, very often in order to improve services between landlords and tenants, or relationships between public or private management services and residents. Although there is more uncertainty on the use of new digital tools by individual home-owners, there are examples of innovative facilities management services in the owner-occupied stock.

Chimni is a West London based tech company founded in 2014. Its aim is to facilitate housing management for homeowners by providing an online tool in the form of a digital dashboard. The dashboard stores and aggregates data, documents and certificates, and generates management templates, whilst also giving immediate access to account information for bills, utilities and insurance companies.

Chimni also helps homeowners in the process of selling or letting the home, by providing a pre-prepared home management digital tool. This gathers all the house documentation together in online files and provides a full property history without no need for paper documentation. Chimni is currently running a trial with a group of West London estate agents, extending the tool to link homeowners directly into estate agent software. As explained by Teresa Brewer, who works for a letting agency, "The agency world is full of digital innovation but most of it is on the agency and supplier side. This is the first time a system has been produced to help the homeowner get 'sale ready".

(Source: Chimni website https://www.chimni.com/)

4.2.4. What is the potential for digital governance in the future?

By reducing design errors and conflicts, and enabling the timely identification of errors, BIM can reduce costs and save time. Easy access to product information through the use of BIM could also reduce the environmental impact of materials, leading to the construction of sustainable buildings with lower energy use and less waste.

It is estimated that further use of Building Energy Management Systems (BEMS) can reduce costs of electricity by around 60%, cooling costs by around 45% and heating costs by around 25% (Araszkiewicz, 2017). There has been a lot of research on various tools and digital facilities management which enhance potential for digital governance in the future: artificial

intelligence, adaptive fuzzy neural networks (ANFIS), model-based predictive control (MPC), individual presence detectors (Martani et. Al, 2012), hierarchical multi-agent control systems (Wang et al, 2012), or digital twins, to name but a few.

4.3. Data collection, the challenge of retrofit and a fragmented market: potential constraints for the uptake of digital tools

4.3.1. Data collection, processing, ownership and access

There is a little current knowledge about collected housing-related data, or how to access it. There is no consolidation of data; for example, Building Control data is collected but is not used or made publicly accessible. There is also an issue with data quality: the annual report and analysis of Building Control Performance Indicator explains there are some limitations with the use, interpretation and validity of data. The data are taken from unaudited returns made by individual participants, and the overall response rate is slightly more than 50% of all building control bodies, which suggest that data extracted from such a small sample size might not be representative.

Across all data issues, there are challenges of data sensitivity and privacy, or blurred lines regarding the use of data and the recording of information. For example, as suggested by the Hackitt Review (2018), the government should support and extend the use of digital records throughout the building life-cycle. However, it also argues that such a record "must be available to those who are authorised to use it in a secure and accessible format" (Hackitt Review, 2018, p104). This means that not all information should be accessible to all stakeholders at every stage of the process. Delimiting and authorising appropriate access to that data still needs to be done.

Security of data is still a barrier to the wider uptake of digital tools. There is uncertainty over who has access to the data, who owns it and who can use it. The Government Communications Headquarters (GCHQ) recently warned of the risk of cyber-attacks through data collected by smart meters. The American research centre EPIC (Electronic Privacy Information Centre) has listed the following risks associated with the use of smart grids and smart meters:

- Identity theft
- Determine personal behaviour patterns
- Determine specific appliances used
- Perform real-time surveillance
- Reveal activities through residual data

- Targeted home invasions (latch key children, elderly, etc.)
- Provide accidental invasions
- Activity censorship
- Decisions and actions based Upon inaccurate data
- Profiling
- Unwanted publicity and embarrassment
- Tracking behaviour of renters/leasers
- Behaviour tracking (possible combination with personal behaviour patterns)
- Public aggregated searches revealing individual behaviour

4.4. Challenge of retrofit

Most new digital tools that are currently being developed for the housing industry, are designed for new build stock. The use of digital records is difficult to apply to existing buildings, and data collection is hindered by a lack of existing information, particularly building safety information. Approximately 80% of the homes we live in today will still be in use in 2050 (Dowson et al, 2012), and the biggest challenge for the housing industry therefore lies in retrofitting existing housing stock.

4.4.1. The fragmented and complex nature of the housing stock

UK housing stock is highly fragmented in terms of housing type, tenure and age, but also in terms of governance structure and regulation, management and maintenance. It can be assumed that a large variety of different tools will have to be adaptable to the fragmentation of the housing stock: this is the main challenge for the digitisation of governance and management services as different regulatory frameworks will need to navigated depending on whether property is managed by a local authority, a housing association, a private landlord or an individual homeowner. Digital tools will need to adapt to the variety in housing type, as well as tackling the inequality between the existing and new build housing stock.

5. What are the gaps in knowledge?

5.1. A wide costs-benefits analysis associated with the use of digital tools

There has been some research into the costs and savings associated with the use of digital tools, as well as on the broader impacts of a digitalised housing delivery process. However, much of this research is focused on the construction industry and on the operational phase of BIM. There seem to be no systematic evidence or evaluation of the benefits derived from the use of BIM during the occupation phase of the building (in terms of through-life facilities management in particular). Although the assumptions are that the use of BIM would improve decision-making based on the accessibility of robust and up-to-date data, efficiency through collaboration and innovation, or quality and compliance assurance in terms of contract management, the long term benefits of these technologies still need to be evaluated.

The current lack of a substantial evidence base which would record data on the impact of the uptake of digital tools, based on existing examples in the building industry and in the FM industry, constitutes a barrier to the wider uptake of digital tools. This should be tackled in research. There is an a further lack of clarity on the variety of tools that can be used: some can be applied to a specific activity or type of construction, but would fail to successfully implement in another. The use of a "digital record" might be adapted to large residential developments or multi-unit blocks where all the information on the stock is gathered in the same record, but it would be necessary to gauge how this tool could be adapted and used for the individual owner-occupied houses which constitute much of the UK's housing stock but for which there is no centralised information or database.

More generally, the diversity of the housing stock and existing management methods make it difficult to implement a single policy for the uptake of digital tools in the housing industry as, for example, management or maintenance services are quite different in the public and private sectors. There is need for further research on the development of tools adapted to each type of housing and existing regulation structures: for instance, the high proportion of individual home-owners make it quite difficult to access data on housing safety. There is need for further research on the adaptation of digital facilities management tools for individual owner-occupied housing units.

The development of a substantial evidence database, based on existing examples in and outside of the housing sector should help to quantify the potential benefits and risks associated with each situation, as well as gauging what kind of tools are best adapted for each situation.

5.2. Human barriers to the implementation of digital tools in the housing sector

Much of the existing research focuses on cost-benefit analysis, but other factors can play a key role, including the lack of information, absence of motivation, lack of trust or inadequate coordination between different actors. Barriers to the uptake of digital tools are not simply financial or technological, they can also be human. A lack of information on how to use the tools (either by residents or professionals of the housing sector), or a lack of coordination and trust between various stakeholders involved in the construction industry or in the through-life management services can constitute a major barrier. There seem to be no large-scale research on these "human barriers" which prevent innovative tools from being successfully implemented and used. This should be explored in further detail, with the use of qualitative interviews among various stakeholders: local authorities, letting agents, housing associations, DFM staff or residents.

5.3. Inequality of access to and use of digital tools between different tenures, housing types and households' characteristics

A major challenge for the uptake of digital tools, not yet explored by research, is that they are not made accessible and ready-to-use for the whole housing stock. This issue has been raised by RIBA. Following the publication of a response to the Hackitt review, Jane Duncan, Chair of the RIBA Expert Advisory Group on Fire Safety, said: "The RIBA welcomes Dame Judith Hackitt's review but we believe it must be more comprehensive, addressing the details of Building Regulations guidance as well as the broader regulatory system. The Review should cover all building types and construction methods not just those relating to high-rise, multiple occupancy residential buildings." This suggests that there is, for now, no regulatory framework for all building types when it comes to fire safety issues. It should be explored in research, which would inform the potential generalisation of such tools.

More generally, existing research suggests that the access to and uptake of digital tools designed to improve housing quality and housing safety with the use of new technologies is still unequal. There should be further research on these inequalities, as well as recommendations regarding the democratisation of digital tools regardless of the type of housing (size, tenure, age), characteristics of the household (in particular for social groups for whom access to and use of digital tools might be problematic) or geographic location (particularly for rural areas).

5.4. Retrofitting

Little is known about how the new technologies currently used in the construction industry could also be applied to the existing housing stock in order to address known quality and

safety issues, or how existing digital tools can be applied to older housing stock. For some new tools such as smart meters, there seem to be no barrier to applying them to the existing stock, but less is known about the opportunities and challenges for retrofitting the stock using other tools. There is a lack of research on how BIM could help retrofit existing buildings and bridge the gap between new build (which is likely to be safer and better quality) and existing stock. Therefore, research should explore ways of using digital tools for the management and maintenance of this stock in order to tackle such inequalities, and not exacerbate them.

5.5. Data ethics and security

The construction industry and the facilities management industry are becoming increasingly digitalised. Not only do they generate data, but they also collect it. This raises questions of data ethics, privacy and security on different but often intertwined elements: who owns the data, who has access to it, who can use and re-use it? This needs to be explored further in research.

Data generated from smart appliances, whether in the construction industry or the digital facility management sector, do create ethical and legal challenges. There is a need for further research on data protection mechanisms, in particular because much is still unknown about the exact nature of the data that needs to be collected. For instance, although the potential of smart meters has already been established (reducing energy bills, allows consumers to have a detailed knowing of their energy consumption, enabling time-of-use tariffs), there are still privacy concerns that need to be explored, specifically the kind of information obtained by smart meters (identifying life style or habits, enabling burglars to target vacant properties?) and access to it (would commercial organisations be able to use such data for marketing activities?).

Other gaps in knowledge relate to the anonymization of data, consent and regulation of access. There is still a lack of clarity on the nature of the consent process for energy consumers, because data privacy notifications can be difficult to understand, and there can be gaps between the multiple uses of the data (research, commercial activities) and the original purpose for which it was collected.

Smart meters are only one example of potential ethical concerns associated with digital facilities management, and there is a lack of research on data protection, privacy and ethical issues in the broader field of DFM. As FM systems become increasingly digitised and interconnected, little is known about who owns the data generated by digital services, an area of particular concern where multiple stakeholders potentially have access to the data. Information on the kind of data made accessible (on the building and/or the residents), as

well as the length of time they have access to it or the use they can make of the data is sometimes unclear, and this needs to be explored through research.

5.6. Governance: challenges and responsibilities

There is need for further research on the governance challenges posed by the increasing number of privately-led management and maintenance services arrangements in the sector. As has been demonstrated by the ongoing Grenfell Tower Inquiry, in the event of an accident, there can be a lack of clarity when it comes to allocating and identifying responsibility, most notably when the supply chain is fragmented. The uptake of digital tools, such as the digital record proposed in the Hackitt Review, might be a solution, but there is still need for research on the concrete implementation of such digital tools. Little is known about how the governance structures of housing stock would be impacted by the digitalisation of management and maintenance services, and it can be assumed that the need for regulation, particularly for the attribution of rights and responsibilities will become even more pressing. Further research should help answer questions concerning how regulation frameworks could be impacted by the uptake of digital tools, how will responsibility and ownership rights might be attributed in a system where data ownership is not clearly defined, and where a large part of the management of the housing stock is digitalised, what kind of structure will be necessary to regulate the proper functioning of these tools?

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