Cambridge Centre
for Housing &
Planning Research

Housing Digital Built Britain Network

Final Report

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UNIVERSITY OF CAMBRIDGE

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1.   Introduction

Housing sits at the heart of many wider social issues, and it will sit at the heart of the development of a Digital Built Britain (DBB). The Housing Digital Built Britain Network addresses the Centre for Digital Built Britain's (CDBB) framework and focuses its attention on residential housing. Delivering DBB is not simply about technological solutions to make supply and maintenance more efficient, although this is important, it is also about understanding how those solutions and efficiency gains interact with wider social policy issues to address UK housing inequalities.

 The broad aims of the networks are:

- To propose the capabilities needed for the UK to deliver and benefit from Digital Built Britain and identify the enabling research to deliver those capabilities;

- To describe the state of the art and leading-edge practice today, and;

- To build communities of people interested and able to participate in future research, demonstrator and pilot projects.

1.1.   Objectives of the Housing Digital Built Britain Network

The Housing Digital Built Britain Network brings together academics, practitioners, policy makers and government to determine the key areas of inquiry in relation to residential housing and DBB. The objectives of the Network are to:

1. Facilitate dialogue between key stakeholders in relation to the construction, management, servicing and lived experience of housing in the development of DBB;

2. To determine the key questions that should be the priority for investigation;

3. To scope out the existing literature in relation to these questions;

4. To identify the gaps in knowledge and gaps in capabilities;

5. To use this evidence base to scope out a research programme to meet the needs of UK plc in delivering affordable, sustainable and inclusive housing in a DBB.

The Network builds on our existing track record of conducting policy-relevant housing research and draws upon our existing links with practitioners, industry and government. It started from a strong base, with a series of CDBB mini-projects having been conducted by partners in the Network, including CCHPR's report and round table with practitioners on DBB and the house building industry.

The Cambridge Centre for Housing and Planning Research (CCHPR) is a research centre within the University of Cambridge, with over 25 years' experience of research in policy evaluation and analysis, and with expertise in housing, poverty and welfare reforms. It sits within the Department of Land Economy at the University of Cambridge. Since its inception, the Centre has attracted over £12m in external research grants, carrying out over 150 research projects for a variety of sponsors, ranging from the Economic and Social Research Council, EU Horizon 2020, the Ministry of Housing, Communities and Local Government and its forerunners, the Welsh Government, Shelter, the Joseph Rowntree Foundation, and a wide range of other bodies including industry bodies, local authorities and housing associations. Our key strength is in understanding the complexity of current housing issues and being able to deliver policy relevant research. Figure 1 presents an overview of the proposed methodology.
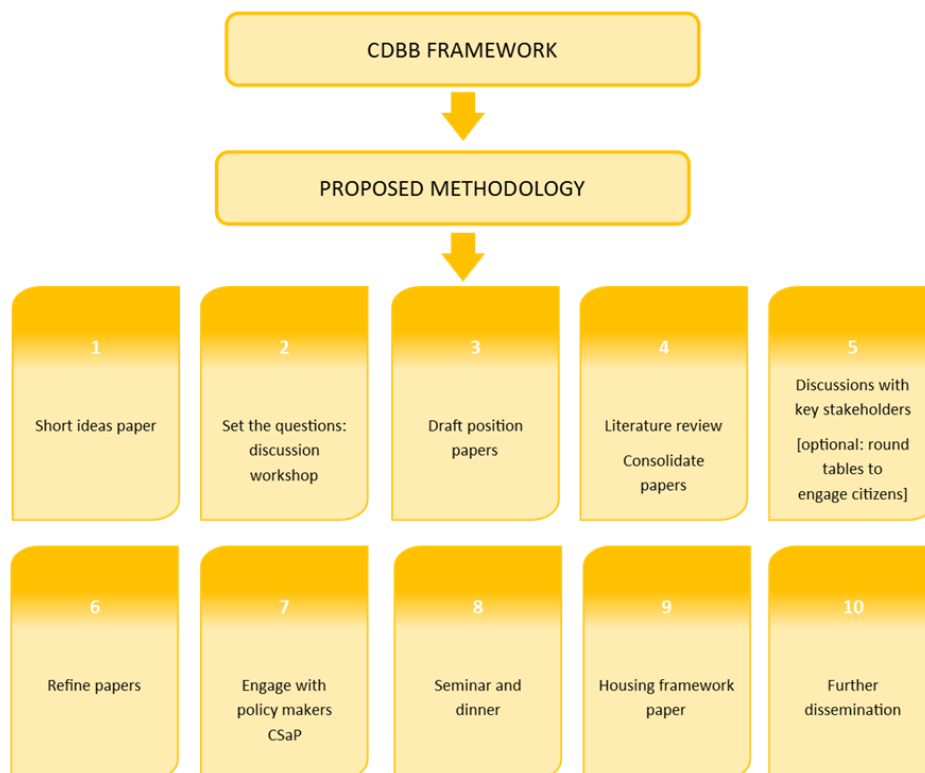
Figure 1 Methodology

2.   The Housing Network

The Housing Network ('the Network') partners include academics in the Department of Land Economy, academics across the University of Cambridge and academics beyond Cambridge, in the UK and internationally. We also have network partners who are practitioners, policy makers, industry bodies and those close to government. Figure 2 shows the makeup of the Network.
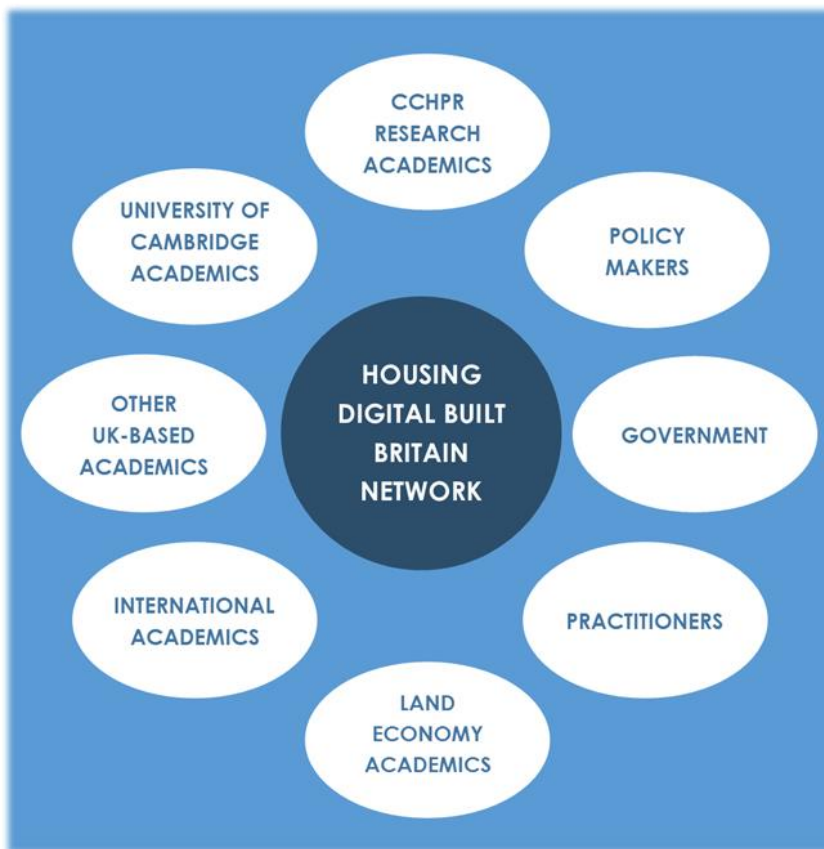

Figure 2 Digital Built Britain Housing Network

2.1. Outputs

The key outputs from the project are:

1. A network of stakeholders interested in housing and DBB
2. Scoping report from workshop 1
3. Four position papers on priority topics identified by the Network at seminar 1
4. Interim report
5. Final report

3.   Priority capabilities and questions

3.1. Four areas of focus

The first seminar of the Network was held at Trinity Hall College, Cambridge on 31 July 2018. It brought together 27 academics, practitioners and policy makers to work on the key issues in delivering affordable, sustainable housing in a Digital Built Britain. The aim of the seminar was to discuss:

1.   Key research questions and capabilities;
2.   The current research landscape;
3.   Discuss a priority list of topics for further focus;
4.   Identify potential collaborations and areas of interest.

We began with a discussion around the key questions that would need to be addressed to ensure UK plc has the capabilities to deliver sustainable housing in a DBB. The group identified the four following broad capabilities as priority:

1. Using digital innovations to meet the housing and care challenges of an ageing population
2. Developing digital innovation and better use of data in the planning system
3. Digitising housing production through off-site housing manufacture
4. Ensuring better housing governance, maintenance and management through use of data and digital technologies

3.2. Existing capabilities and research

The Position Papers focus on these capabilities. They scope out the existing research landscape and identify areas where there are gaps in knowledge for further research. The papers address:

1. How can digital tools and technologies support independent living for older people, now and into the future?
2. How could better use of data and digital technologies improve housing delivery through the UK planning system?
3. What is the role of off-site housing manufacture in a Digital Built Britain?
4. How will the UK govern, maintain and manage housing stock in a Digital Built Britain?

4. Research priorities: Using digital innovations to meet the housing and care challenges of an ageing population

We were asked to describe what research will be needed to underpin these capabilities, and to identify the priority for such research. In the following sections, we identify the research that the Network think is needed and indicate its priority.

4.1. Research to evaluate the impact and benefits of digital tools

There are two components to this research need. One is the need for effectiveness evaluation to provide a robust evidence base about outcomes of the support provided to older people by different digital tools and technologies. Following from this evidence base, there is a need for cost/benefit analyses of such digital tools and technologies. This will be useful in guiding investment.

There is little research on the more recent digital innovations in this field, such as 'smart' homes for older people, home sensor technologies and digital interventions focused on social interaction. The outcomes of existing research into the benefits of digital housing and care support remains mixed. Further good quality research is needed into this area to weigh up potential benefits (e.g. increased wellbeing, cost savings) against potential costs (e.g. dependency, increased isolation). Research should aim to identify which interventions work best for which people. A solid evidence base would give commissioners confidence to commission technology which is both appropriate and cost-effective.

4.2. Research on the attitudes and acceptance of new digital tools and technologies

More research is needed into the attitudes of older people to different types of technology. Attitudes vary significantly by country - for example, it has been reported that there are cultural differences between the UK and Japan which make it difficult to predict whether care robots will be as widely accepted here as they are there. It is also likely that different cohorts of older people in the future will have different expectations and desires from technology in their home. Further research is needed in this area to anticipate future demand.

4.3. Research on the integration of new technologies into a portfolio of services

More research is needed into how digital technologies will fit in with existing services and ways of working, including public service delivery. Research is also needed into the application of this technology into homes in different circumstances. For example, a greater number of older people are expected to age in the private rented sector and it is not known how applicable digital technology is to this group. If these technologies become widespread, it is likely that roles in the care sector are going to change dramatically. Further research is needed into the impact on this area, and how this sector should adapt.

4.4. Research on the ethics and unintended consequences of new digital tools and technologies

Various potential ethical issues with telehealth and telecare were outlined in the Position Paper. Research will need to be carried out in this area as the technology continues to develop and become more widespread, and the existing systems adapt around these developments. There are concerns that use of the technology may result in unintended consequences such as increased loneliness and isolation, and a decline in mental health, due to the reduction in face to face contact. Research should investigate this area.

4.5. Research into access to digital tools and technologies and inequality

Research is needed into the differential access to digital tools and technologies amongst older people. The fragmented nature of social care around the country means that telecare provision seems to be a 'postcode lottery' with services varying by geographic area. In particular, the four countries of the UK have taken very different directions in their provision of telecare. Research is needed into the provision in different areas so best practice can be shared and, ideally, access can become more standardised across the country. There is also a disparity in the technology available for self-funders versus social care recipients. Lack of awareness of the technology or how to access it may mean that there is considerable inequality in the services received by different older people. Further research is needed in this area.

4.6. Research on business model creation and the consumer market

Very little is known about the private economy in telecare, how many individuals privately purchase telecare services, what needs they have and whether these needs are being met.

More research is required on which products are most desirable and how telecare can reach potential users and beneficiaries. Research is needed into new business models through which digital support can be provided.

4.7. Research into whether new digital tools and technologies should be priority for investment

Older people are disproportionately more likely to live in poor quality housing, particularly when they live in socially disadvantaged areas. Research undertaken on behalf of Public Health England found that one fifth of all older household groups lived in a home that failed to meet the Decent Homes standard in 2012. The main reason for failure was that homes contained at least one Category 1 hazard under the HHSRS[1], such as excess cold and risks from falls. Physical home adaptations can be claimed by those who are assessed as having sufficient need but provision is patchy. Additionally, 780,000 households aged 55 years and over were in fuel poverty, which negatively impacts the physical and mental wellbeing of occupants. It is not known whether investing in digital technologies for the home is the right solution, when more basic provisions to aid health and wellbeing such as grab-rails and sufficient heating are not available to significant numbers of older people. Further research is needed into these areas to ensure that older people are receiving the help which best meets their needs.

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[1] Housing health and safety rating system (HHSRS)

5. Research priorities: Developing digital innovation and better use of data in the planning system

In this section, we identify the research that the Network think is needed on digital innovation in planning, and indicate its priority.

5.1. Research on the benefits of digitisation to planning

Although much has been written about the potential or expected benefits of digitisation on the planning system, there is little research on the exact benefits of digitisation and how they could be measured. Very often, expected benefits are listed (cost saving, time saving, increased efficiency), but there is little empirical or quantitative evidence on the cost or time-savings saving associated with the use of digital tools in the planning system. In the fields of digital facilities management (DFM) and Building Information Modelling (BIM), there has been some research and evaluation of such benefits: for instance, US-led research proved that using digital records might help to save 5% of the cost of the construction of newly built projects.

Similar research needs to be conducted and expanded, based on existing empirical evidence in the places already experimenting with digital planning, in order to measure the precise effects of digitisation on the planning system. Knowing more about how digitising the planning system would impact upon the pace of delivery or the affordability of the new stock would encourage a wider uptake of digital tools. It would incentivise Local Planning Authorities to engage with new digital platforms, tools and methods in order to meet the objectives set by their Local Plans. There is a need to engage with, evaluate and gather learning from industry leaders in innovation, but also from innovative Local Authorities across the UK and the world, and to disseminate this learning. To this end, further research needs to conduct impact assessments in order to determine which benefits can be expected and how they can be applied in different contexts.

5.2. Research on which parts of the planning process to prioritise for digitisation

Some stages of the planning process are more digitised than others: while most planning applications are now submitted electronically, implying savings in terms of costs and time, the digitisation of other stages of the planning process is an area that has been less well explored through research.

There have been significant improvements in the use of digital platforms for online consultation and community engagement, but in order to be aware of ongoing online consultations, residents must express their interest or frequently read the local press, which leaves many groups out of the information loop. There needs to be further research on how digital consultation can target groups which do not often have a say in the planning process.

5.3. Research on specific technologies: robotisation and Artificial Intelligence (AI)

Robotisation and Artificial Intelligence are central in the wider uptake of digital tools, particularly when it comes to the construction industry (with the use of BIM) and its application in city-modelling (in computer integrated manufacturing (CIM) technologies). The use of AI technologies has been investigated in current research on smart cities, for instance, in the use of sensors and prediction models for traffic congestion or parking spaces. However, there has been limited research on the direct use of robots and AI for urban planning purposes.

The extent to which robots can replace planners, or the benefits and risks of the uptake of AI in planning decisions (as opposed to human decisions), still need to be explored. More generally, there is a current lack of knowledge on the need for new skills in the planning system, on how robots and AI might address this lack, and what ethical issues this could raise. Little research has already been done on how AI might address the current flaws of the planning system - for instance whether it would allow a more objective decision-making process.

These new digital tools are, however, progressively being explored by Local Authorities: Milton Keynes is developing planning decision-making entirely based on AI, particularly for permitted development applications which only require technical assessments. In London, the Borough of Southwark is looking into the use of algorithms that will advise applicants on the likelihood of getting planning permission. Such innovative processes must be investigated by research, in order to assess their potential risks and challenges, as well as assessing their exact benefits.

Furthermore, although these digital tools have found an application in the construction industry, and possibly in urban planning more generally, little is known about their impact on the housing industry. Research must explore their ability to accelerate housing delivery or allow a more democratic decision-making process, based on local people's need for housing.

5.4. Research on the optimal regulatory framework level and coordinating innovation

There is a lack of research about the optimal level for the digitisation of planning, and how innovation should be coordinated. Although existing research has pointed out that the uptake of digital tools should be mentioned and explored further in national planning documents such as the National Planning Policy Framework (see Position Paper 4: Allmendinger & Sielker, 2018), it is unclear whether digital planning guidance should be provided at a national or local level. If it seems more appropriate to consider Local Plans as "key vehicles for the further roll-out of DBB and BIM given the position at the nexus of national policy concerns and local needs and issues" (see Position Paper 4: Allmendinger & Sielker, 2018), leaving local authorities a large room for manoeuvre may also generate inequalities between those who have resources to implement digital tools (such as London) and others who may lag behind.

There has been little research on how responsibility for coordinating and evaluating innovation should be attributed. If each individual LPA is responsible for adopting innovation and developing its own tools, then there is a risk of an increased fragmentation of knowledge, as well as scattered requirements and processes between different LPAs. This would make it harder and more costly for developers who often work across different LPAs. Data collection at a national level might also be hampered by non-standardised and heterogeneous innovative techniques in each LPA. This needs to be tackled by further research.

5.5. Research on the specific application of digitisation to the housing sector

The majority of existing research on digital planning focuses on the uptake of BIM technologies in the building and construction industry in general, or deals with the broad concept of 'smart cities' and the general advantages of digitisation in the urban environment, whether it is transport, the economy, or large infrastructure projects. There has been little research specifically related to housing. This needs to be explored: how can a wider uptake of digital tools in the planning system address the current housing crisis? Housing delivery is a main objective of planning, and future research should explore how the uptake of digital tools and better use of data might improve housing supply. For example, how might the systematic use of digitised data on local needs help in allocating the right amount of housing in the right place?

6. Research priorities: Digitising housing production through off-site housing manufacture

In this section, we identify the research that the Network think is needed on off-site housing manufacture and indicate its priority.

6.1. Research to develop and build a consensus around a taxonomy

Whilst much has been written about off-site construction generally, there is little information about how digital technologies are used in off-site manufacture. As identified by the House of Lords, off-site manufacture encompasses many different systems, and for the Government's presumption in favour of off-site construction to be understood and responded to, some taxonomy is required and needs to be developed through research in consultation with the industry.

6.2. Research to identify the nature and scale of the current provision of digitised housing manufacture

We do not have a comprehensive picture of the current market, who the existing providers of different types of digitally produced housing are, who is investing in new technologies, what types of digital tools and technologies they use, how many units they produce or aim to produce, and who purchases, or is expected to purchase, them. More work is needed to explore which areas of the housing market are currently most engaged with digital manufacturing and off-site production, for example, this might be the student housing developers, apartment construction, or production of bathroom pods, and which actors are driving this innovation forward. Many Housing Associations have been experimenting with new forms of off-site and modular homes, as have some volume house builders. Assessing the current market and its scale would be an important first step.

6.3. Research to understand the reasons why other countries are progressing faster with digitising housing production

The UK lags significantly behind other countries in the use of off-site housing manufacture and digital technologies in the low-rise residential sector. The UK has been slow compared to countries such as Sweden, Germany and the USA in its adoption of new technologies and use of data. Research is needed to review the reasons for this faster progress in other countries, and to analyse what lessons the UK might learn in order to stimulate wider uptake of digital innovation in off-site housing construction.

6.4. Research to evidence the outcomes of such housing to date

Useful research would be to explore and evidence the experiences of the construction firms who have been investing in and using digital technologies to develop off-site housing of various kinds (what the market is like, technical developments, digital innovations, scale and nature of production etc.), the experiences of purchasers e.g. Housing Associations (why go for this type of off-site, costs, benefits, challenges of data sharing, delivery and installation etc.), and the experiences of residents living in such homes (are the homes different, what are they like to live in, etc.).

An important issue to explore in research is costs, analysing not just the upfront costs of housing produced off-site but also the operating costs over the lifetime of housing assets, and the wider potential benefits of asset management, particularly for organisations such as Housing Associations, who frequently have extensive housing portfolios.

There is very little evidence of the outcomes of digital innovation in housing production. This includes information about build costs, running and maintenance costs and requirements, energy efficiency, and the experience of living in them, for example. What will the economic impact be of wider take-up of digital innovation in off-site housing? How might it impact upon small and medium house builders, for example, if the preference becomes for volumetric factory housing production? How can robust cost/benefit analysis be conducted? What role should government subsidy play?

6.5. Research to identify which digital technologies will make off-site housing viable

Some forms of off-site housing construction have been used for many years. More research is needed to identify the digital innovation and new developments in housing construction, and to identify where and how data and digital technologies play a role. For example, will the innovation come through BIM, new forms of factory production, or the robot bricklayers and 3D printed homes noted by Lloyds Bank?

Emerging digital technologies might have the potential to transform off-site construction into a more viable alternative to on-site construction, but it is not clear in what specific ways this will happen. More research is needed to identify the particular issues and problems that off-site might realistically solve. For example, whilst off-site may solve some of the labour shortages in the industry, new digital skills will be required for the off-site sector to flourish and this needs to be identified in further research.

6.6. Research to identify lessons from the UK's previous use of off-site housing on a large scale

The UK construction industry has experimented with off-site methods of construction before but these efforts have been widely criticised for the low quality of the building materials and the poor workmanship of this form of construction during the post-WW2 period. The UK should therefore learn from its previous mistakes to avoid repeating the same social and economic problems (e.g. lost identity, poor quality of design and construction materials, dullness and lack of variety in the products, etc.) in the ongoing digitisation of housing production. It is important to review the lessons of previous attempts to expand the off-site housing sector and ensure that learning is taken from this experience.

6.7. Research to identify supply and demand factors that shape digital needs

Technological and digital knowledge alone is not sufficient to develop the off-site housing sector. More data is needed about demographic and socio-economic changes over the next generations in order to assess what size and tenure of housing unit should be produced using new digital tools and technologies. For example, home ownership is declining and over 20% of the UK population now lives in the private rented sector, set to rise further over the next decade. In 2017, the build to rent market attracted £2.4bn in investment and it is forecast to grow by a further 180% over the next six years.

These wider changes in housing tenure, incomes, aspirations and housing need must be taken into account in developing the market for digitised housing production. Will people want to live in such homes? Public attitudes towards modular and 'prefabricated' housing are currently quite negative. This is likely to be because of the failures of prefabricated homes in the post-war decades, and because of little knowledge about modern off-site methods and house styles. How might such attitudes be shaped? Where does the greatest potential in the market lie, for example, will affordable/social housing and the build to rent market be where greatest uptake occurs first?

6.8. Research to identify the barriers and constraints

As described earlier, there are a range of issues which may constrain the development and success of off-site construction that are not related to specific technologies, engineering, architecture or design. There are issues around the structure of the house building industry, land supply, the planning system, finance, regulation and mortgage lending. Research is needed to analyse what challenges these issues in the housing supply chain pose for the

expansion of digitised off-site housing development, and to explore what policy and practice solutions might be needed to remove the constraints on the transformation of housing production.

7. Research priorities: Improving housing governance, maintenance and management through use of data and digital technologies

In this section, we identify the research that the Network think is needed on housing governance, maintenance and management in a Digital Built Britain and indicate its priority.

7.1. Research on impact and cost/benefit analysis 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 is 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 facilities management (FM) industry, constitutes a barrier to the wider uptake of digital tools. This should be tackled in research. There is 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.

7.2. Research on 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 anonymisation 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.

7.3. Research on the 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 is 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 and residents.

7.4. Research on access to 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).

7.5. Research on governance challenges

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 regulatory frameworks could be impacted by the uptake of digital tools, how will responsibility and ownership rights 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?

7.6. Research on the challenge of retrofit

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 barriers 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 of 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.

8. Summary of research priorities

The Network has identified four areas of focus where UK plc needs to develop stronger capabilities and invest in further research. There are similarities between the areas of research identified as the key priorities and they need to be considered together, not in silos. The key priorities for research can be summarised as:

1. **The interrelationships between housing demand, planning, off-site housing, management and the digital agenda**
   A key priority for research is thinking across issues and working across disciplines. The above areas of focus in the housing sector should not be considered in silos, but together. Research needs to consider how we might we link digital innovation and its potential impacts on housing demand, planning, construction, finance and business models, and housing management and governance. We need to consider what it would entail for the housing delivery system to become digitally transformed and data-driven, and how such transformations might open up new opportunities for housing models that are not yet the norm.

2. **Developing an evidence base**
   Research is needed to provide evidence of the benefits of digital innovation and investment. Research is needed to identify the outcomes from the use of digital tools and technologies in order to carry out robust impact assessment and cost benefit analysis. Case studies and demonstrators can also be identified through further research.

3. **Identifying innovation**
   Further research is needed to understand the current market, to identify those organisations investing in digital innovation, to understand their innovations and scale, their supply chains and the use of data and business models.

4. **Data security and ethics**
   Data security and ethics is an area where research is needed. This was a concern across all digital innovations in the housing sector.

5. **Regulation and governance**
   Regulation and governance was also identified as an area where further research is needed. New forms of data collection and digital innovations are a governance

challenge in housing, and it is not clear at what level interventions should be regulated, or how.

6. **Developing taxonomy**

   Taxonomy needs to be developed through further research. Categorising digital tools and technologies in different areas is a good first step.

7. **Retrofit challenges**

   The challenge of retrofit versus new build is an area for further research. Most of our homes are existing stock, but digital innovations tend to be focused on new builds, rather than integration with existing homes.

8. **Integration**

   The integration of digital tools and technologies with existing systems and services is a key area of future research.

9. **Unintended consequences**

   Another cross-cutting area for further research is the identification of inequalities and potential unintended consequences of digital innovation.

10. **Human barriers**

    There are clearly a wide range of non-digital barriers to implementation of digital innovation. These include issues of trust, awareness, skills, education and training and resources. Further research would help to identify how to overcome such challenges to ensure the benefits of digital innovation in housing are realised.

Cambridge Centre
for Housing &
Planning Research

Summary diagram of achieving better housing and planning in a Digital Built Britain

Enablers

Finance and business models

Resources

Skills

Awareness

Trust

Security/Ethics

Governance/Government

Technology/ Data processing systems

Supply chain

New public/private partnerships

Outcomes

Increased productivity

Improved health and well-being

Reduced costs

Housing delivery that meets needs

Improved housing safety and security

Housing and Planning in a Digital Built Britain (DBB)

- Data/ demand demographics
- Digital and data-based planning
- Feedback systems
- BIM
- Digital FM and governance, lifecycle BIM
- Digitally-enabled smart homes
- Digitised housing production

Research

- Key enablers
- Evidence from international examples
- Integration of each component in the system and how to develop linkages between them
- Evidencing the outcomes

Overcomes

Potential barriers or challenges

- Human barriers
- Financial barriers
- Technological barriers
- Ethical barriers

Capabilities

Digital tools and technologies to house and care for ageing population

Use of data and digital technologies in the planning system

Digitising housing manufacture and delivery

Housing governance, management and maintenance using data and digital tools