Dynamic lives - flexible homes

A Global Futures and Foresight paper prepared for the Bromford Group

Introduction

With the economy and social lives increasingly virtual, housing remains one of the few physical barometers of just how the convergence of multiple future trends will impact our personal lives. Environmental, technological, social and financial trends, not to mention political positions, will all shape and reflect the future of the home – both externally and internally. It is also a key international issue. Between 2011 and 2050, the world population is expected to increase by 2.3 billion, passing from 7.0 billion to 9.3 billion. At the same time, the population living in urban areas is projected to gain by 2.6 billion, passing from 3.6 billion in 2011 to 6.3 billion 2050[i]. Simultaneously the processes of work and education are undergoing various processes that ultimately enable them to be more footloose. The same technological processes are enabling the home to become a pseudo-environment for what would once have been considered specialist spaces, such as a doctor's waiting room or even a hospital bed. A range of changes to the form and function of the home looks set to take place, in part because of the growing environmental and associated economic cost of inertia, but also thanks to the possibilities evident in an increasingly connected society and built environment.

Demography is destiny

Ageing of the UK population is projected to continue. By 2035, it is estimated that the median age will have risen to 42.2 years, an increase of 2.5 years in the quarter century after 2010[ii]. The number of people of ages 65 and over could increase by 23 percent from 10.3 million in 2010 to 12.7 million in 2018. Growth in this age group is projected to continue for the foreseeable future, with the 65+ population expected to reach 16.9 million by 2035. The rate of increase means that within 20 years 50 percent will be over 50[iii], and those over 65+ will constitute 23 percent of UK population by 2032[iv]. By 2035 it is projected that the number of people aged 85 and over will be almost 2.5 times larger than in 2010, reaching 3.5 million and accounting for 5 per cent of the total UK population[v]. Although ageing is perhaps the most obvious way in which home form, function and use could change, issues of boomerang children and declining family sizes will also shape the contours of what the future population wants and needs from its housing stock. For example, the number of single occupancy households is expected to increase by almost 20 percent to 26 million by 2026 (from 2006)[vi]. Irrespective of how these interact, the need for more

sustainable and flexible options is pressing as UK retrofitting for people who become disabled already costs £350 million per year[vii]. With an ageing population, this figure is set to rise dramatically unless standards are adopted that make houses more adaptable from the outset.

Social change

The decision as to where we live will also impact how we live. Living close to work is more important to Britons thinking about moving or buying a new home than being near friends and family. Figures from Santander research reveal that a quarter of Brits looking to buy a new home in the next five years would be happy to pay a premium of more than £5,000 for a property that made their daily commute less punishing. Of course, the teleworking trend could likely upset this current hard held view.

However, living in the same neighbourhood as friends and family did not even make the top ten on their list of priorities[viii]. This suggests that close social ties are not as important for many as is perhaps assumed. The impact on house design could be far reaching in terms of how space is utilised. Work stress could play a key role in shaping these trends – with 32 percent of UK companies indicating that employees often experience excessive pressure in their job[ix]. Indeed, research suggests that 34 percent of UK adults feel stressed on a daily basis as a result of their financial situation. This is followed by fourteen percent who state they are most stressed out by their health, and a further thirteen percent by their job[x]. In part due to the range of worries evident in society, convenience, customisation and flexibility and value have become key consumer buzzwords and these will help shape and contour the future of housing construction.

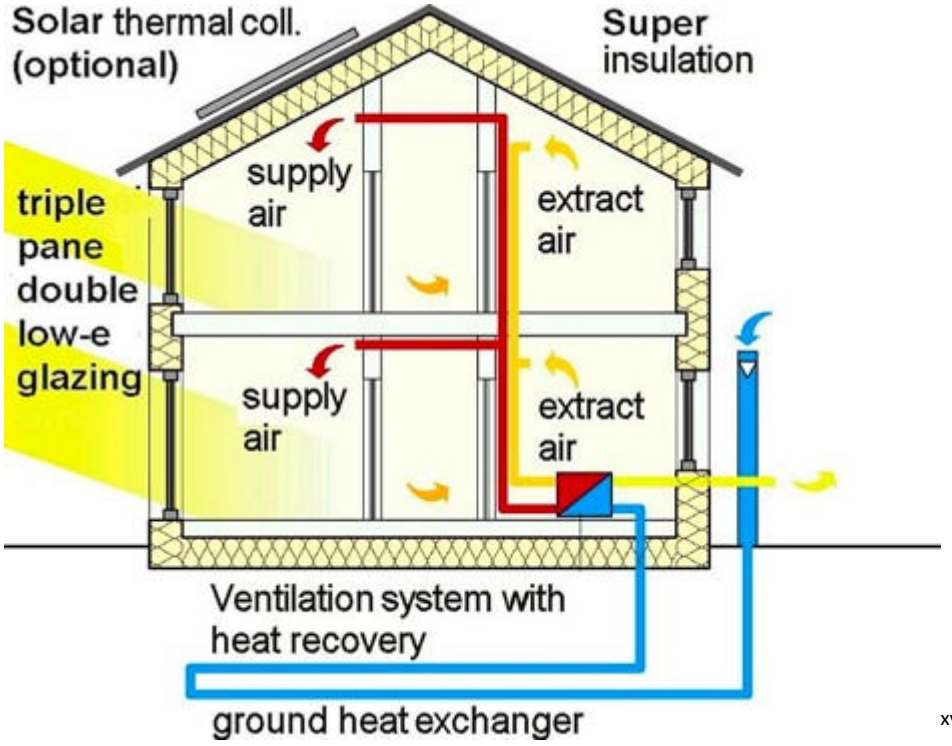
Environmental challenge

Given that the global built environment is responsible for 30-40 percent of global energy consumption, 30 percent of greenhouse gas emissions, 3 billion tonnes of raw materials used annually and 20 percent of global water usage, there is an evident need for inbuilt sustainability. Although the bulk of future population growth will occur in emerging economies, the need for the UK to rise to the environmental challenge is of no less import. The construction industry consumes around 6 tonnes of materials per year for every person living in the UK, whilst the industry sends 36 million tonnes of waste to the landfill each year. Housing alone generates 27 percent of UK emissions, of which 73 percent is used for space and water heating[xi].

It is estimated by the UN[xii] that current standards of green buildings can deliver a 30-50 percent reduction in energy use, a 35 percent decrease in carbon emissions, a 70 percent decrease in waste output and 40 percent reduction in water usage. It should also be noted

that carbon emissions from UK buildings must fall by 77 percent by 2050 if Britain is to meet its carbon reduction targets[xiii].

Emerging processes and principles promise to further enhance the sustainability of new housing stocks. 'PassivHaus' construction techniques, developed by the PassivHaus Institute in Germany, aims to embed high levels of energy efficiency into a house whilst in the construction phase. Using 90 percent less energy for heating and cooling than a typical UK house, such buildings can cost as little as £75 to heat a year[xiv].



[xv]

Building to PassivHaus standards reportedly costs 14 percent more than conventional construction methods but the typical payback period is around 14 years[xvi] and could fall further if 2012 predictions come true that British household electricity bills could rise by more than 50 percent by 2020[xvii].

Emerging materials

One of the ways in which houses may become more energy efficient is through an expanding range of new building materials. Self-healing coatings have already been developed '...that sense cracks and use tiny capsules filled with resins to fill the damaged areas with a new layer of the shell[xviii].' Self-healing concrete has also been produced, using

bacteria to help form a 'bio-concrete,' a substance that fills in its own cracks and holes. The bacteria grow into cracks as they form, releasing calcium carbonate, a substance similar to limestone. Advances in material science is not confined to the exterior cladding, rather we are witnessing a redesign of the home in its entirety in an attempt to make them more sustainable, economically, environmentally and in terms of personal health. German researchers for example, have developed a method of infusing mineral compounds with zeolites into particleboard that reduces formaldehyde emissions by 40 percent[xix]. These given examples, are in effect, forms of 'living' architecture.

Biomimetic / living architecture

They do not however represent the notion of living architecture in its totality. A societal desire for personalisation will necessitate a degree of flexibility in both the structure and design of houses previously deemed impossible. Biomimetic architecture is a proven concept that combines high-tech ideas with basic cellular functions to create 'living' structures that operate like natural organisms. In it the exterior of buildings, such as houses, is a living 'skin[xx],' which can respond to allow light, air and water into the structure and reduce the need for artificial heating, cooling and lighting.

3D Printing

3D printing could also usher in a new era of housing, with Danish architects having used a computer, a printer and 820 sheets of plywood to build a 125 square meter home in four weeks. The designers and fabricators have been touting the process of mass-customising houses and responsibly producing them on site. The project uses no concrete, structural steel is minimal and sustainably forested wood is the only wall material used, with the exception of glass windows[xxi]. Although the profusion of radical new designs that frequently appear, it is quite possible that the standard house as drawn by children will look similar in the future, albeit with cutting edge materials and processes used in their construction. 3D printing has already demonstrated the ability to move into materials other than wood. Professor Behrokh Khoshnevis at the University of Southern California, for example created a layered fabrication method dubbed Contour Crafting. This can be used to build a single house or '...a colony of houses,' using such materials as concrete. In this process, concrete pours out and is set down layer by layer, like a typical 3-D printer would melt plastic layers together, allowing a quick and customisable method for constructing housing[xxii].

Redesigning the old to create the new

The holistic nature of the revolution in material sciences extends into decor. Kinetic glass[xxiii] (also known as living glass) monitors carbon dioxide levels in the ambient environment and responds to optimise levels. The surface is embedded with wires that contract due to

electrical stimulus and thus allows the glass to 'breathe the air' and help purify it. Other health benefits could be found in the move towards translucent concrete. 'Translucent concrete is mixed with (4 percent) glass fibre optical strands,' that allow light to pass through the structure and help provide greater levels of natural light in the home. Greater levels of natural light have been associated with quicker recovery times for patients and greater work productivity – both of which could increasingly occur in the home, as opposed to a hospital or office environment as economic and technological trends evolve further. For example telehealth allows patients to be diagnosed and treated without having to leave their own homes, whilst increasing numbers of people are basing their business from their own homes *(see later in paper).*

Changing form

The revolution in building materials is being accompanied by an evolution in building processes. In 2011 China's Broad Group demonstrated their rapid building technology by constructing the 15-story Ark Hotel in less than six days. Using a team of 200 workers the structural framework was erected in just 46.5 hours and the external cladding and internal non-structural surfaces were completed in another 90 hours. It was reported that '...the Ark Hotel used one sixth the material of an equivalent sized building with a cost saving of 20 percent while still being able to withstand a 9.0 magnitude earthquake. In addition the building uses several technologies to result in energy efficiency five times that of comparable buildings. This includes triple pane windows, external solar shades, 6 inches of thermal insulation, heat recovery ventilation, and LED lighting systems[xxiv].'

A key design tenet for the Ark hotel was the use of prefabricated modular pieces. Mashable even opines that '...the development of sustainable, modular, immediate architecture is key in creating a habitable urban environment[xxv] .' Ideabox, based in the US, has an aim of providing '... an efficient, high tech and sustainable prefabricated home that is not only totally customized to your daily needs, but comes at a fraction of the cost of a traditional home.' One critical aspect of modular homing is the notion of flexibility, a term central to an emerging school of thought and exemplified by the SuperFlex system[xxvi]. The system itself refers to housing components that can be reconfigured for completely different user oriented purposes. 'Structurally, the SuperFlex has been divided into three separate zones: the indoor, the semi-outdoor and the outdoor. The indoor space follows the conventional ambit of privacy, though the segregation components (like the walls and panels) are mobile for adjustable re-arrangement on the part of the user. The essence of easy accessibility is maintained by usage of pliable materials such as plyboo, translucent polycarbonate and transparent glass sliding doors and windows.'


[xxvii]

The overall modular system allows for each of the individual spatial elements to be personally and effortlessly classified according to a specific function or user desire, which can change from time to time. This in turn efficaciously regulates the usage of power and resources, in relation to the building capacity. Moreover, the designer has also thought of certain structural attributes for usage of renewable energy. For example, the flexible roofing system can be embedded with solar panels for 'clean and green' electricity.

Changing function

Despite some of these technologies and processes having been around for years now, cost has long been an impediment. However Dr. Tobias Bube from Rolf Disch Architecture suggests that the additional cost for constructing a net-zero-energy home is only 7 percent to 10 percent more than that for construction meeting the minimum energy efficiency standards required by codes in Germany. Dr. Bube added that net-zero-energy construction can reduce heating and cooling costs by 90 percent for a 100 m2 home, bringing the payback period for energy conservation technologies under 10 years.

Rolf Disch utilizes technologies such as daylighting, passive solar heating, insulation better than R 10/inch, and zoning in windows. It also uses solar photovoltaic energy for on-site generation. A combination of high electricity prices and strict building energy conservation codes have made Germany the first geography where net-zero-energy buildings (NZEBs) can potentially take root even in the residential segment[xxviii]. Even in jurisdictions with lower electricity prices and lower energy conservation standards, it would seem that elements of NZEB's could still prosper. Indeed, companies like GE and IBM have gone so far as to predict that within a decade, up to half of American homes will be generating their own renewable electricity[xxix]. The notion of housing developments generating energy, as opposed to being net users is one that is beginning to gain traction in Japan.

Innovative housing '...with a zero energy bill,' is the goal of the Akaishidai housing community, which aims to sell surplus electricity to power companies[xxx]. Using a combination of fuel cells and solar power generation, it's estimated this housing community will soon be able to generate 2,508 MWh of electricity a year, 70 percent more power than Akaishidai and its 2,650 people need. In effect the community is a local power plant, and given that Akaishidai is part of a wider trend within the country, the possibilities of mass produced local energy have far reaching consequences.

In the UK, South Shields recently became home to Sinclair Meadows – a community that may well be the most environmentally conscious in the country. The development is carbon negative, which means that within three years the carbon footprint from the construction could be negated.

Inhabitat[xxxi] reports that '...Each of the buildings at Sinclair Meadows in South Shields has been constructed with natural materials at the forefront, such as timber frames, hemp insulation, lime render, and sustainable timber. In addition to creating a solid structure that helps lock in CO2, these materials are largely recyclable or biodegradable if and when the buildings are not in use. The architects have oriented the houses to the south to maximize natural light and allow the sun to heat the interior of buildings. Each roof is also equipped with photovoltaic panels, and the electricity demand for the street should be covered on-site. The building feature a high degree of thermal insulation, so their heating requirements should be easily covered by a communal biomass boiler that runs on recycled wood pellets for fuel.'

Adapting to the internet age

The idea of the home becoming a chief economic centre is not confined to the possibilities of power generation either. Given that the number of home-based businesses has grown by 28 percent over the last decade to a figure of 2.43m in 2012, the home is already the new business centre for many in the UK[xxxii]. This translates as 18 percent of all homes being used to run a business. Beyond the headline figure however, statistics show that 24 percent of owner occupied homes are used to run a business, whilst only 10 percent of social housing homes do so. This disparity suggests that future changes in function may be more applicable, at least in the UK, to those individuals in owned homes. There are other differences between social and owner homed housing, with connectivity being a major one. The home of the future is in many ways predicated upon connectivity, and whilst mobile internet rates are increasing, in-home internet access remains critical. 47 percent of adults living in UK social housing have no in-home Internet access[xxxiii]. Not only does this impact the ability to work out of one's home but households with no internet access miss out on savings of £560 per annum that could be achieved by shopping and paying bills online[xxxiv].

These missed opportunities look set to increase in number and value. In the next three years more than 20 percent of UK adults are predicted to start a business. Already some 1.8 million people in Britain combine working for themselves while working for an employer, and such actions almost always require, or benefit from, internet access[xxxv]. Education is also adopting a more virtual interface. 284,505 people were studying at a UK higher education institute through distance learning in 2011 and some 30 percent of North Europeans in general pursued some sort of dual mode learning that combined distance (online) and in person learning[xxxvi]. By 2020 there will be a projected 120 million students worldwide in higher education[xxxvii] and informal education online, such as via the non-profit Khan academy is also proliferating. As the home becomes increasingly connected, the opportunity cost of not having the internet will increase, and as work and learning become increasingly virtual, any digital divide could limit the opportunities of those on the wrong side of it.

Housing gets smart

The projected annual spending on smart city technology will reach $16 billion by 2020[xxxviii], and whilst transport infrastructure and other buildings are key components, given the physical volume of housing stock, the home of tomorrow will be a critical component of the smart city. The uncabled home is not so much a future possibility as a current reality. 'Theoretically, the technology is already there,' says Peter Cooney, an analyst at ABI Research in London[xxxix]. 'But there needs to be something to motivate consumers to get it into the home. And there's no one system to pull it all together. It's early days.' Several components of the system are already visible. The Nest is a wireless thermostat that adjusts home energy use for maximum efficiency. Sales levels of the $249 thermostat since the October 2012 launch in the US have meant that the item has been out of stock until January 2013 – indeed in the first three days, the company, Nest Labs of Palo Alto, California, sold what it thought it would sell in three months[xl]. In addition, several companies offer air-conditioning, security and irrigation systems that are managed by iPads and other smart devices.

'Improving the efficiency of homes with wireless Internet connectivity is where the industry is headed[xli],' says Robert Kleiman, the co-founder of Structure Home, a custom builder in Los Angeles. IHS suggests that the number of homes worldwide with ethernet connections, which is necessary for Wi-Fi, will double to 800 million by 2016 from 400 million in 2012. It also expects the number of low-power, low-bandwidth networks essential for monitors and always-on sensors to surge to 28.8 million by 2016 from 3.3 million in 2012.

The next step?

However the potential for connectivity in the household eclipses some of the more prosaic features appearing ad hoc in homes, such as appliances that communicate their status to you. An engineer at Washington State University thinks that the future home will not only be able to respond to, but predict its inhabitants' wishes by learning their habits. The possible implications of this are far reaching - with the house potentially able to spot early signs of cognitive decline, for example. 'Smart home systems could preserve an independent lifestyle for people who, because of age or illness, can't control or remember all the functions in their house. The home could remind them to take medications, or it could feed the cat for them and check the lights and windows after they've gone to bed[xlii].' It is also possible that a fully integrated smart system could monitor health signs by proxy – for example, people older than 65 change their walking speed just before experiencing cognitive decline. By assessing inhabitants' movements it is possible that a future smart home could spot precursor signs of ill-health and alert the owner or other stakeholders.

Wired for success

According to the company, the Microsoft Home is '…a place to explore technology scenarios that could transform the way we live in five to 10 years[xliii].' Built as a full-scale model home in the company's Executive Briefing Center, the Home features such advances as

- Touchscreens, wireless and 'smart' charging plates that also read sensors in your products to interpret your personal data, including vital health statistics
- Interactive walls consisting of various screens – which are in turn controlled by a simple flip of a light switch
- Visual analysis via image-to-image search for each image featured in your home entertainment screen (i.e., ability to search for travel schedules, restaurant information)
- Motion-controlled digital wallpaper capturing your personal digital ecosystem, including real-time texts, Facebook status updates or Twitter feed updates

The social revolution[xliv]

Designers Alastair Parvin and Nick Ierodiaconou have started exploring practical applications of their philosophical commitment to a more democratized design movement. Mr Parvin argues that '…For too long, cities have been made by the 1 percent and consumed by the 99 percent. We wanted to see what it would take to create something that would allow the 99 percent to make cities for the 99 percent.'

 [xlv]

The blueprint, dubbed ‘wiki-house’ allows everyday people to build their own homes using open sourced designs and locally sourced materials. Their designs and assembly directions have been uploaded online and they have encouraged anyone to try it out, iterate on it, and upload their own ideas. Since they first initiated the project, five prototypes have been assembled.

Financing the future

However, the ability of the home(s) of the future to be realised in great numbers depends greatly on the overall housing market. A study by the Future Homes Commission, a body instigated by the Royal Institute of British Architects (Riba), has concluded that building 300,000 extra homes every year on brownfield land (compared to the current 100,000) would help instigate a ‘housing revolution.’ The report also suggested that some of the assets in local government pension schemes could be pooled to provide a £10bn housing fund[xlvi].

It also concluded that a greater focus on design in all new homes was needed ‘...to ensure they met residents' needs, making them fit for future generations and attractive to UK and international investors to allow the Local Authority pension funds to recycle their investment[xlvii].’

The president of the Royal Institute of British Architects, Angela Brady, said the commission's recommendations ‘...provide an excellent starting point for delivering a

radically improved housing market[xlviii].' However, in addition to financing, the possibility of a skills deficit could block the rapid progress envisioned and hoped for. John Alker of the UK Green Building Council says that the green skills deficit is the major challenge facing the construction industry[xlix], which could be a major impediment given that carbon emissions from UK buildings must fall by 77 percent by 2050 if Britain is to meet its carbon reduction targets[l].

Conclusion

Academics Schnieder and Till ask '…why, to put it simply, would one not design for flexibility and adaptability[li],' given that the housing market tends to volatility and is subject to a range of cyclical, non-cyclical and trend changes. These changes highlight the risk of obsolescence, or at best, poor utility as lives are dynamic, in contrast to the homes in which they take place. A new era of emerging material, construction methods and processes and widespread connectivity is already upon us. Pulling these threads into single harmonised structures that enable more flexible, customised and sustainable living are within reach, but still constrained in their extent and penetration. Resolving market imbalances and skills deficits are crucial if the promising homes of tomorrow are to become a common reality.

About the Bromford Group

Bromford is a social business that inspires people to be their best. Through our range of housing and support services we help customers and colleagues to achieve ambitions and succeed at reaching personal goals. Whether that's getting in to training, volunteering or employment, owning or renting a home, getting life back on track or simply living independently - we're here.

We don't work to a mission, vision and values. Instead we look for colleagues who share our DNA, the principles of which are; Be Good, Be Brave, Be Different and Be Commercial. These are the guiding principles that shape our every decision and action.

It's a culture thing you see. We've done away with head offices and managers, and instead have commercial and brave leaders who lead teams of like-minded colleagues. It's this great mind-set that makes us different and has ensured we've built up 50 years of heritage through homes, support and much more.

http://www.bromfordgroup.co.uk/

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Global Futures and Foresight (GFF) is a strategic futures research organisation. The aim of GFF is to develop views of the future to help their clients embrace change with more certainty thereby releasing the full power of their creativity and innovation. GFF helps its clients to reduce their risk of being blindsided by change and to be better enabled to adapt to the fast changing world. GFF clients number some of the largest and most prestigious firms from around the world including: NATO, HSBC, Lloyds/TSB, RBS, Lloyds, More Th>n, e-sure, Kraft, Mars, Steria, CSC, Unisys, Cisco, Microsoft, Siemens, Equinix, Intel, Deloitte, Ernst & Young, PWC, Royal Mail, Bausch & Lomb, Bromford Group, Linpac, Kraft, Heinz, SAS airlines, Philips and many other businesses, associations, institutes and academic institutions.

www.thegff.com

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