From Smart Homes to Cities and Back

– How Smartness Shapes Residential Buildings

White paper

Fortum

SmartLiving

DEMOS EFFECT

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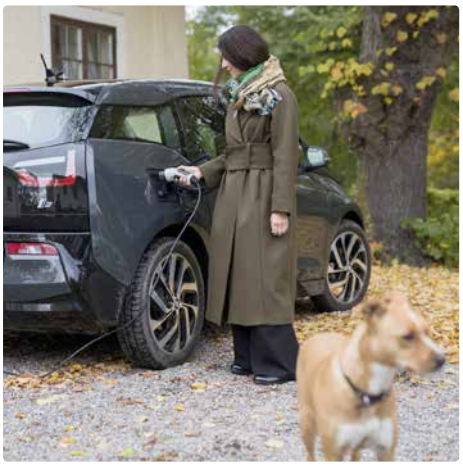
Abstract

ACTORS IN THE FIELD OF BUILT ENVIRONMENT are being forced to redefine their business in the wake of a multitude of trends. These changes include urbanization, changing values and servicification of living as well as emergence of sensor technologies, 3D printing and robotisation. The climate change acts as a fundamental driver for the transformation, creating pressure for decarbonising the energy system, enhancing resource efficiency and emission reductions. Smart infrastructure is a crucial enabler for a resource smart urban environment and it creates means for residents' active participation. Accelerating development of technologies will provide us with unprecedented tools to shape our living environment. The variety of stakeholders in the field creates imperative for smart solutions with open interface as well as standardised and shared data, and encourages cooperation among actors with different competences. This plays a crucial role in allowing different actors to develop interoperable, personalized and life-improving services for smart homes. In addition, smartness gives developers and constructors an opportunity to expand their market and potential to boost their profits.

Overview

WHAT ARE THE MAIN DISRUPTIONS in the built environment and more specifically in apartment buildings during next five to ten years? What are the biggest opportunities and threats related to them? Where do the opportunities for value creation lie in the future? Demos Effect and Fortum's SmartLiving unit conducted a study to answer these intriguing questions. During the project, a background study was conducted to identify central megatrends affecting the built environment and to define their possible impact on residential buildings. In addition, 13 stakeholder representatives from Finland (9), Sweden (3) and Poland (1) were interviewed to test the hypotheses and gather information on their views of the future market and service offering. Interviewees were typically from companies involved in property development. This paper presents the key factors driving the industry transformation, highlights the main challenges in transformation and provides an illustration of 'smartness' in residential built environment. In addition, a few case examples are presented. During the project, "smart living" was defined as the collection of technology and practices that make life easier and optimize the use of the built environment.



Changing landscape creates imperative for built environment transformation

ACTORS IN THE FIELD must understand the importance and scope of changes driving the transformation of the built environment in order to maintain their relevance in the future. Three key drivers for change were identified during the project. First, climate change acts as a fundamental driver for the transformation, creating pressure for decarbonizing the energy system, enhancing resource efficiency and reducing emissions. Second, prevailing trends like urbanization and aging population shape the roles of cities and change the demand for services regarding to living. Finally, new ways for optimizing and developing our living environment arise with the emergence of sensor technology and big data.

Decarbonization of the energy system and active participation

The climate change affects our society on a fundamentally different level compared with the scale and scope of the other prevailing challenges as it threatens the critical life-supporting systems. The rapid changes in the global ecology force societies to drop GHG emissions in order to prevent the collapse of life-supporting ecological systems. For instance, the EU's ambitious long term goal is to cut the emissions by 80-95% compared to 1990 levels by 2050, accompanied with important intermediate milestones of emission reductions, renewable energy and enhanced energy efficiency by 2020 and 2030 (EU Climate Action). In consequence, energy efficiency regulation in EU countries has restricted and will likely continue to do so. Some examples of that include the updated Energy Efficiency Directive, which among other things states that energy consumers should be empowered to better manage their consumption, and nearly zero energy requirement all new buildings in Finland face by 2018 (Finnish Ministry of Environment, 2017). The 21st century should mark the end of fossil fuels which will gradually be replaced by energy from decarbonized and renewable resources.

"An increasing proportion of people's income is spent on living, transportation, energy, food and health, which creates new opportunities for value creation on one hand, and paths for active participation through consumption on the other hand."

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Urbanization, ageing population and changing values are shaping the services regarding to living

Megatrends like urbanization, aging population, and people's changing values highlight the crucial role of cities as a platform for change and shape the demand for services regarding to living. Accelerating urbanization strengthens the role of cities as global players as sustainable development challenges will be increasingly concentrated in cities (United Nations, 2014). Currently, over half of the world's population lives in cities and by 2050, the proportion will increase to 66% (United Nations, 2016). People are increasingly interested in participating in solving societal problems and there is a perception of a shared responsibility for dealing with climate change amongst consumers (Wells et Al., 2011). An increasing proportion of people's income is spent on living, transportation, energy, food and health (Statistics Finland, 2012; Eurostat 2017), which creates new opportunities for value creation on one hand, and paths for active participation through consumption on the other hand. However, our work indicates that consumers' opportunities to influence are scarce when it comes to living as many decisions made on the home level have only incremental impact. Both citizen participation and transparency of the built environment industry can be enhanced through developing smart solutions that enable ethical self-management and deliberative engagement (Carcassone, 2016; Giesler and Veresiu 2014)

Sensor technologies and big data as unprecedented tools

Rapid advances in sensor technologies and the growing benefits of big data provide us with unprecedented tools to manage, optimize, and develop our living environment. Smart infrastructure is a crucial enabler for building resource smart and sustainable urban environment. If cities have good institutions, functioning infrastructure and they are able to adapt, they can significantly enhance productivity (Frick and Rodriguez-Pose, 2017) and quickly scale the best practices and operating models. The future will be shaped by our ability to take advantage of the powerful technologies and create common goals.

A hot housing market, incremental benefits in the short-run and lack of organization-wide motivation are hindering the willingness to take action

SMART INFRASTRUCTURE is necessary for enabling resource smart urban environment and active participation of the citizens. Thus, long term investments in the smart infrastructure are required from the developers, constructors, property owners and government bodies. However, the current situation in the housing market does not create incentives for companies to invest in long term development as the housing market has been growing significantly in all Nordic countries during the past years and the national average house prices have risen significantly: 71% in Norway, 59% in Sweden, 17% in Finland, and 3% in Denmark (Nordea Markets, 2017). Consequently, apartments and buildings built in the traditional manner can easily be sold, and even though actors in the field of built environment perceive smart solutions as probable state of the future they do not feel particular pressure to revise their business right now.

Grounds for energy pricing are changing

Our findings indicate that in Finland, a majority of the developers think that end-customer is not currently willing to pay extra for smart features in their traditional form. This assumption was mainly justified by the prevailing energy pricing model, as monetary benefits that can be achieved by optimizing consumption are not substantial enough to drive people's behaviour. However, the grounds for energy pricing are changing as we speak due to the strong increase in the share of intermittent energy production that likely shapes the way energy is priced and therefore stresses the weight of potential monetary benefits for the end customer (Koistinen, 2017; Auvinen, 2016). This has been recognized by the leading developers as for example Bonava and YIT have already taken action in testing or implementing the future solutions (Fortum, 2017; YIT, 2017)

Green values rarely strong enough motivation to take action

In addition, part of the interviewees doubted the strength of green values as a motivating factor for adopting smart homes. Even though green values are considered to be important by an increasing number of consumers (eg. Do Paço et Al., 2009), our results highlight the need for stronger motivation to take action, as green values alone are not enough to drive people's behaviour. This aligns with the findings of Ozaki's study on adoption of sustainable innovation (2010), which suggests that consumers sympathetic to environmental issues do not necessarily adopt green innovations due to lack of strong social norms and personal relevance, inconvenience of switching, uncertainty about the quality and lack of accurate information. Therefore, the winning solution must provide greener future complemented with other benefits for the customer. Our study indicates that these other benefits can be best captured by focusing on creating convenience of life.

Drivers for change in property development are external

In fact, current drivers for change in property development seem to come from external forces. Regulation, newcomers entering the market, changing end user needs and property operator requirements push developers and constructors towards accepting the ever-increasing standard of smartness. Although the built environment players recognize the imminent change, a thorough and organization-wide understanding of its implications for business is lacking in most cases.

"Regulation, newcomers entering the market, changing end user needs and property operator requirements push developers and constructors towards accepting the everincreasing standard of smartness."

Smartness as an enabler for resource smart cities and people's active participation

UNDERSTANDING THE CHANGING OPERATION LOGIC of built environment is crucial for businesses. Homes will not be just homes in the future rather than crucial components of wider smart infrastructure. New actors like IT giants Google and Apple enter the industry (Molina, 2014), new ownership models gain ground (Velasco-Fuentes, 2013) and novel technologies arise (Balch, 2017). These developments will change the way value is created in the built environment, which poses a direct threat to some companies and challenges them to rethink their business. Homes cannot be seen as a separate entity when changes shaping our landscape will force us to restructure societies and cities during the upcoming years. For instance, a shift towards renewable energy driven by the climate change requires readiness for demand response and energy storages. Smartness connects homes and individuals to the larger transformation of the landscape and plays therefore an integral role in the functioning infrastructure of the future.

Case 1: New entrances by non-traditional and emerging companies

TRADITIONAL ACTORS in the field of built environment need to recognize the potential of new actors entering the market. Smart home solutions are being developed by companies whose main business has traditionally lied on other fields as for example energy company Fortum enters the market with SmartLiving and IT giants Google Apple and Amazon present their own solutions Google Home, Apple HomeKit and Amazon Echo. These entries push traditional built environment actors to redefine their business model and revisit their service offering in order to maintain their relevance in the future.

Four interconnected layers: smart city, smart district, smart building and smart home

Smart infrastructure can be considered through four interconnected layers: smart city, smart district, smart building and smart home. Based on interviews conducted during the project, a smart home by definition includes technologies and practices that make life easier, optimize the use of homes, and allow homes to interact with systems physically outside home but closely linked to living. Smart building in turn leverages the sensor technologies and data to optimize the usage of an entire building. Thereby, smart buildings leverage the features of smart homes and connect them to district and city level (Building Efficiency Initiative, 2011). A smart district is a unit that has capacity to aggregate home and building level features, while physical proximity contributes to creation of communities. Thus district level is ideal for the development of energy communities and decentralized energy production that can benefit from the best features of both distributed and centralized energy systems (Hirvonen, 2017). District level allows experimenting new service models for example in smart mobility, which highlights its relevance also for the city level systems and actors (Fraunhofer Society, 2017). Finally, smart cities use different types of electronic data collection and sensors to supply information used to manage assets and resources efficiently (Cohen, 2015).

"Smartness connects homes and individuals to the larger transformation of the landscape and plays therefore an integral role in the functioning infrastructure of the future."

In order to create conditions for successful transformation towards resource-efficient urban space, action on all of these layers is needed.

While consumers are increasingly willing to make a difference and participate in solving societal challenges, their opportunities to influence are low when it comes to living. Majority of the interviewees recognized the fact that decisions made on the home level have only incremental value and the benefits for individual residents remain low from both a monetary and an impact perspective. In order to support responsible consumers and create motivation for responsible consumption, communities need to build the capacity for deliberative engagement (Carcasson, 2016) and develop a market for products and services that enable ethical self-management (Giesler and Veresiu,

2014). Smart homes have potential to empower residents to grasp an active role in their living environment and to provide the link from individual homes to a larger context of the transition. This makes actors in the field of built environment important gatekeepers of the participatory future cities.

Case 2: Providing platforms for residents' active participation

RESIDENTS' ACTIVE PARTICIPATION in developing urban environment and tackling future challenges might require further measures, but some actors in the field of built environment are already taking big steps towards the right direction. For example, Swedish urban environment developer Atrium Ljungberg has experience on both providing people platform for participation and nudging them towards more sustainable lifestyle.

For instance, Atrium Ljungberg arranges markets in the areas they are developing, inviting people from the neighbourhood to enjoy the program and simultaneously providing a platform for dialogue about future needs of the residents. This has led to for example adding more shared spaces to the properties. In addition, Atrium Ljungberg considers social challenges and sustainability as they develop their properties, and seek to provide residents and customers concrete options and nudge them towards sustainable choices by for example ensuring that areas they develop have balanced services, and sustainable businesses as well as health and wellbeing promoting services are represented.

These kind of experiences highlight that people are willing to participate and will make smart choices as long as they are provided with the opportunity to do so. Smart homes and buildings have potential to create new kind of resident communities and platforms for dialogue. Furthermore, smart solutions can be seen as a complementary way for nudging people towards sustainable consumption in addition to wider urban design.

Imperative for open interface and shared data

The potential of smart homes will be defined by the ability of the industry to take advantage of sensor technologies and data. The variety of stakeholders in the field creates imperative for open interface and shared data, and encourages cooperation among actors with different competences. This plays a crucial role in allowing different actors to develop interoperable, personalized and life-improving services for smart homes. New possibilities for information sharing between households emerging from smart infrastructure open up a terrain for new practices (Naus et Al., 2014). At its best, smart home enables creation of new services around living, transportation, energy, food, health and security. Along all this, new opportunities for value creation arise. Successful companies are those that are able to pivot to adjacent industries, find new business models and create services around emerging needs.

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Currently new-built houses form only small part of the housing market. For example, in Finnish capital district the market share of new-built houses was 6% in 2016 (Statistic Finland, 2017). Smartness has potential to expand this market as it can be used for differentiating new-built houses from older building stock. Instead of competition on the shares of the existing market, the true potential lies in the creation of a bigger one. Actors in the field of built environment have an opportunity to determine their future market by making smart choices today. Providing smart home solutions can also boost company's profit potential. According to Consumer Electronic Association's Annual Survey (2015), approximately 30% of American builders in 2015 felt that prewiring homes for

later smartness, that is e.g. security systems, would boost their profit potential, and one in three builders reported that installing home technologies increased their revenues in 2014. The consensus opinion was that millennial buyers and renters have come to expect some level of smart home features in their dwelling, and the builders are realizing that they should take advantage of wiring homes from the foundation up to be 'smart'.

"Millennial buyers and renters have come to expect some level of smart home features in their dwelling, and the builders are realizing that they should take advantage of wiring homes from the foundation up to be 'smart'."

Case 3: Smartness is becoming a standard

THERE ARE SIGNS INDICATING that smart homes will not be only a nice-to-have solution for 'tech-geeks' rather than a standard feature for wider audience in the future. An American homebuilder Brookfield Residential announced in May 2017 that it will make Apple HomeKit a standard for its new developments (Kahn, 2017). Brookfield Residential Chief Operating Officer Adrian Foley justifies the decision with the desire to think forward and anticipate consumer demand. The features implemented by Brookfield Residential are related to lighting, temperature, smart locks and Wi-Fi. The first development that will benefit from the HomeKit tech built-in will be the Delano neighborhood in Irvine's Eastwood Village in Southern California.

Brookfield Residential is not alone, as Seattle builder Quadrant Homes announced in June 2017 that it will also include a package of smart-home features as part of its standard offerings (Busta, 2017). Smart home systems are becoming more accessible for typical buyers.

Summary

ACTORS IN THE FIELD OF BUILT ENVIRONMENT are forced to redefine their business as several big changes are shaping the landscape they work in. These changes include urbanization, changing values and servicification of living as well as the emergence of sensor technologies, 3D printing and robotisation, while the climate change acts as a fundamental driver for the transformation, creating pressure for decarbonising the energy system, enhancing resource efficiency and emission reductions. People have potential to make a difference by making smart choices in their everyday life but currently, when it comes to living, their opportunities to impact are low. Smart infrastructure is a crucial enabler for a resource smart urban environment that creates means for residents' active participation.

Accelerating development of technologies, like sensor technology, big data, artificial intelligence and quantum computing to mention a few, will provide us with unprecedented tools to shape our living environment. Regardless of the current heat of the housing market, understanding the wider change of the business environment is crucial. Smartness connects homes to the larger transformation of the landscape and plays therefore an integral role in the infrastructure. Residents' will have increasingly important role in making sustainable choices, developing cities and determining the future of living and the services related to it. However, infrastructure for this needs to be built to make it happen.

The variety of stakeholders creates imperative for open interface, standardised and shared data and cooperation among actors with different competences, which plays a crucial role in allowing different actors to develop services for smart homes. Along this, new opportunities for value creation arise. Capability to pivot to adjacent industries, find new business models and create services around emerging needs will define successful companies of the future. In addition, smartness gives developers and constructors an opportunity to expand their market. Instead of competing against each other, current players have possibility to expand the market by targeting the aftermarket customers and moving their buying decisions from aftermarket apartments towards new-built stock.

Smart homes have great potential to contribute to resource smart urban environment that enables residents' active participation and development of life easing and time saving services as smartness connects homes to the comprehensive urban infrastructure. Built environment actors have both reactive and proactive role in the change, as they are forced to redefine their business due to imminent changes on the one hand, while these changes create new business opportunities and reveal possibilities for new value creation on the other hand. Multiple actors have already taken the first steps towards the future. Therefore, action and agility is required from everyone.

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