SmartThings Future Living Report

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Foreword

Since the dawn of time, we humans have strived to enhance our living and working environments. The environments we live in today are almost unrecognizable from those that existed just a century ago. The Internet is a great example of this. As this technology has spilled over from laptops to smartphones, we've become used to having total knowledge and control in the palm of our hand. The smartphone revolution is now ushering in the smart home revolution, making it possible for anyone to easily monitor, control, and secure their home from anywhere through one simple app.

This wave of technology is already here, and it's having a massive impact on how we secure our homes, stay connected to loved ones, and save energy. The lights, locks, appliances, and everyday objects in our homes are waking up. As we continue to breathe intelligence into these ordinary objects, our homes are becoming smarter and can detect the presence of things like people, pets, smoke, humidity, lighting, and moisture. They're beginning to become intuitive and sense our habits, automatically responding to our personal needs and preferences. And this is just the beginning.

Just as the technology driving the Internet has spread to smartphones and smart homes, the smart home revolution is destined to wash over us and spill into larger communities and countries. As more and more homes and cities wake up and develop a sixth sense, it will have massively positive implications on how we live.

By simply turning this off when we don't use them, we can reduce emissions by up to 30%. If enough homes become greener, we can attain widespread energy conservation and create a greener planet. By being able to better monitor and secure our homes, we can reduce the overall crime rate in cities. By better monitoring the habits of ageing relatives, we help seniors achieve greater independence and a higher quality of life.

James Monighan,
UK MD Samsung SmartThings

Introduction

Dr Maggie Aderin-Pocock MBE, is an acclaimed space scientist, managing director at Science Innovation Ltd and co-presenter of the long running, popular astronomy program 'The Sky at Night'.

Award-winning architects and Westminster University lecturers Arthur Mamou-Mani and Toby Burgess have spent five years exploring the concept of future living; everything from autonomous communities to new materials and digital fabrication tools. Linda Aitken and Els Leclercq are professional urbanists who established their own practice, studioAitken, in 2003 and who embed sociological and urban design solutions to rapidly evolving and increasingly complex urban issues. Alongside Dr Aderin-Pocock and Samsung SmartThings, they have joined together to conduct research into the future of living.

Overview

Technology and engineering are evolving at a faster rate than at any other time in history. The world today is unrecognisable from 100 years ago, and not just in an aesthetic capacity, but in the way that we, as humans, function within it. Advances in these fields have redefined the way in which we live our lives, how we communicate and interact.

We all remember the beginnings of the internet. From noisy modems to ICQ chats, AOL, Netscape and Compuserve – we were able to access dynamic pages from our computers; making information interactive and instantly accessible to people around the world. Then Google, Facebook, Samsung and the likes organised this immensity of data, gave us better access to it – and in doing so, connected us to its billions of users.

Now, over a quarter of a century later, we are faced with a new game-changer –known as The Internet of Things – and like the internet before it, its evolution is set to reach a phenomenal speed. First developed through DIY initiatives such as Arduino and Pachube, it is already being developed by companies such as Samsung with its recently acquired business: SmartThings. Expanding upon the principals of the internet, this technology is just the beginning in a movement that will see further interconnectivity between the digital and physical worlds, as in the first instance, we become able to control physical elements of our lives via our smart phone devices. Motion sensors, Presence sensors, Moisture sensors, Locks, Electrical outlets, Speakers, Thermostats are now controllable via the SmartThings app and this list is only expanding.

Twenty-five years ago, this would have seemed like a pipe dream, inconceivable even – much like the internet before it. But both are here; the future is now. The internet allowed all of us to connect as a single collective brain – this global and inter-connected intelligence can now encompass the material world, opening up endless possibilities.

So given the advances already in motion now, what can we expect to see in 100 years' time? How will we live; how will we work; how will we relax? With so much more scope for what can be achieved than ever before; is the sky the limit?

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Accommodation

Malleable, adjustable, personalised home/ work environments

According to the World Urbanisation Prospects 2014[1] issued by the United Nations, the urban population in 2014 accounted for 54% of the total global population, up from 34% in 1960, and will continue to grow (approximately 1.84% per year between 2015 and 2020; 1.63% per year between 2020 and 2025; and 1.44% per year between 2025 and 2030).

Just as the last 100 years have witnessed a seismic shift in the way we live, the way we interact with our living space will also change beyond all recognition.

As living space in cities becomes scarce, our buildings and interiors will evolve into hyper-flexible spaces.

Rooms will serve different functions, walls, floors, ceilings will have embedded technology which will allow them to change position depending on the activity (i.e. making the bedroom much smaller and living room larger when receiving guests)[2].

These smart walls will be able to change their own shape in 3D by using small responsive actuators pushing and pulling a flexible skin - creating temporary seats or shelves. All this hardware will be connected to wearable devices to which we will add and manage the components of our homes in a similar way to how we currently buy and use apps.

(Even Smarter) SmartThings

With the development of technology like Samsung SmartThings (which already allows objects within the home to be interconnected online and controlled via a simple app or automated through everyday routines), progress to incorporate these wearable devices that are able to give remote control over a wider array of things, the fundamental way in which we utilise our homes will shift. Imagine being able to just search online to find lost items within the home without having to scour the entire building for hours.

Houses will be controlled through a new generation of software that will learn from our living patterns and suggest the appropriate wall configuration, furnitures or add-ons that will then be implemented or 3D printed. Actuators, connected to sensors, as well as home apps, will also have the intelligence to adapt to body shape - informing of any posture issues and correcting them through bespoke exercises.

Even the buildings themselves will be capable of adapting to the needs of its inhabitants and the external environment. Based on sensors and user-interfaces, terraces will open up when drones arrive or when solar radiations are too high[3] and will retract again when the interiors are too cold.

[1] World Urbanization Prospects - The 2014 Revision **View**

[2] As researched by the Changing Space studio of Kent Larson at MIT Media Lab **View**

[3] For Origami Facades See the Al Bahar tower in Abu Dhabi

Virtual Decoration

Advances in augmented reality and projection mapping will mean that people's homes will function as the backdrop for projections, seen only by the inhabitant[4]. As a result of this, walls will be plain and unadorned to the outside observer but seen as anything desired by the user.

Anything from ornate 3D sculptures, to baroque dreamscapes and rural pastures will be downloadable, so through wearable technologies two people sharing the same room may experience totally different spaces. For a more communal experience, projection and LED wall surfaces will become commonplace, with home interiors reading and then adapting to the inhabitants' mood. Embedded within the interior wall furnishings, a multitude of tiny interconnected LEDs will be programmable via wireless computer technology. These will alter in appearance to an almost infinite number of responses - from mirroring traditional wallpaper designs, to displaying (including in real time), scenes from places throughout the world.

A new ubiquitous information age of free and unlimited data will open up possibilities of continuously connected streaming infographics displayed on all the walls internally and externally.

3D printed furniture and homeware

3D printing, which is already a reality, will take off in a big way. We will be able to purchase and download designs, and then customise them to fit our exact requirements in terms of shape, size and colour. We will each have small capacity 3D printers in our homes enabling us to print smaller items, whilst for larger items, we will take our purchased designs to a local 3D print shop where they will be generated to our particular specifications.

This will lead to a reduction in transportation and delivery costs, as only raw materials will be shipped to homes and 3D shops, allowing for the local production of the desired item. 3D printing will not just be confined to single items, in fact, in recent years it has been developed to construct homes in a fraction of the time of conventional building practices, as well as utilising recycled materials. With homes and parts of the home being available to download and print as the user wishes (even fabrics), anyone will be able to live in a designer home.

Furniture will be 3D printed, making it possible to upload houses onto a 'Domestic Facebook' in which people will proudly share their homes like they currently share their pictures. People will visit or reprint people's homes through Virtual Reality headsets or 3D Printers of their own. Landlords will be able to print bespoke virtual interiors before his or her tenants move in.

Not only that, but it will be possible to generate homes using algorithms that will take into account social patterns, search engine usage, structural forces, site-specificity, latest innovations and sponsorship. These algorithmic homes will then be printed by swarms of 3D printing drones also controlled by the algorithm.[5]

In terms of recycling, new developments in solvents will be able to breakdown the polymers that make up these 3D printed items into it monomer blocks. These will then be reconstituted to make new items for the home, again limiting transportation costs and tying in to the recycling culture of the time. The ultimate in recycling.[6]

3D printing has already allowed for components within the aerospace industry to be manufactured in a tenth of the time traditional components can be, and made and using less than a fifth of the material – and this technology can work using novel materials such as titanium.

[4] Through technology like **Samsung Gear VR** and **Oculus Rift**

[5] ETH Zurich University's Institute for Dynamic Systems and Control and Gramazio Kohler Research

[6] Printed homes **View**
New ref. polymer dissolving salts **View**

Sustainability

As non-renewable resources reduce, sustainability will be at the heart of our lifestyle choices.

Recycling will be fully integrated in our own homes and our wastes will create fuel and electricity through a process called Microbial fuel cell stacks[7]. This will be applied to food and plastic wastes as well as toilets and wastewater. A bio-electrochemical system within the home will mimic bacterial interactions found in nature. This 'digestion tank' will produce both gas and clean water in a process called anaerobic digestion. Power will be stored in each home through efficient lithium-ion batteries[8], taking everyone off the grid and removing the need for large power-plants, thus reducing nuclear waste and carbon emissions.

Energy will also be harvested via the natural environment. Smart solar panels, wind turbines and piezo plates will be integrated in the building fabric and connected to the individual's smart apps. The software and sensors will highlight the wattage being stored in real-time and warn about wasted power.

As communication is transmitted in an increasingly wireless manner, so too is the likelihood that alternative forms of electricity and/or its transmission will emerge. This could include capturing the energy generated from particle/atomic movement and collisions. Fusion will become less of a lab experiment and more commonplace as we utilise Einstein's equation E=mc2 to generate copious amounts of energy cheaply, cleanly and efficiently. The possibility of using our neighbour in space, the moon, to generate electricity using solar panels on its surface could become cost effective. The energy would then be transmitted down to Earth wirelessly via microwaves giving us another clean source of energy here on Earth.

Grow your own at home

People will grow their own food indoors, using hydroponics and aquaponics farms.[9][10]

Sustainability will not just be apparent in energy production and usage, but also within food production. As education about diet increases, it will become commonplace for people to grow their own food at home.

Hydroponics is the process of growing plants without soil, only using nutrients; aquaponics combines this process, using an aquarium, to create the plant nutrients from fish waste. Having such a closed-loop system in kitchens will provide fresh fruit as well as fresh fish and shellfish. It will also provide the materials needed to create the bio-plastic used in home 3D printers.

We are likely to see the emergence of growable surfaces both inside and outside the home. Rain will be captured and stored, then redirected to nurture the plants – which provide insulating properties thus reducing heating needs into the home; they also serve to clean the air; provide food; and will be used to create an architecture that is reconnected to nature.

[7] Microbial fuel cell stack **View**

[8] See the powerwall batteries by Tesla **View**

[9] Hydroponics is a method of growing plants using mineral nutrient solutions, in water, without soil **View**
See products being sold, the urban cultivator **View**

[10] Aquaponics **View**

Self-cleaning/repairing materials

Our use of cleaning products and plastic packaging will ultimately be reduced or eliminated within the home as self-cleaning and self-repairing materials render this excess waste unnecessary...

Techniques such as biomimicry, the act of copying and furthering nature's designs, have led to many advances. For example, looking at how the lotus removes water off itself effortlessly on a molecular scale, has led to the invention of spray-on waterproofing[11]. Nano-treatments of surfaces such as this will become commonplace, so the concept of cleaning will be completely redefined.

Furthermore, it will be possible to create self-repairing materials. Self-activating limestone-producing bacteria will be embedded within concrete, fixing any cracks as they appear[12]. The Bacteria (Bacillus pseudofirmus or Sporosarcina pasteurii) are mixed with concrete and can lie dormant for up to 200 years. They only start to produce limestone when cracks let rain or moisture in. This is a similar process to that carried out by osteoplast cells which make and repair bones in our bodies. This will therefore dramatically change the security of our houses as well as eliminating the need to continually spend money on maintaining them.

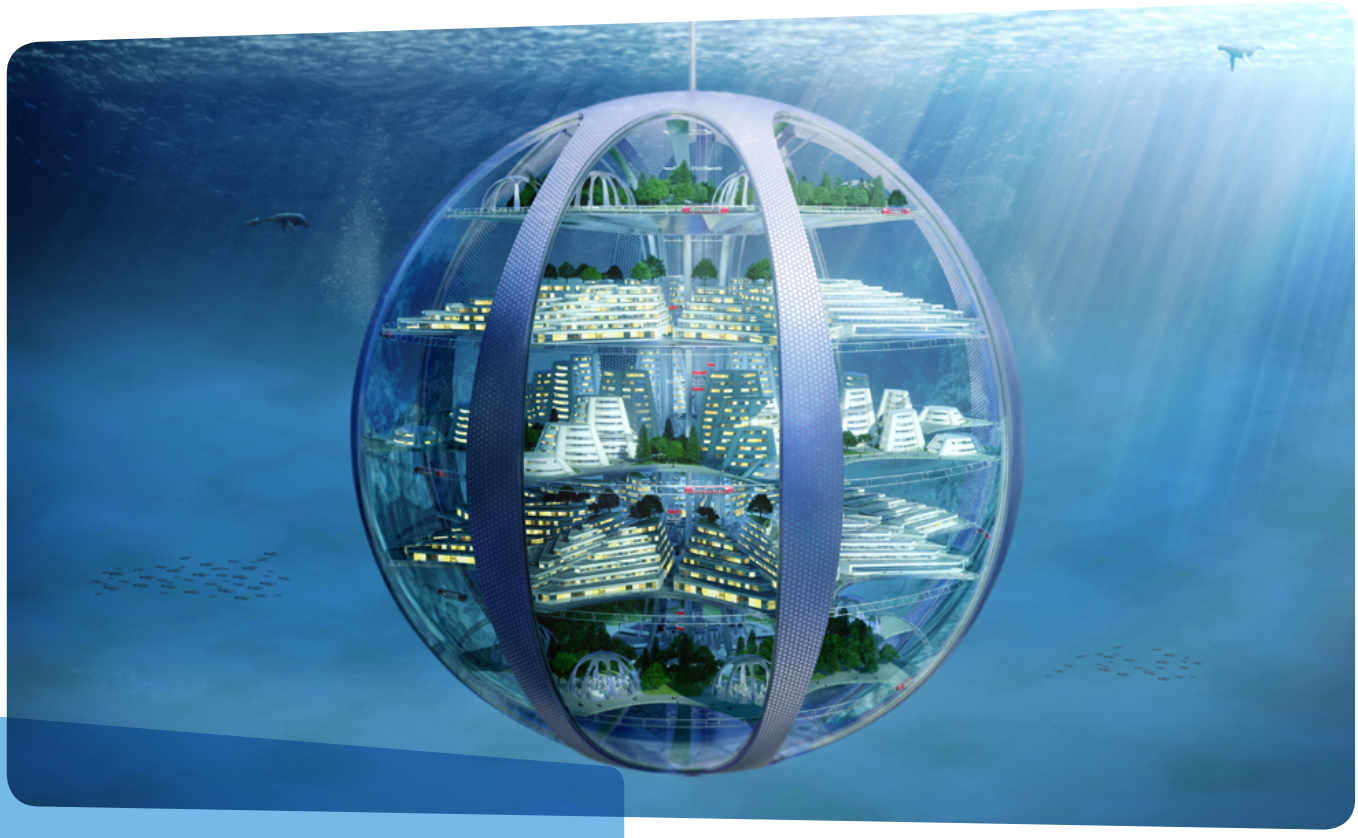
Architecture of the Future

With urban space in high demand, we will see exciting advances and innovations in the architecture of the home and shape of our cities.

This will include the emergence of super-skyscrapers, sub aquatic and floating communities and a new trend for building deeper into the earth.

[11] Spray-on Waterproofing **View**

[12] Hendrik Jonkers, Delft University



Underwater cities: are likely to become a reality – using the water itself to create breathable atmospheres and generating hydrogen fuel through the process.

Aquatic Homes

Water, H2O, can be split through electrolysis[13] to create Hydrogen, a viable fuel source; and oxygen, the element we as humans need to breathe.

With advances in the efficiency of solar cells it is likely that this free energy source will be used to create sub aquatic communities, breathing the oxygen they create and fuelling their electrical needs through the act of hydrogen creation below the waves. Sub aquatic communities could also draw free energy from the water currents and waves as is already done in wave farms[14] around the world today.

Water will be desalinated[15] through mass implementation of solar technology such as the watercone[16]. This will allow communities floating above the waves to continuously cruise to the best climate all year round, never needing to stop on land to restock as they would be growing their own produce 'onboard' and making their own electricity.

[13] Electrolysis **View**

[14] Wave Power **View**

[15] The process of removing dissolved salts from water, thus producing fresh water from seawater or brackish water

[16] Watercones **View**

Super skyscrapers: Carbon nanotubes and diamond Nano threads will help us create towering megastructures that will dwarf today's skyscrapers

Building up/digging down

There will be great advances in building materials. Carbon nanotubes cement composite will replace conventional reinforcements in concrete[17] making it sixteen times stronger (tensile strength of 0.5gpa for steel against 8.5gpa for portlandite nanotube[18]). Diamond nanothreads[19] will replace steel cables with a resistance 100 times greater at one-sixth the weight.

The construction process will increasingly be automated. Workers and cranes will be replaced by mobile robotic arms and remotely controlled drones (this is currently being tested at the new Google headquarters in Mountain View[20]). Automation of machinery with remote-controlled trucks is already being used in the mining industry[21].

The new materials and the automated construction processes described above will allow skyscrapers and infrastructures to reach unprecedented height and spans. Whole cities will be extended high above ground within vertical mega-structures hosting public and private spaces. Prefabricated houses will be assembled on these elevated grounds, connected by giant aerial highways, elevated pedestrian streets, with shopping hubs, bars and cafes, parks.

We are already seeing extreme height being achieved in the construction of single buildings, with the Kingdom Tower in Saudi Arabia set to surpass a kilometre. And these architectural advances will act as a catalyst for further changes.

In terms of circulation, a new kind of drone-car will fly directly to the different levels of the high rise buildings - the concept of streets will no longer just be confined to the horizontal plane (an early adoption of this idea is apparent in Tokyo where shops are stacked – accessible via escalators). With the development of vertical roads, skyscrapers would not need lifts, and as such the internal architecture of high-rises as we know them would completely change, most likely becoming open floors with Sky Ports that people buy as sites and occupy/construct as they please.

Just as we colonise the urban skyline, we will also build deeper underground. 100 years from now will see the introduction of 'Earth-Scrapers'; multi-level, subterranean structures built deep into the ground, such as BNKR Arquitectura's planned 300 metre-deep build in Mexico City. The rise in the prevalence of 'super basements', especially in London, is evidence of a wider move to create more habitable space in desirable city centres. The benefits of digging down include isolating oneself from the elements and using the natural insulative property of the soil to keep warm and reduce energy usage.

[17] John E. Fernandez, MIT

[18] Cementious Nanotubes **View**

[19] Thomas C. Fitzgibbons et al. - Natures Material **View**

[20] **View**

[21] Automated Mining **View**

Integrated Artificial Intelligence (AI)

The predicted technological advances in computing, molecular nanotechnologies, biotechnology and AI will be used to increase our intellectual and cognitive ability by connecting us to a global knowledge bank, and make us stronger physically (potentially even mentally), fusing together man and man's technology, in what is known as a movement called 'transhumanism'[22], creating a new life form that is so markedly different in its abilities, both physically and mentally, that it can no longer be termed human. Welcome to the post-human age.

Humans will be assisted/augmented by AI in all areas of life. Symbiotic man-machine existence becomes a reality, where the boundary between technology and the human organism blurs. Haptic[23] feedback clothing will become standard, providing immersive physical feedback, synchronised with the digital information being streamed into our ears and eyes, and possibly even our mouths and noses. Advances in AI may eventually mean that our memories and even personality traits could be stored electronically.

Furthermore, with the ability to map complex brainwaves, activity could lead to complete transparency between the inner workings of the mind and the outside world, opening up opportunities such as being able to control complex machines with just thought or even apparent telepathic communication, aided by technology.

Telescopes have evolved of over the last forty years due to a system called adaptive optics which monitors and cancels out atmospheric turbulence, taking the 'twinkle' out of stars. Currently the largest telescopes in the world sit at 8 - 10m in diameter. The VLT, (very large telescope) has four 8-metre telescopes working together in the driest place on Earth, the Atacama Desert. Planning has now started for the ELT (extremely large telescope, currently) which will have a primary mirror 39-metres in diameter. Beyond that, the development of the OWL (overwhelmingly large telescope) would be next in line, with a primary mirror 100-metres in diameter; a mirror literally the size of a football pitch. As well as these enormous telescopes, hundreds of smaller telescopes will be set up into huge arrays allowing light to be gathered over large areas.

But what will we discover with these leviathans? Fundamental questions about life, the universe and everything, may well be answered within the next 100 years. Exo planets (planets orbiting other stars) have already been detected using our current generation of telescopes. But in the future, with such massive telescopes, we may be able to conduct detailed measurements of distant planetary atmospheres, and as such, look for signs of life on other planets in our galaxy. The discovery of other life forms in the Universe may lead to a new enlightened view of the cosmos and have the ability to unite humans as never before. This could well accelerate the end of countries and the formation of a world governance.

[22] **View**

[23] The use of the sense of touch in a user interface design to provide information to an end user

The working week

The way in which we work will also see a dramatic shift over the next 100 years, efficiency as well as development in communication will render the working week almost unrecognisable.

The use of holograms in the workplace will become more prevalent. By beaming into one's home or working environment, this realistic 3D image will remove the need for actual presence in group meetings. This will have massive implications in reducing the need for travel both nationally and internationally, significantly reducing energy demands related to travel, and acting as a major time saving resource. These elements combined would then facilitate the potential for a reduced working week. It is probable that a digital currency similar to bitcoin replaces local currencies to simplify and accelerate ever growing online transactions.

Medicine and Ageing

The Office for National Statistics states that the population is projected to continue ageing, with the average age rising to 40.6 years by mid-2022 and 42.8 by mid-2037. Furthermore, it is predicted that the number of people aged 80 and over in the UK will more than double to 6 million by mid-2037. Taking these projections, it is safe to assume that when making predictions about life 100+ years from now (governmental intervention notwithstanding), there will be a focus on medical care, disability and ageing.

Homes equipped with medical screening equipment

Health provision is currently a hugely expensive process. The digitisation of health care will provide a more efficient system; more accurate diagnosis; and the ability to dispense instant prescriptions and remedies.

Health care will become decentralised with the emergence of wearable devices tracking any issues in one's body and giving a live report as well as advice via a smartphone. This technology is widely tested through innovative start-ups developing solutions for asthma monitoring[24], back therapy[25], chronic pain relief[26], to name but a few.

Homes will be equipped with a step-in capsule, which will be able to fully scan bodies and provide a digital diagnosis. A connected machine will then dispense treatment in the form of a pill, patch or jab – this could be within the home or collectively within the neighbourhood.

Medicine and Procreation

Our rapidly advancing understanding of the human genome and genetic pre-birth screening techniques could lead to a world where the new science of synthetic biology may enable us to have customised medicines based on our own genetics.

Furthermore, the space industry is currently investigating the possibility of remote operations and medical procedures for personnel living independently of Earth, (on a Moon or Martian base for example), and this could be a possibility made available to all of us. Why have a waiting list when the world's best surgeons are able to operate from anywhere in the world - doing the complex procedure, after which patients recuperate locally, with local support?

[24] ADAMM (Automated Device for Asthma Monitoring and Management) is a wearable technology that provides a complete solution for managing y asthma. **View**

[25] A 3D gyroscope, a 3D accelerometer, a 3D magnetometer and algorithms are merged into one single sensor to capture movement. **View**

[26] Quell was created by a group of scientists and technologists at NeuroMetrix, Inc. NURO (NASDAQ) who have spent over 15 years developing patented diagnostic technology and innovative wearable therapy solutions for people suffering from chronic pain and sleep disorders. **See more**

With technological advances allowing for a reduced working week, our leisure time will be much more prevalent. We will not only have more time to enjoy our pastimes and discover new passions, but improvements in areas such as transport will allow us to enjoy a wider array of experiences all over the globe.

Commercial space flight a reality

After numerous tests and high-end sub-orbital flights carried out by companies such as Virgin Galactic, SpaceX and Blue Origin, space flight will be democratised and allow for high speed transportation across the globe as well as to communities in space, the Moon, Mars or perhaps low Earth orbit space hotels.

As outlined, this technology is already being developed – once perfected, it will completely shift our attitude towards going abroad. With people being able to travel further, more frequently, a global understanding of different cultures will be achieved, which will have a knock on effect on how we interact. This increased fluidity in mobility will also allow for a migratory or nomadic attitude to living.

Drone delivered holiday homes

Furthermore, with the advances in 3D printing, which will be able to combine electronics (conductive materials) with standard polymer technology so as to create structurally[27] sound drones, people will be able to utilise these 'drone mules' as and when they wish in order to transport heavy loads – such as people's houses.

Changes in work/life practice will mean people's homes will be movable – able to fold onto a truck and move to a new location, or moved by drone. This concept is set to be tested in 2016 by an American company called Kasita in Austin, Texas.[28] These homes will be designed as pods within a flexible infrastructure and will be movable by request from the tenant using an app specifying which city he wants to live in.

Drone delivered holiday homes: Some of us will be travelling skyways with our own personal flying drones, some strong enough to carry entire homes around the world for holidays

[27] See the Voxel8 3D Printer. **View**

[28] **View**

3D printed food and leisure materials

3D printed food is already becoming a reality[29] and will soon be in every kitchen.

Famous chefs will share 3D files of dishes that will be downloadable from the internet, to be printed at home. This will completely revolutionise the concept of a 'microwave dinner' – allowing people to spend minimal time in the kitchen whilst also ensuring a healthy balance of nutrients. It would be possible to completely tailor food to specific dietary requirements without the hassle of going to the shops. Furniture will also be 3D printed in giant 3D printers and using Bio-Materials grown in aquaponic farms. Designers, like chefs, will share their furniture online for the public to download and print.

Virtual leisure

Going on virtual holidays (including sensory stimulus), hologram/virtual pets

Utilising advances in technology (in systems such as Samsung Gear VR and Oculus Rift), it will be possible to take virtual holidays. Through electrodes that will be attached to the individual's head, computer software will generate the sounds, the sense of movement, and even smells in the mind, while the headset place the visuals before the user's eyes.

When it comes to personal relationships we will see the emergence of Hologram dating sites – advances in technology will enable us to interact with potential partners in 3D before agreeing to real time dating. We may also start to adopt Hologram pets – these would be programmed with a range of 'commands' and emotions that it would respond to – sit, fetch, lie down and roll over.

[29] See 3D by Flow **View**

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And finally. . .

Colonising space: we will colonise the moon first, then Mars and then beyond - out into the galaxy

Living in space. Colonies established first on Mars, and then on nearby habitable planets

Ultimately, as we utilise and thus exhaust more of the planet's resources, it will eventually be cost effective to start looking elsewhere in the solar system for the provision of sustainable accommodation and resources.

Asteroid mining will become a viable commercial enterprise and with these changes it is very likely that communities will emerge on the moon, testing our ability to live outside Earth whilst staying nearby, then further afield on Mars, where streams of underground water can be found. As new discoveries occur and theoretical concepts like Worm Holes (the current mode of teleportation used by Dr Who) become a reality, we will travel outside our solar system and onto distant exo-planets. This will lead to a rapid expansion of humankind as we will no longer be limited by the resources of one planet but will have the ability to source resources throughout the galaxy and possibly beyond. Population expansion is likely to accelerate as we find and utilise Earth-like planets orbiting distant stars. The possibility of genetically changing the human template could mean that we could also live and thrive on less-Earth-like planets.

Climate change, space travel and eventually new planet living will lead to a complete revolution of our social patterns and of our homes. Homes will increasingly become self-contained, autonomous spaces generating their own oxygen and food - we will effectively all be creating our very own little planet Earths.

The Authors

Dr Maggie Aderin-Pocock MBE is a space scientist, a science communicator and the founder of Science Innovation Ltd. She has a passion for presenting science to general audiences and has engaged over 250,000 children around the world. She is also a TV presenter and co-hosts 'The Sky at Night' the world's longest running science television series. She has a Degree in Physics and PhD in Mechanical Engineering and as a space scientist she has spent her career making novel, bespoke instrumentation in industrial and academic environments.

Arthur Mamou-Mani (AAdip, ARB/RIBA) **www.mamou-mani.com** is a French architect and director of the award-winning architecture practice Mamou-Mani Architects. He is a lecturer at the University of Westminster in London (WeWantToLearn.net) and owns a digital fabrication laboratory called the FabPub. Arthur has co-written the software Silkworm for 3D Printers and has taught parametric design tools at many leading academic bodies such as the Architectural Association School of Architecture and the UCL-Bartlett. Prior to founding Mamou-Mani in 2011, he worked with Atelier Jean Nouvel, Zaha Hadid Architects and Proctor and Matthews Architects.

Toby Burgess (AAdip, RIBA II, BArch(hons), BA(hons)) **www.tobyburgess.com** is the director of Toby Burgess Design ltd and teaches at postgraduate level at the Architectural Association and Westminster University, with a focus on the funding and delivery of student projects (WeWantToLearn.net), previously coordinating London Metropolitan University's entry in the Solar Decathlon Europe 2012 (RIBA Silver Medal 2012) and managing the delivery of student architectural installations at Burning Man Festival. Toby was previously lead designer on 'Casa Kike' by Gianni Botsford Architects (2008 Lubetkin Prize) and a founding member of the 'Project Sustainability Group' at Grimshaw Architects.

Linda Aitken is a highly experienced urban planner with additional urban design skills. With this combination of expertise she is focused on the deliverability of planning schemes and strategies, subtly tailored to ensure an efficient, well mannered, urban fit and form. Her particular strengths include the management of urban mixed use new build schemes and new school developments, from inception through to the securing of detailed planning consents; policy appraisals; masterplanning; the formulation of viable and deliverable development strategies focusing on the client requirements and aspirations, ensuring timely public/political involvement; to the art of enlightened and sustainable place making.

Els Leclercq is an experienced urban designer and a published researcher. Her design expertise lies in delivering a range of planning, design and development projects for the public and private sectors including urban analysis, urban design and masterplanning, and project management. The characteristics of a site/area's social, cultural and physical attributes are thoroughly appraised in conjunction with contextual economic realities and viability requirements, the findings of which then form the starting point of each project. Els has a professional interest in observing and researching the evolution of urbanity. To this effect, she is currently undertaking a PhD at the department of Design as Politics at TUDelft, Netherlands, examining whether the European 'urban renaissance' of the late 20th and early 21st centuries has delivered the regenerative revival it promised to deliver.

About Samsung Electronics Co., Ltd.

Samsung Electronics Co., Ltd. inspires the world and shapes the future with transformative ideas and technologies that redefine the worlds of TVs, smartphones, wearable devices, tablets, cameras, digital appliances, printers, medical equipment, network systems, and semiconductor and LED solutions. We are also leading in the Internet of Things space with the open platform SmartThings, our broad range of smart devices, and through proactive cross-industry collaboration. We employ 319,000 people across 84 countries with annual sales of US $196 billion. To discover more, and for the latest news, feature articles and press material, please visit the Samsung Newsroom at **news.samsung.com**.

About SmartThings

SmartThings is the easiest way to turn a home into a smart home, bringing users peace of mind, savings, and convenience. As an open platform with a thriving ecosystem, SmartThings also brings users freedom of choice in devices and limitless possibilities. Since SmartThings was acquired by Samsung in August 2014, the team has tripled in size, tripled developer activity from a community of over 20,000, and has one of the largest ecosystem of compatible devices. SmartThings is headquartered in Palo Alto, CA and operates independently as a wholly owned subsidiary of Samsung Electronics. Find out more at **www.samsung.com/uk/smartthings**