# INTELLIGENT HOMES ARE THE EVOLUTION OF SMART HOMES

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INTELLIGENT LIVING

# WHAT IS AN INTELLIGENT HOME?

An intelligent home adapts to your needs and desires – automatically controlling the functions of the home. It will learn and work around you, observing how you actually live, which rooms you spend the most time in and how you use heating and lighting. It seamlessly and intelligently supports and enhances your living environment without your input and taking into account the external factors such as weather.

# WHAT IS A SMART HOME?

It seems that these days everyone is talking about smart homes, so before we discuss further about intelligent homes, it is important to understand first about smart homes and home automation and what they do.

As the advert goes, a smart home lets you control your home from your phone. Smart home technology, also often referred to as home automation or domotics from the Latin word "domus" for home, provides homeowners security, comfort, convenience and energy saving by allowing them to control smart home devices via a smart home app on their smartphone.

When you're not home, nagging little doubts can start to crowd your mind. Did I turn the lights off? Did I set the security alarm? Did I leave the heating on? With a smart home, with a quick glance at your smartphone, you can check whether all is OK and turn off the lights, turn on the security and set the heating to your desired level.

A smart home is one in which the multimedia and household appliances interact and can be controlled remotely. Smart home technology can be programmed to automate everyday tasks, while appliance settings such as heating, lighting and loudspeaker volume can be adjusted quickly via your smartphone to your personal preferences.

This is however, not an intelligent home. It is not really smart either. It is much like using a remote control for a TV and calling it a smart TV. Smart homes are convenient and have some attractive features but are only a stepping stone towards the intelligent homes of the future.

# GROWING MARKET

That said, the market for smart homes or home automation is undeniably growing very fast. Currently, less than 1% of homes employ full smart home technology. However different market research companies are all predicting significant growth. The market data company HIS Technology predicts that 45 million smart home devices will be installed this year, and the annual business volume will reach $12 billion. ABI Research predicts $14.1 billion. Allied Market Research projects that the global smart homes and buildings market will grow at almost 30% through 2020, at which point the market will be worth $35.3 billion. Juniper Research rather optimistically predicts that the market will be $71 billion.

Regardless of the company or their respective predictions, there is widespread agreement that the market is growing very rapidly and is sizeable. This growth is being driven by the global spread of smartphones as well as the recent adoption of smart speakers, most notably the Amazon Echo range with Alexa.

Additional drivers include the decreasing costs of smart home devices, increased government regulation regarding energy use, the increasing cost of electricity and gas, a desire to protect the environment and general concerns about personal security.

However, home automation systems have struggled to become mainstream, in part due to being too “technical” or requiring frequent or detailed input from the users. A drawback of smart homes is their perceived complexity -- some people have difficulty with technology or will give up on encountering the first hurdle. Smart home manufacturers are working to reduce complexity and improve the user experience to make it more enjoyable and beneficial for all kinds of users and technical levels.

"Manufacturers haven't found a way to present a real value proposition yet. The situation will change, but it will take time," says Windsor Holden, Juniper's research director. “Making smart-home technology easy to use will be key to its appeal.”

# WHAT DO PEOPLE WANT FROM THEIR SMART OR INTELLIGENT HOME?

One thing is clear that smart home devices on their own are not what homeowners want. They are looking for integrated systems that control all the major functions of their homes.

Research by Coldwell Banker showed that most people think a home can be considered "smart" if it has smart security, temperature, lighting and safety. When asked about what needs to be in a home for it to be considered "smart," 63 percent said security e.g. alarm systems, 63 percent said temperature e.g. thermostats and fans, 58 percent said lighting and 56% safety e.g., fire and/or carbon monoxide detectors.

Importantly, more than three-quarters of participants thought that having just one category of smart technology in your home isn't enough for it to be considered smart. Specifically, 60% thought that for a home to be considered smart, it needs to have at least three categories of smart products with security and temperature control being the priority.The same report looked at what smart home technology would influence whether people would purchase a home. Home buyers were most attracted to smart security and temperature with 58% saying smart security would be appealing and 56% saying temperature. The least popular types of smart home technology were smart appliances such as smart refrigerators, washers and dryers and entertainment.

# GOOBYE SMART HOME- HELLO INTELLIGENT HOME

Digital disruption is happening right now in the smart home and home automation market as we see a move from a smart home to an intelligent home.

Consumers are open to using more advanced smart home services. Respondents to a Strategy Analytics survey were found to be interested in owning technology that knows them, learns their needs and recognizes their lifestyle".

Furthermore, according to a State of the Smart Homes report for iControl, consumers want smart devices that can learn to automate themselves so that the consumers do not have to controlling them constantly. In other words they want their homes to be intelligent, not merely smart. "Devices doing it on their own." That's what nearly 60% of consumers wanted from their smart home devices. They don't want to have to tell their smart home devices to complete an action (turn the bedroom lights off at 10PM) or worse a series of actions (when I leave the house turn the lights, heating off and turn on the security alarm). They want their devices to use data, analytics and sensors to work on their own. However, if the devices are unable to control themselves, then voice control and the ability to give instructions via a smartphone are the next best options.

# SO WHAT EXACTLY IS AN INTELLIGENT HOME?

We are not talking about individual devices like smart thermostats or video cameras but rather about an integrated, self-aware system, a system that uses multiple data points to create more of a holistic view of the occupants of the home and then acts on their behalf.

As mentioned before, one of the reasons given for the slower adoption of smart home products than expected is because they are considered “too technical”. In customer experience terms, we talk about low versus high-effort experiences and there is a sense that smart home devices and home automation are high effort. An intelligent home will lower the effort required for homeowners to interact with their homes - meaning no more messing around with apps, no more shouting at Alexa or Google, no more manually programming schedules or IFTTT scenarios. The home will already know what to do, and do it automatically, without you having to ask or tell it what to do.

The intelligent home is the next stage of evolution beyond connected, smart and automated homes.

It will define the next ten years of opportunity in smart home technology and services. Intelligent home implies awareness, learning and personalisation. It will involve a machine learning and predictive modeling ecosystem covering all the functions of the home including home entertainment, security, safety, control, comfort, health and energy management applications.

It is the next step in how our homes will be designed and function in the future. The intelligent home learns the behaviours and preferences of the occupants of the home. It adapts to, and anticipates, their needs. It is a home that uses data gathered from multiple devices and sensors around the home, as well as other data sources such as weather and traffic.It anticipates the needs of the occupants of the home and responds accordingly. It is a fully autonomous home that acts on the homeowner’s behalf ?without the need for explicit instructions.

The home of the future, the future smart home, will incorporate learning technologies that constantly learn a consumer’s moods, patterns, and behavior and adjust its own “behavior” accordingly.

# WHAT DOES AN INTELLIGENT HOME NEED?

For an intelligent home to work, there are some prerequisites about what sort of data and functionality it needs in order to make it intelligent.

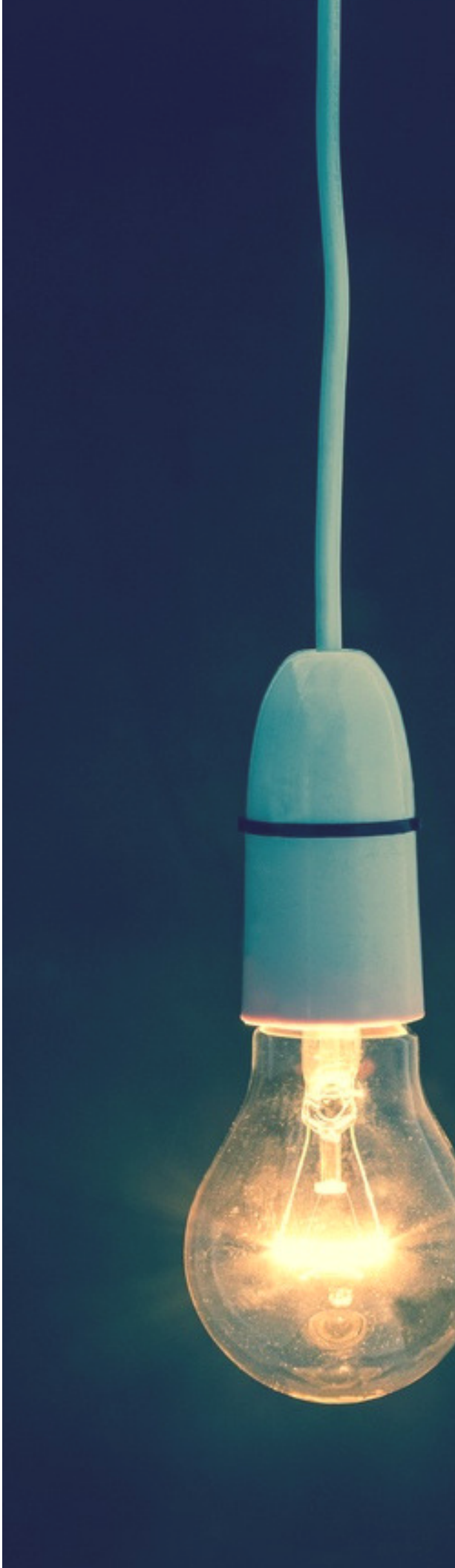
**The home should learn how many people are inside, and also how many people are in each room and the general patterns of movement from one room to another.**

This can be used to control the heating systems, lights and also setup the security. It becomes possible to shut down the TV, turn off the lights and save the cooling and heating energy by not coming on in empty rooms. The home will also automatically know when you are gone on vacation and pause the heating or cooling.

**Home should understand the environmental conditions inside and outside the home and how they change.**

The home should be aware of the environment in the home. What the temperature is and how quickly the home heats up and cools down and how the weather affects this. How bright are the rooms and how this affects the temperature of the room. What is the CO2 level and the air quality? What is the humidity? In this way, the home can take action as specific environmental factors happen, for example automatically turning on the ventilator when the air quality deteriorates or the humidity levels rise. Or close the blinds and open the window automatically when the sun is shining.

Additionally the home owner can be alerted if the home is found to be leaky and preventive measures can be taken. Similarly, energy usage can be compared against similar households like water bills do right now.



## House should be connected to the internet.

This goes without saying really. The data storage and learning capabilities reside in the cloud. It is not possible or at least not economical to have the required levels of data storage and computational power locally in the home. It also allows the ability to override any of the decisions of the home and allows manual control. It also allows access to online weather forecasts for example, which can be combined with the measurements from sensors in the home to allow weather compensation for the heating and cooling systems.

## An intelligent house should talk with you.

It should be able to give you real time notifications regarding improvements and adjustments that you can do. It should tell you that you forgot to close the window and nobody is in the house. It should tell you that you are heating the guest bedroom but that room is not being used. There is loads of information that can be delivered based on the sensor readings. You should also be able to talk to the house. For instance you should be able to tell your house that to increase the temperature, or to arm the security system. You should be able to ask questions and expect intelligent answers.

## An intelligent home should interconnect with other smart devices.

Today, despite the widespread availability of smart home devices, there is no common language for them to talk to each other. Various manufacturers try to establish their own proprietary communication protocols. These devices do not talk to each other, or at least not readily. In other words, these smart home devices are not smart in a collective sense. Just calling something smart does not make it smart. There is nothing smart in being able to watch youtube on your TV or create a shopping list on your fridge.

# WHAT SHOULD AN INTELLIGENT HOME DO?

So what can an intelligent home do for you? Why do you need one. Here's a few scenarios that show how an intelligent home can behave in a way that benefits you without you having to ask it. These capabilities allow the intelligent home to perform better than a smart home. In some cases this functionality is already available on the market and in some cases, will be coming soon. Once you read a few of these, you can probably start to imagine your own scenarios.

## Controlling heating and cooling to save energy

An intelligent home will learn the occupants schedule and control the heating and cooling accordingly. For example, if you leave the home at 8.00am every morning, the home will learn this. It will also learn that it will stay at the ideal temperature for 30 minutes (dependent on the weather and outside temperature) and will automatically turn the heating or cooling off at 7.30am. It will learn when you return home and will also recognise different patterns on different days of the week, for example adapting if you typically work from home on a Friday. It would also learn your patterns in the home, which rooms you typically use and when; and control the heating automatically to avoid heating or cooling empty rooms.

## Automatically controlling lights

An intelligent home will automatically switch on and off lights in the house. As it gets dark, when you are going from one room to another, you switch on the light in a room that you enter and at the same time switch off the light in the room that you leave. The house will learn your habits of switching the lights on and off and in the future will switch the lights on and off automatically. So for example, if you are watching TV and in the break, you go to the kitchen to make a cup of tea, as you get up and walk to the kitchen, the sensors will detect your position and the appropriate lights will be switched on and off automatically.

## Detecting a break in to your home

Intelligent homes can be clever about detecting intruders. The house is constantly monitoring all inhabitants. Different sequences of sensor inputs are stored and used in a search for patterns of behaviour. These patterns can also be used to detect situations that differ from the ones learnt and saved by the home. Imagine you are asleep and a burglar is breaking into your kitchen. Clearly the house will detect the movement in the kitchen. The house realises that this is not normal as you have not moved from your bedroom and that you do not usually enter your kitchen in the middle of the night. It also classifies this part of the home as a secure area and therefore sounds the alarm and flashes the lights to scare off the burglar. It is not just motion sensors that can help, for example if the home hears the sound of breaking glass, and no one is in the room at the time, then it sees this as an anomaly and sounds the alarm.

## Listening to music

Imagine you are listening to music in the living room and decide to go to the kitchen to fetch some food. On your way there, the house detects your movement and notices that the music is still on in the living room. The house automatically switches the music from the living room to the kitchen so you can continue listening while you are there. The home also knows that you usually switch off the sound system in a living room to reduce energy consumption so it automatically turns off the sound in the living room. As you return to the living room, it turns off the music in the kitchen and starts it again in the lounge.

## Health monitoring

In this case, the intelligent home can detect when the occupants need help. This is particularly important for elderly people that live independently in their own houses and apartments. to detect accidents. Imagine your elderly relative Betty usually gets out of bed every morning at 8.00am. The house however detects that she is still in bed at 10.00am. This is clearly not the normal behaviour so the home will raise a notification to warn you or a neighbour or carer that Betty is potentially not well and you can get in contact to check in on her. An intelligent home can go a step further and look at patterns of behaviour and compare them to patterns known to indicate the onset of illness.

For example the early onset of dementia is marked by random and unexpected movements such going repeatedly back to the same room, which is recognised by the home and raises a notification that Betty is potentially unwell even before she herself is aware.

These are just a few examples but as you can see, an intelligent home can use multiple data sources and machine learning to understand patterns and can then automatically take actions, making your life easier and better without you having to tell it. This is very different to a smart home that needs to be told everything.

# HOW TO MAKE A HOME INTELLIGENT

Intelligent Home systems and services will be supported by key enabling technologies such as cloud computing, IoT (Internet of Things), big data and analytics, contextual computing, machine learning, predictive modelling and artificial intelligence.

A powerful infrastructure is required. To be intelligent, the home needs to have lots of sensors and be able to collect data from all those sensors. The biggest challenge is being able to integrate sufficient sensors to be able to accurately monitor the habitational patterns of the occupants as well as the environmental performance of the home.

Adding the sensors themselves is not difficult. Adding the sensors without adding lots of bits of plastic and making them inconspicuous and unobtrusive is even more challenging.

The easiest way is to look at what is already available and add the sensors to those devices, for example plug sockets, light fixtures and light switches could all make sense.

The data collected needs to be stored and analyzed. This requires very high levels of data storage and very high computational power. It is beyond the capabilities of most companies to develop this platform themselves but fortunately cloud platforms like AWS exist that provide a scalable platform with sufficient storage and computational power.

Intelligent homes require advanced machine learning algorithms and writing efficient machine learning algorithms is not an easy task. It is possible to create efficient learning algorithms for a specific functions, but such tasks are difficult and requires a lot of development and time and effort and some very clever data scientists doing the work.

Clearly creating an intelligent home is more than just adding a few smart speakers and smart thermostats and lights to your home. There is a whole infrastructure that needs to be created and developed.

# ARE INTELLIGENT HOMES THE END OF PRIVACY?

The key components of an intelligent home are the analytics engine, the artificial intelligence (AI) solution underpinning the solution, and most importantly, a high level of user trust and data transparency.

There is a degree of scepticism and even fear around the idea of intelligent machines and the collection of personal data. Given this, it becomes very important for people to understand its application and ‘what’s in it for them’. Intelligent home technology needs to bring instant and obvious benefits to the homeowner and be easy to understand and implement.

Understanding the technology has the power to collect private data makes some people uncomfortable. Over time, this will ease and an understanding that the more technology knows about you, the more benefits you will receive. But it is an area we must be aware of and acknowledge as we start to widely deploy intelligent homes

Are we ready to have our lives managed in this way? Or is it a step too far? Some people may find it overbearing. Others may not care.

And for certain segments of the population, for example the elderly who want to live independently for longer, having a home that intelligently looks after them and monitors them and makes sure they are comfortable and healthy and raises the appropriate notifications to the appropriate people at the right time will be invaluable.

The future of the Internet of Things and intelligent homes should not be about technology taking over but freeing us up from domestic tasks so we can live in comfort and have more time to focus on what really matters to us.

A final challenge is that there will initially a problem with the house doing some unwanted activities or the house not performing activities that were expected as it learns patterns. While an intelligent home will eventually learn the right patterns, occupants might be annoyed with the home not understanding what they want. Some level of education will be needed to explain to homeowners that just like a child has to learn, their home will also need to learn. However the longer they have it, the more it learns and the better able it will become to anticipate their needs.

# WILL IT COST MORE FOR AN INTELLIGENT HOME?

You might think all this intelligence comes at a price. In fact, intelligent homes are cheaper than home automation and potentially even smart homes.

Intelligent home technology being based on smart home devices and technology has a lower price than home automation, similar to smart home products and devices. Since it uses proprietary technology and protocols, home automation tends to be expensive to install.

On top of this, the installation and configuration costs add considerably on top of the already high product costs. Since home automation products need to be hard wired in to the home and need programming to perform automation jobs, the installation costs are considerably higher.

While smart home devices are cheap, they cannot function as a true intelligent home as they are not integrated making the implementation of automated functions difficult and expensive.

As full functionality is included in the home, for example adding smart speakers, smart thermostats, smart security systems, smart lighting and so on, the costs rise quickly.

So while the initial entry costs may be low, the cost to have a fully integrated smart home increase rapidly.

Neither system has the required number of sensors integrated with an AI platform to allow the systems to become intelligent as we have described above. This can only be achieved by a system designed specifically to be intelligent.

Intelligent homes offer the best of both worlds being based on smart home devices but integrated together within a single intelligent infrastructure that controls all the different devices. In this way, it is possible to convert a standard home in to an intelligent home for an affordable price.

# WHAT NEXT FOR INTELLIGENT HOMES?

The advent of the intelligent home will bring with it new business models that will benefit homeowners and property developers alike. Not only will it deliver new enhanced home control to optimise the cost and running of a home, it will also deliver new innovative business models to sustain and further develop the intelligent home of the future.

Examples are assisted living to help the elderly live independently for longer, or new models of home insurance that actively work to reduce risk but allow new policies to be developed specific to the consumer and provide better service as if something does go wrong, the home will already know and the insurance provider can already be taking action even before the homeowner reports the issue, simplifying and speeding up the claims process. It could also be new models of local and community energy generation and storage that do not just reduce the cost of energy for the homeowner but earn them money by trading their spare energy to the wider network of energy consumers.

There may be a lot of growth in, and talk of, smart homes. But the home of the future will be intelligent and this is the direction that the market is now taking.

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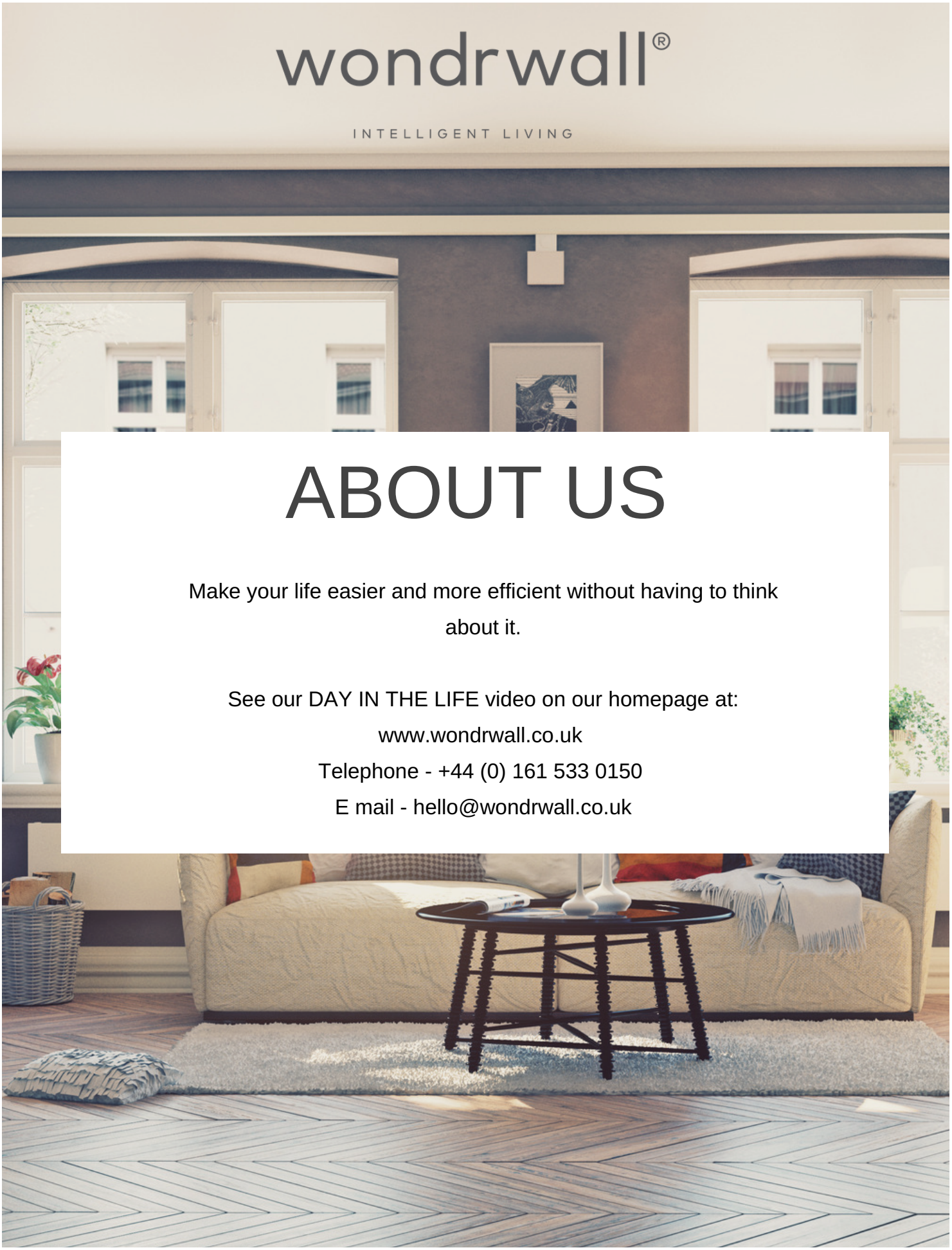

# ABOUT US

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