Professional MBA
Facility Management

The Next Generation Residential Space

A Master's Thesis submitted for the degree of
“Master of Business Administration”

supervised by
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Vienna, 26.04.2021

Affidavit

I, **ELIE MATAR EL RAACHINI, DIPL.-ING**, hereby declare

1. that I am the sole author of the present Master's Thesis, "THE NEXT GENERATION RESIDENTIAL SPACE", 129 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted the topic of this Master's Thesis or parts of it in any form for assessment as an examination paper, either in Austria or abroad.

Vienna, 26.04.2021

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Signature

Acknowledgments

It is the time to worship those who contributed to the success of my diploma project.

I emphasize great appreciation for the assistance of Professor Dr. Alexandre Redlein who accompanied my work closely and whose assistance and professional practice and theory have been valuable and instructive.

Yet the words are so insufficient to address cordial respects and thanks for all the teachers and administration board of the program "Professional MBA Facility Management" who contributed to my success. This accomplishment would not have been possible without you.

I would like to acknowledge my colleagues for a cherished time we spent together. I really appreciate your personal and professional support during the time I spent at the University. I am extremely glad to share our success together.

With deep love, I dedicate this work to my dear family, in recognition of their tremendous sacrifices and patience during my years of study. This thesis stands as a testament to your unconditional love and encouragement.

Thank you…

Abstract

Technological developments and new user expectations have placed considerable strain on businesses to adopt innovative, flexible, and customized new models. As the covid-19 pandemic contributed also to the disruption of the residential sector and skeptic the benefits of home service, the question remains on how to anticipate new demand to lure back consumers and gain back their trust. The purpose of this paper, to study the factors influencing user demand characteristics and get a comprehensive idea of the prevalence and expansion of demand for space and services to better understand the meaning of "New demand" and its implications on real estate and facility management. In addition, this paper serves as a guidance for designers and businesses operating in the residential sector, providing them with user-centered concepts and models to integrate in their design and services. The study starts with a focused literature review and continues with a multiple case study methodology, as the impact of Covid-19 is in the early stages of theory development. The result shows that demand for space is shifting towards sustainability and energy efficiency as users become more sensible about the environment and climate change. In addition to a shift toward different structural model like co-living and serviced apartment, especially for millennials where they prefer even to invest more in exchange for high quality and convenient services. The result also shows that the impact of Covid-19 on residential sector has not been as severe as it is in other industries. The consequences of covid-19 reflected reduced demand for co-living models, student residences and apartment versus a boost in demand for smart, individual, and mobile houses. Demand for home office space is expected to increase by 90% as 50% of employees have started working from home and 44% of home office employees are planning to adopt a hybrid employment agreement even after the end of lockdown. Covid-19 has reoriented consumers spending on entertainment, vacations and commuting towards on-demand home services which has created an opportunity for home service providers (specially cleaning, contracting, and landscaping) to take advantage of it by pivoting their services to align with the new demand for home improvement. Drawing on these findings, the next decades will witness substantial changes to home-life through technological advancement in response to societal, demographic and climate changes. The family home of the future will evolve to be more resilient and more adaptable to society's ever-evolving needs.

List of abbreviations

2D	Two-dimensional.
3D	Three-dimensional.
3DP	Three-dimensional printing
AC	Air conditioning
AI	Artificial intelligence
AR	Augmented reality
AREC	Austrian real estate companies
AT	Austria
ATX	Austrian Traded Index
BACnet	Building Automation and Control Network
BMS	Building management system
CBD	Central business district
CO2	Carbon dioxide
Covid-19	2019 Novel Coronavirus
EMF	Electromagnetic fields
EU	European Union
FM	Facility Management
FS	Facility Services
GDP	Gross Domestic Product
HR	Human Resources
HVAC	Heating, ventilation, and air conditioning
IoT	Internet of Things
IT	Information Technology
KPI	Key Performance Indicators
LCC	Life Cycle Costs
LCCA	Life cycle cost analysis
LEED	Leadership in Energy and Environmental Design
MBA	Master of Business Administration
ML	Machine learning
PPE	Personal protective equipment
RE	Real Estate
RFID	Radio frequency identification
SWOT	Strengths, weaknesses, opportunities, and threats
TU	Technical University
TV	Television
UK	United Kingdom
US	United states
UV	Ultraviolet
VR	Virtual reality

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1 Introduction

The world is changing rapidly, everything is transforming and evolving at a fast pace and nothing can guarantee the stability of the market. Demand will always continue to change, and investors keep wondering how to predict and implement users' new requirements in their offers to ensure a strong position in the market.

When thinking about the future of the residential sector, the first thing that comes to mind is the IOT (Internet of Things), Smart Building AR (augmented reality) and digitization. Well, the future is where cutting edge technology meets innovative design for smarter living. Now, that technology has started to shape all businesses around the world and sensors are getting cheaper, the idea of smart home is no longer a dream. However, the future demand does not arise only around the demand for services and technology. In shaping new demands, spatial design, architecture and several other variables play an important role.

What is the house of the future going to look like? What are the new trends? What home services are required? What is the impact of Covid-19 in a short and long run? What are the strategies that investors and the real estate company should follow to target future demand?

In this research, the author will answer these and other questions by exploring the main factors influencing the demands of the next generation and predicting new demands based on user behavior. In addition to analyzing demands for new services, studying available solution in the market, and developing a strategy for businesses to implement in their future investments. Ultimately, the author will focus on how a significant external force such as a pandemic can disrupt and reverse the table and delve into the impact of Covid-19 on demand for space and services in the residential sector.

All these points will be examined in detailed in this research, which can be used as a guide for creative solutions not only to answer the demand of users, but also to enlighten them.

2 Background

The residential sector is a remarkably interesting and exciting sector, and many researchers have addressed this subject, but few have nailed down the demand of the next generation with emphasis on services in this sector. Of course, the future is a hazy horizon, but nowadays the sky is the limit.

In 2019-2020, the author participated in ME310[1], an exchange program between TU Wien and the University of Stanford. ME310 is a radical and innovative course that brings together students across seas to teamwork on complex engineering projects sponsored by industry partners. The objective of the program is to explore problem rooms in many areas, identify potential users, create characters/personas representing the target group, explore the paints points and struggles of the personas, and build and test many prototypes to achieve the ultimate goal of presenting an authentic final product as a solution to the imposed problem.

The author was part of team AREC (Austrian real estate companies) led by Professor Dr. Alexander REDLEIN and sponsored by the industry partners IMMOFINANZ[2], ÖSW [3] and SIMACEK[4]. The team had to explore the new demand for office and residential space and to provide users a smooth journey. After interviewing several people, the team concluded that users do not know what they want, they have a lack of confidence, and are reluctant to make decisions, and this tension continues to increase relatively with the increase in number of offers. AREC has also found that users need help with their decision-making process, especially when multiple people are involved in the process, then prioritizing and categorizing properties become a hectic journey.

In addition, AREC team discovered how technologies such as virtual reality (VR) can help users assess and prioritize their preferences, how a simple 3D virtual tour can be an important requirement in the decision-making process and how the absence of these small services can eliminate a property from competition.

[1] ME310 Design Innovation at Stanford University
[2] Your Partner for Retail and Office Properties | IMMOFINANZ AG
[3] Immobilienangebot | ÖSW (oesw.at)
[4] SIMACEK Facility Management Group

AREC team's product was “Space Book” a decision-making and note-taking mobile application (app) that helps users find the perfect space as it provides the opportunity to narrow down user choices, provides smart suggestions for checklists, assists in rating of listings, and provides a smart interactive dashboard to summarize the journey of users.

During this Me310 cycle, the author found that a large portion related to the prediction of users' demands, requirements, parameters and preferences in residential buildings were not covered in the Space Book app. Many real estate companies are advancing in construction without even considering users 'requirements and many home service companies are struggling to respond to the change in users' demand precisely when users are not aware of what they need.

The purpose of this study is to recognize the emerging patterns in user behavior and the market change arising from the pandemic of covid-19. In addition to provide a support for real estate and service provider companies in predicting new demand and taking advantage of crises such as the pandemic to acquire a strong position in the market.

This topic became more interesting and challenging for the author. He decided to address and highlight the demand for residential space and services of the next generation in his master's thesis in Facilities Management at TU Wien.

3 Methodology

This paper is a basic type of research that aims to develop knowledge, strategy, theories and predictions based on quantitative and qualitative data to explore the future demand for space and services in residential buildings. The methodological approach consists of research, analysis and verification of secondary data already collected by researchers and academic publishers.

For the quantitative method, data were collected in the field of Residential real estate (RE) market and facility services (FS) using subject-related keywords such as Facility Management, FS, residential services, residential space, future demand, RE market, home improvement, housing, property and service provider. The data were collected from numerous and trustworthy sources conducting surveys focusing on numbers and statistics such as McKinsey & Company, PWC, CBRE. SAVILLS, BUWOG Group, BCG and HARVARD business review. Due to the lack of many inputs, this research was based on non-probability sampling and conclusion was drawn only about specific subject of the research. In addition, all these data were interpreted according to the descriptive research methodology which is based on using the data without altering them or changing any variables. After collecting the data, a verification and validation method has been established, such as cross-reference checking, to verify the numbers and ensure that the author had the recent version of data.

The same approach has been adopted for the qualitative method, after collecting the data in the field of FS and residential RE market, a further study was conducted to identify patterns and relationships between subjects, to research missing information, and to validate the data before proceeding with the analyze. In addition, the author resorted to data collection from different countries and various search engines such as Google Scholar, pear reviewed articles, authentically research institute and scientific literatures in the area of FM and RE market such as The Facility Service industry in Europe (Redlein & Stopajnik, 2020) and Modern Facility and Workplace Management (Redlein, Höhenberger, & Turnbul, 2020).

4 History of houses

4.1 Housing timeline

As with everything, homes evolve over time, not only in concept, size, and design, but also in terms of features and services that are driven by new technologies. Homes evolve to address users' expectations in a certain period of time and by looking back on the timeline provided by (IAAC, 2017) it is interesting to observe how this industry evolves from a cave culture to a three-dimensional (3D) printed house. (Fig. 1).

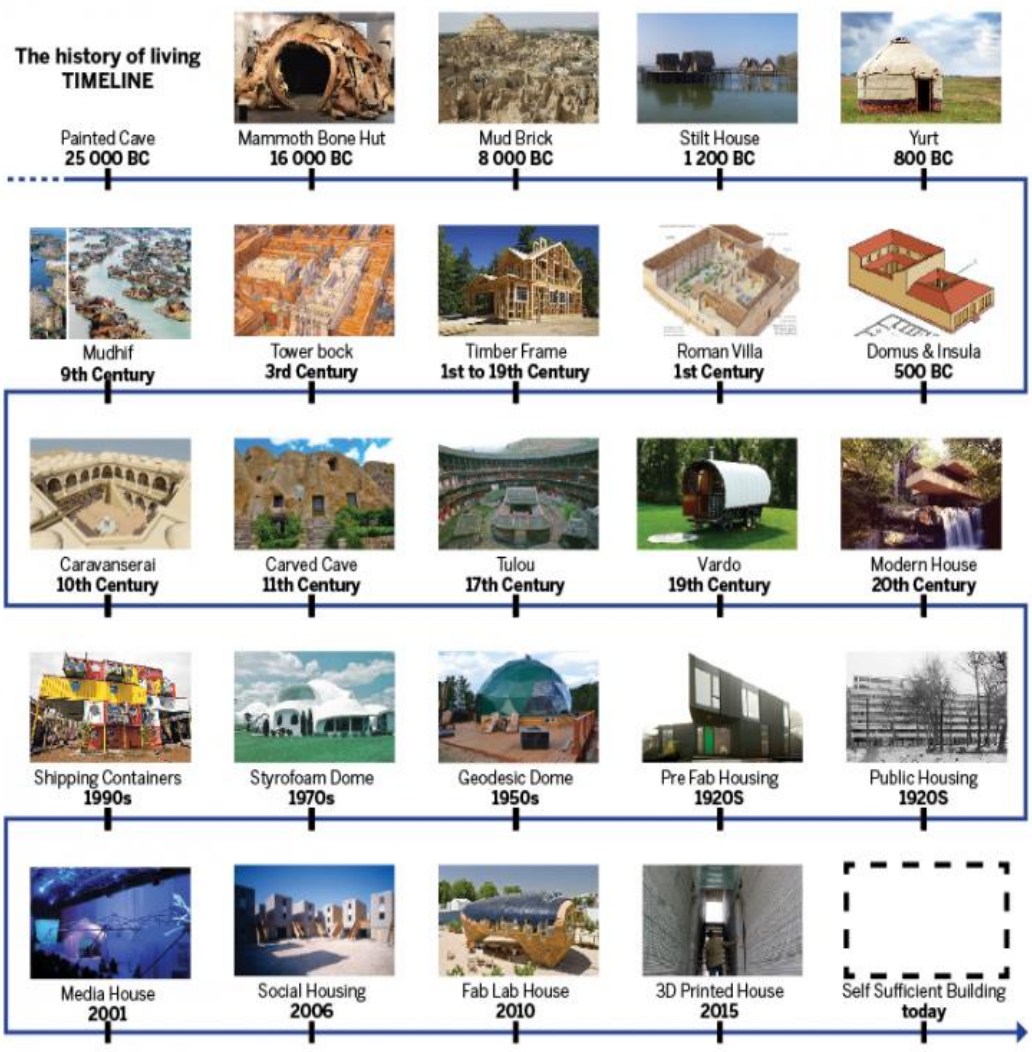


Figure 1- Evolution of living habitats through the centuries. (IAAC, 2017)

4.2 Housing Topologies

Figure 2- Housing topologies (IAAC, 2017)

As clearly defined in figure 2, the residential sector can be divided into different types, as each type has significant value throughout the housing schedule.

Starting with a single dwelling, which is a stand-alone home used as housing for one or more families. The advantages of this type are more privacy, more freedom and high use of land. The disadvantages are the high maintenance costs and repair costs that must be borne by the owner alone in addition to a high-energy consumption as there is no common wall with other apartments.

Multi-user housing, which is a form of urban planning that incorporates residential, industrial, cultural, institutional or entertainment uses in one space. A feature of this type of housing is lower risk but potential for higher price entry.

The mixed-use architecture tends to incorporate four or five uses, such as housing, shopping, grocery, hotel, parking, transport, culture and entertainment, into one framework (Urban-Hub, 2020). This type of home demonstrates how commercial and professional changes can affect real estate as mixing business and living in one building is no longer a dilemma. In addition, the outcome of this type of home is change in consumer behavior towards commuting time and accommodation that is more convenient.

Short-term rentals accommodate tourists or travelers on short-term vacations. For example, Airbnb is a short-term solution that has taken the world by storm and is today a big competitor for the hotel industry.

Student or dormitory apartment like “room4rent” a furnished apartment offered by Österreichisches Siedlungswerk (ÖSW), which accommodates students during study periods or employees, on business trips. This type of accommodation focuses on making the stay of the users as comfortable as possible by providing them with a temporary furnished house where the users can select many services, according to their needs, from the wide range provided by the client.

Non-conventional houses are non-standard homes such as caravans or boats. This type of accommodation is associated with vacations, cruises, or road trips. It is a secondary type besides the main house and is more used for luxury or pleasure purposes.

Emergency houses made of prefab are a solution for emergency cases like wars or epidemics. They play a vital role in a community's homelessness response system by providing an immediate place of residence while people reconnect with housing.

Homes will never stop growing, as users are always on the lookout for what is new on the market and what is best for them. However, what kind of accommodation is the most in demand? Which type will be the future pioneer?

To answer these questions, it is necessary to study the main factors that determine user demand and focus on factors that influence decision-making during the buying or leasing process. At the end of the day, the offers should cater to users’ needs.

5 Demand Drivers

Homes have changed a lot over the past 300 years and many internal and external factors have played an important role in the development of our homes such as building materials, new mechanical and electrical systems, creativity in architecture, family size, new technologies, government incentives, user preferences, raising the standard of living and quality of living. These changes have transformed and shaped families and social relationships.

5.1 Market equilibrium

First, let us define some terms used in macroeconomics (Pinkasovitch, 2020)

Demand is the relationship between the price of a good and its demand from the standpoint of the consumer.

Supply from the point of view of providers, it is the relation between the price and required supply of a product.

Market Equilibrium whereby both parties can engage in ongoing business transactions to the benefit of consumers and producers.

Surge pricing an effective technique to increase supply to meet demand.

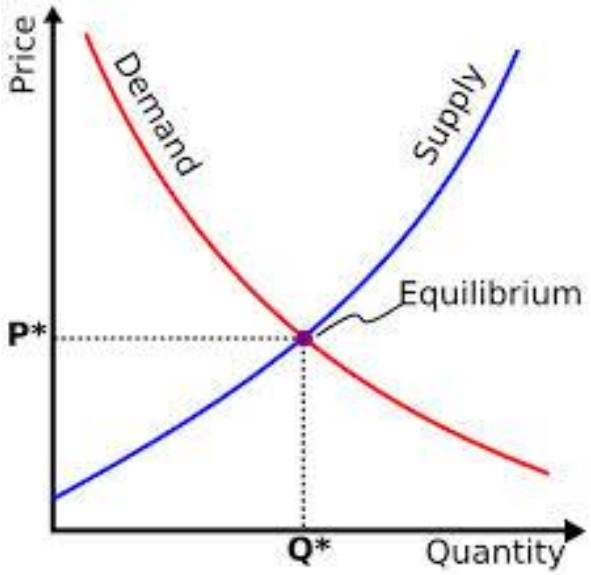


Figure 3- Supply and demand curves (Kaznatcheev, 2019)

5.2 Shift in demand curve.

A shift in the demand curve occurs when there is a determinant of demand other than price changes. This happens when the demand for goods and services changes even though the price has not changed.

The change in the demand curve to the right implies a rise in demand at either price, as a factor such as market patterns or preferences has improved. Conversely, a shift to the left displays a decrease in demand at whatever price because another factor, such as number of buyers, has slumped (Kimberly, 2020).

Figure 4 -Shift in demand curve (Spaulding, 2020)

A change in any curve (whether supply or demand) can change the equilibrium price and equilibrium quantity of the good or service. As shown in Figure 4, the increase in demand represented by the shift in the demand curve to the right, has led to an increase in the price to a new equilibrium level and thus the increase in the quantity supplied in response to the market equilibrium.

Nevertheless, what are the reasons of the right change in the demand curve?

5.3 Determinant of demand

5.3.1 Demographic changes

The number of potential buyers will affect global demand. Since an increase in the number of customers will ultimately lead to an increase in demand which will cause the demand curve to shift to the right. In response to this shift in demand, the market must increase supply to achieve market equilibrium.

Demographic and economic aspects have been shown to affect shifts in the real estate (RE) industry. In fact, according to a study by Henry Li on the effects of demographics on the RE market in the US, a 1% increase in the labor force leads to a 2.7% increase in house prices (Li, 2014). Thus, along with demographic conditions, the labor force continues to be the primary customers of RE and the key marketers of increases in RE prices (Li, 2014).

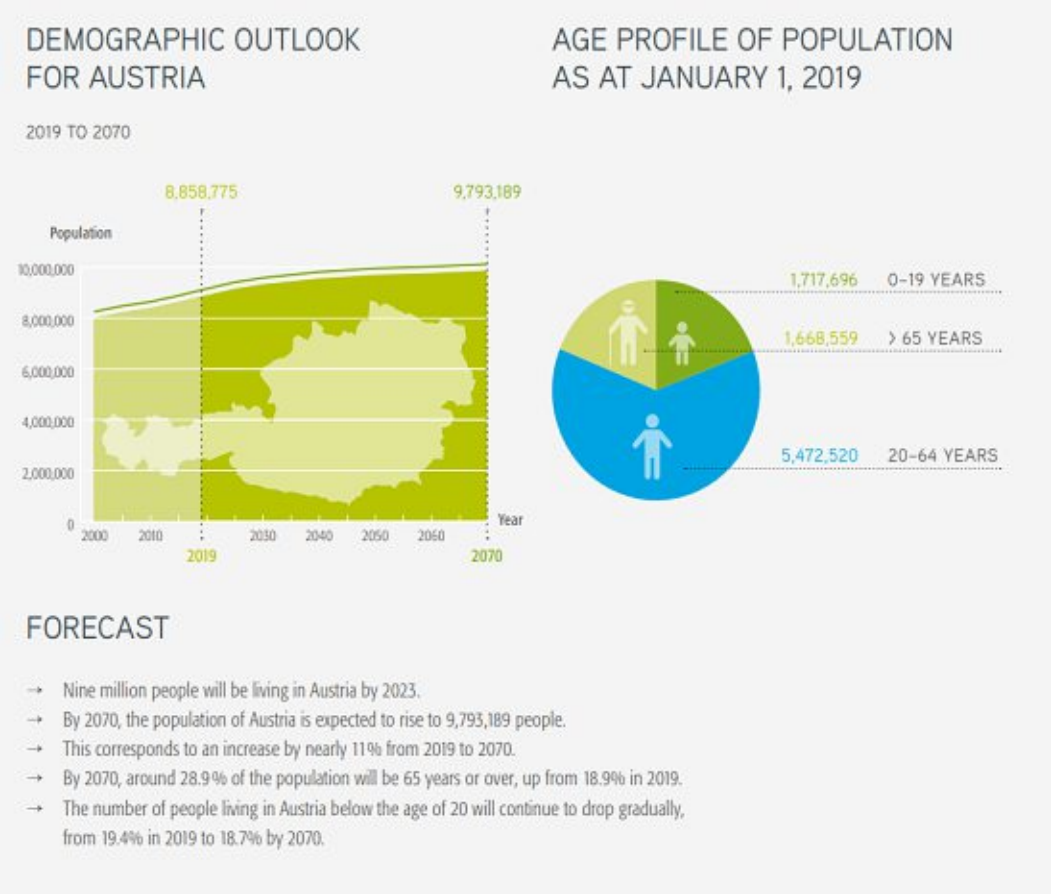


Figure 5-Demographic Outlook for Austria (Buwog, 2020)

5.3.1.1 Future changes in family and household composition

Family structure has a great influence on demographic and demand changes. Nowadays the family is getting smaller and smaller, the marriage rate decreases while the divorce rate rises. According to First Vienna Residential Market Report (Buwog, 2020) the average household size of 3,947,204 private households in Austria was 2.22 people in 2019. The downward trend in families continues. The analysts, who studied the average family size, expect the size to fall from 2.70 (in 1984) to 2.09 by 2080. In Vienna, there were around 930,979 families with an average family size of just 2, 04 people in 2019.

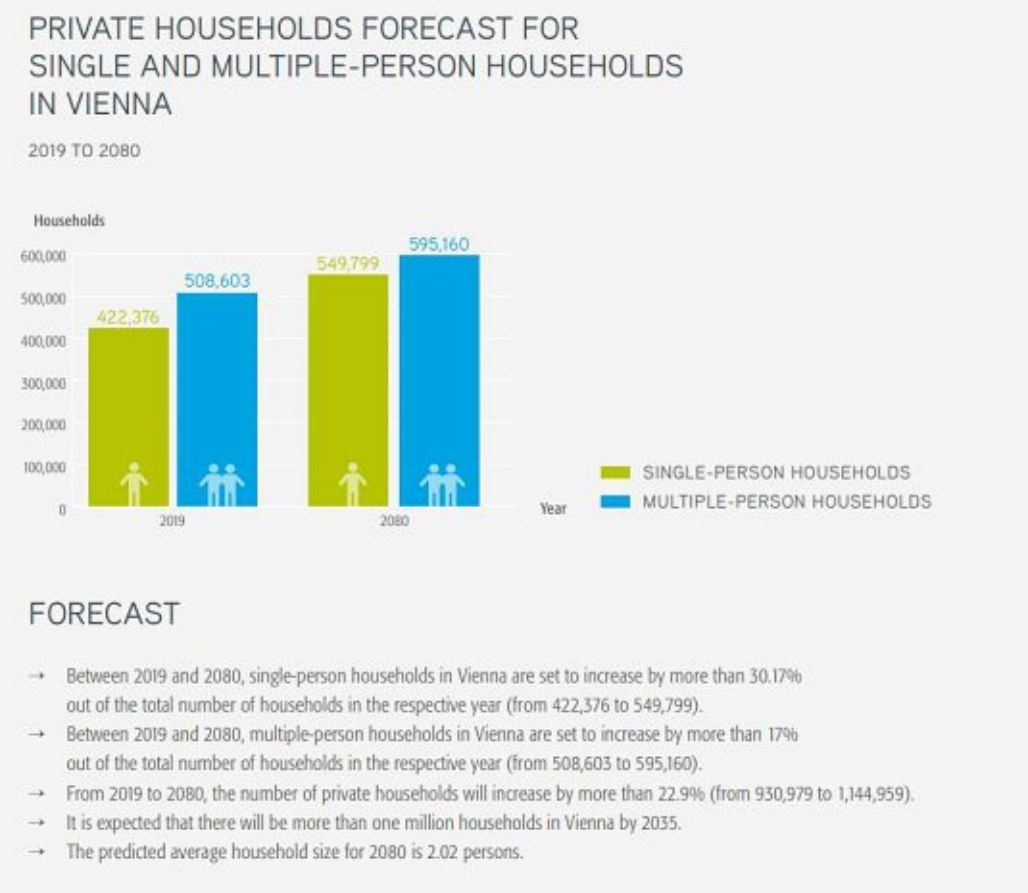


Figure 6- Projected share of single households in Vienna (Buwog, 2020)

In the most developed European countries, the share of single households is projected to hit forty percent of all households by 2030. (OECD, 2011). Therefore, the next demand in residential houses will be for a smaller apartment that can accommodate a small family and the idea of owning a large house with many rooms will not be the customer's preferred option.

5.3.1.2 Urbanization & immigration

People transition and migration from village to cities will keep growing. According to Tauber and Feldkamp, the population in cities with over than 1 million inhabitants will increase by 22 percent by 2030. This pattern is already visible in Germany's major cities, as the multi-story constructions rose by twenty percent in 2018 (compared to 2008) and reached eighty percent of newly built residential units (Tauber & Feldkamp, 2019).

5.3.1.3 Life expectancy

It is generally expected that the longevity gains made over the past decades will continue to increase due to the development of technologies in the medical fields and the reduction of fatal events such as wars and natural disasters.

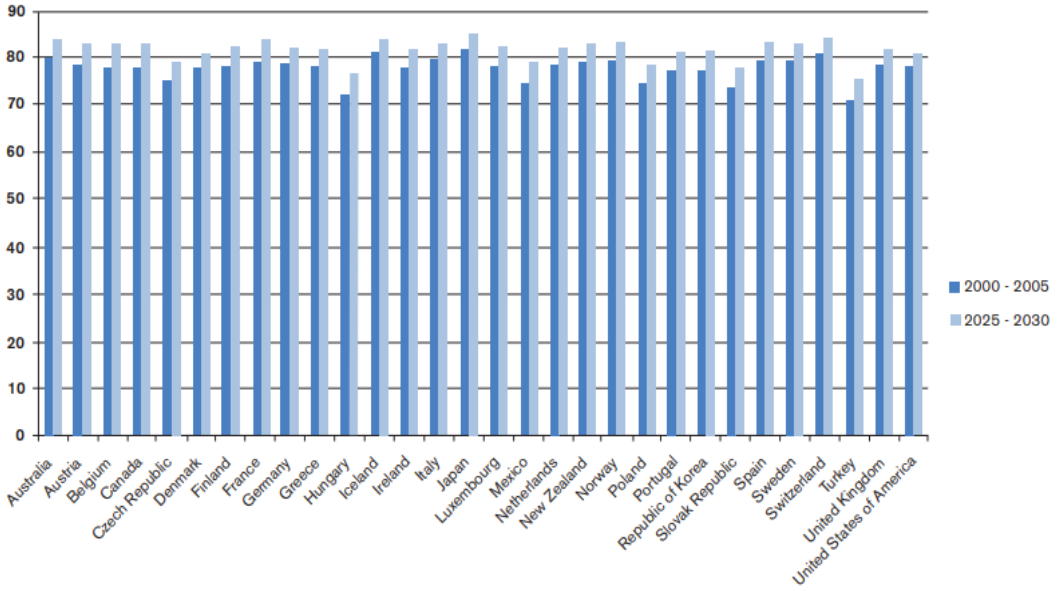


Figure 7-Projected life expectancy rates (OECD, 2011)

Companies and service providers should consider that the world is moving towards an aging population and that this group of people can become an interested group to adapt and personalize services according to their requirements. It is also expected that there will be a great demand for serviced apartments and apartments equipped to accommodate people with special needs, with an emphasis on services that support the elderly in their daily activities.

5.3.2 Affordability

The rental rise is largely attributed to the lack of affordable housing, especially in urban areas where the capacity to build new buildings is slightly limited and where the government tends to adopt certain strategies such as up zoning to develop new buildings on the outskirts of urban areas (Tauber & Feldkamp, 2019).

According to study by European Construction Sector Observatory on Housing affordability and sustainability in the EU, here are the main factors that can balance and increase consumer demand (EU Construction Sector Observatory, 2019).

5.3.2.1 Income of buyers

If a person gets a raise, they tend to buy more products even if the price does not change. This is an example of how the income of buyers shifts demand curves to the right. Thus, higher income will increase the percentage of affordability of the product / service, which will lead to increased demand.

5.3.2.2 Job growth

Customers do not feel safe in a society where job growth is weak and unemployment rate continues to rise. For them, they have uncertainty about the future and are afraid to invest or perhaps fear losing their job and this fear of unemployment affects their decision to invest. Therefore, in a society experiencing job growth, the demand for real estate will increase particularly for the rental market, as the job opportunities for people who are unable to buy a home can at least rent a home.

5.3.2.3 Socio economic trend

Socio-economic factors, such as education level for example, play an important role in the decision-making process, especially regarding the type of building and the area in which they are conduction their search.

5.3.2.4 Availability

In the event that there are many houses available in the market, this is good for the clients as competition between suppliers will increase and lead to lower prices and higher accessibility for users. However, the reduction in available products would, in reaction to a higher demand, causes the market price to rise.

5.3.3 Consumer trends

Consumer trends are essentially to be analyzed to identify the behavior and habits of the customer in relation to the service or product provided. For example, during the pandemic, customer preferred to be located outside the cities and be more connected with the nature. Although the rent in the cities remained unchanged, the demand was less at each price (Savills, 2020).

According to PWC reports on the emerging trends in European RE, here are the main factors that are shaping the consumer trends (PWC, Emerging Trends in Real Estate, 2020).

5.3.3.1 Lifestyle's preferences

The lifestyle and preferences of consumers are constantly changing, and it is important to recognize the future preferences of users and to have a high degree of flexibility to be able to act quickly according to those changes. Nowadays, technology is taking over our daily life and users are demanding more access to these new smart devices in their life.

5.3.3.2 Sustainability.

Increasing consumer appreciation of sustainability, tighter regulations on energy consumption and green development stimulate the production of more environmentally friendly housing options. In 2018, the number of countries with obligatory or optional requirements for energy use and CO2 emissions, increased from thirty-eight to eighty-eight (compared to 1994). These developments have been reinforced by global pacts, including the 2015 Paris Agreement on Climate Change. Which were approved by 195 countries at the beginning of 2019 (Tauber & Feldkamp, 2019).

5.3.3.3 Digital Economy.

As the economy becomes digital, so does what people look for at home. Currently, the majority of users have access to the Internet. In developed countries, 65% of Millennials and Generation Zs interact more digitally than they do in person. These trends are boosting the demand for remote work, home offices, smart homes, and co-living, among others (Tauber & Feldkamp, 2019).

5.3.3.4 Home office

Nowadays, many people spend part of their time working from home, either as an elective, to comply with the demands of raising a family, or due to certain circumstances such as an epidemic. Between 2012 and 2016, there was a 12.4% increase in flexible time (HSO, 2020). This new trend led to an increase on demand for property equipped with an office where people can carry on their office duties from home. In addition, this new trend led to an increase on demand for services like internet services, postal services, and many others. Taking an example, the United Kingdom (UK) where 50% of the workforce predict to be working remotely by 2020 (Gough, 2017). 67% of full-time workers wish they were offered a flexible time. 40% would choose it over a raise (Ladle, 2017). 30% of 2,261 fathers surveyed would work flexibly when given the opportunity to do so, to share childcare responsibilities (Equality and Human Rights, 2016).

5.4 Demand Vs Supply perspective

According to Boston Consulting Group, the residential sector must be seen from two different angles. The first is the consumer (demand) perspective, where future drivers will be related to urbanization, demographic changes, sustainability, affordability, and digital economy. The second is the supplier (supply) perspective, where future drivers will be related to construction technology, construction methods, building technology, supplier landscape and access & distribution.

Figure 8-Ten Trends are shaping what types of housing will look like (Tauber & Feldkamp, 2019)

6 Future housing

The concept of the house is changing, and comfort, safety and family are no longer the main features of the house. User preference is not the only factor influencing the evolution of housing demand; many other external factors play an important role such as population growth, shortage of affordable housing, sustainability regulations and building industry that is during a technological revolution.

The revolution in home is now focusing on new attributes such as affordable, shared, ecofriendly, flexible, stylish, or healthy. These substitutes to conventional homes now account for four to six percent of all new residential units constructed in each year, and these figures are expected to rise in the future, according to the BCG report (Tauber & Feldkamp, 2019).

6.1 Sinus Milieus Model

Sinus Milieus model is a concept, which group likeminded people according to their preferences, their characteristics, and their lifestyle. The Sinus Milieus model reflect the changing society and provide a true picture of the social and cultural diversity of the society. This makes it one of the most important models to target the group research in German speaking countries. Sinus model is based on a two-dimensional (2D) matrix that maps people based on their basic orientation and social status. Here are some possible classifications of people in the community.

6.1.1 Traditional milieus

Figure 9-Traditionnel Milieus (Buwog, 2020)

6.1.2 Central milieus

THE NEW MIDDLE CLASS. *The adaptive mainstream – seeking professional and social establishment, secure and harmonic circumstances, support and orientation, peace and a slow pace. They prefer interiors with neo-rustic, conventional aesthetics.*

ADAPTIVE-PRAGMATISTS. *The young pragmatist middle stratum – pronounced life-pragmatism, strong desire for anchorage, membership, security, performance orientation, but also the wish for fun and entertainment. The prevailing lifestyle is either trendy or quiet and down-to-earth.*

Figure 10-Central Milieus (Buwog, 2020)

6.1.3 Upper class

ESTABLISHED. *The performance-oriented elite with a strong anchorage in tradition – strongly focused on status, exclusiveness, responsibility, and leadership. The apartments are often a stylishly harmonious combination of traditional and modern.*

POSTMATERIALISTS. *Open-minded social critics – intellectual, educated milieu, interested in variegated aspects of culture; cosmopolitan orientation, but critical towards globalisation; socially committed. Home styles are dominated by a sense of nature and authenticity; distinction from the mainstream plays a crucial role.*

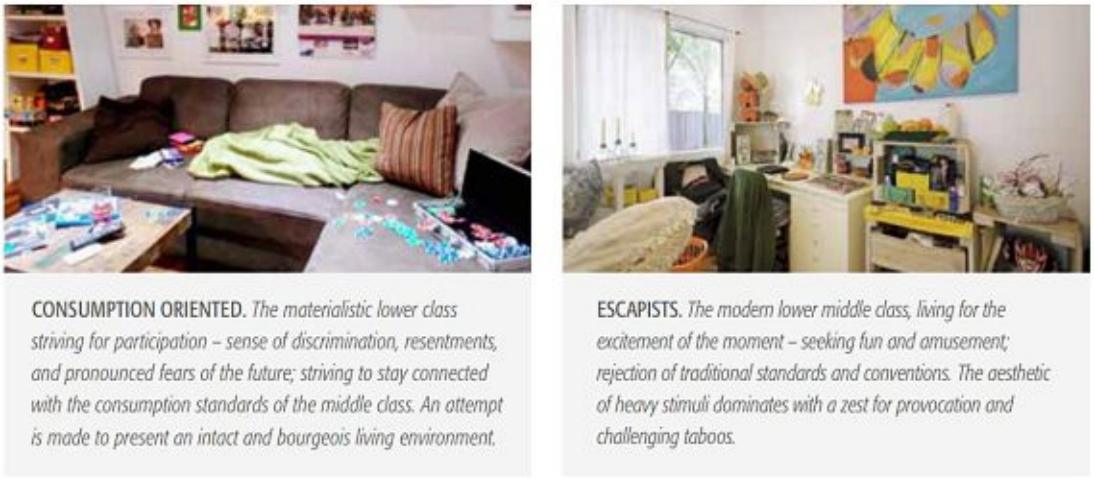
Figure 11-Upper Class1 (Buwog, 2020)

HIGH ACHIEVERS. *The flexible and globally oriented performance elite – individual performance, efficiency, and success take top priority; competent in business and IT. High achievers appreciate open, generously dimensioned interior designs that focus on presentation.*

DIGITAL INDIVIDUALISTS. *The individualistic, networking, digital avant-garde – mentally and geographically mobile, cross-linked online and offline, permanently looking for new experiences. The home is creatively designed with deliberately unconventional highlights.*

Figure 12-Upper Class 2 (Buwog, 2020)

6.1.4 The modern lower class



CONSUMPTION ORIENTED. *The materialistic lower class striving for participation – sense of discrimination, resentments, and pronounced fears of the future; striving to stay connected with the consumption standards of the middle class. An attempt is made to present an intact and bourgeois living environment.*

ESCAPISTS. *The modern lower middle class, living for the excitement of the moment – seeking fun and amusement; rejection of traditional standards and conventions. The aesthetic of heavy stimuli dominates with a zest for provocation and challenging taboos.*

Figure 13- Modern Lower Class (Buwog, 2020)

6.1.5 Sinus Milieus Diagram

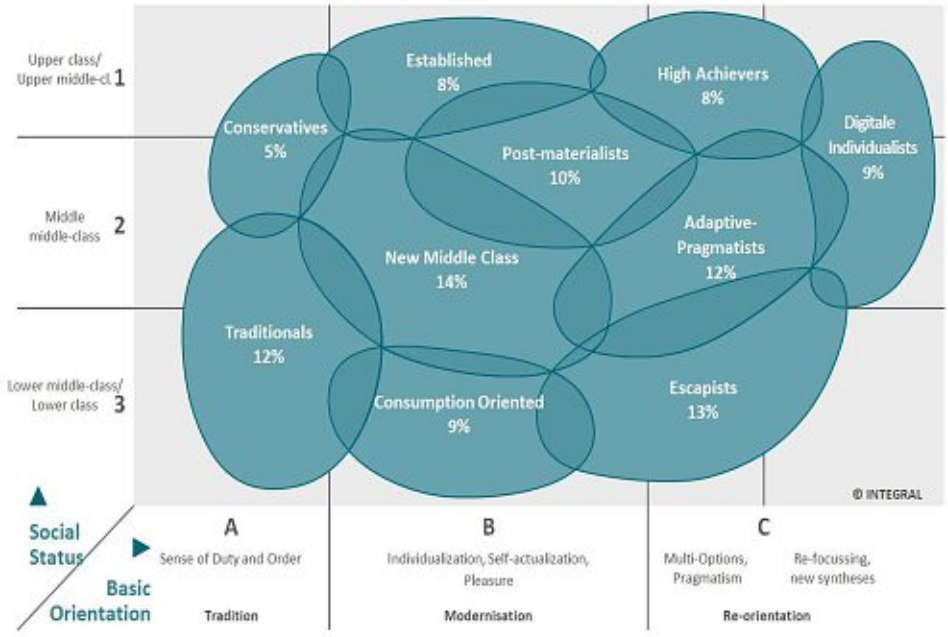


Figure 14- Sinus Milieus Diagramme (Integral.co.at, 2020)

The diagram shows the current group landscape with each group's position in Austrian society.

The axis of X illustrates the fundamental orientations per category inside the social structure. The further one moves to the right on the graph, the more modern the general orientation of the milieu.

- Category A: signify the sense of duty or obligation.
- Category B: require the desire for individualization and self-realization.
- Category C: Illustrates the differentiation in contemporary culture between various options and pragmatism.

The axis of Y illustrates the social status per group according to their class categorization.

- Lower class
- Middle class
- Upper class

A greater value of X indicates an elevated orientation toward social, economic and cultural fundamental. A greater value of Y indicates an elevated socioeconomic standing, higher level of schooling, wages and job qualifications.

According to the model, 17 % of the Austrian population still live in a traditional way (column A), 41 % prefer modern life, individualization, and self-actualization Column B), while 42% tend to adopt new way of life, pragmatism, and new syntheses (Column C).

Looking at row 1 & 2 and column C, 70% of the people who are moving toward re-orientation basics they come from a middle and upper class of society. These people share different interests such as digital avant-garde, success orientation, modern performance, high achievers, and fun & money driven.

This model can be a solid foundation and statistical tool for any investor; it helps them examine the likelihood of a product's success before launching it into a market.

The graph highly reflect that new trends are moving toward digitalization, technologies, and new ways of life. The next few years will witness changes in the lifestyles and preferences of educated people through the advancement of technology in response to societal changes.

Therefore, in this section, the author will concentrate on innovative and current real estate market solutions and on how artificial intelligence (AI), internet of things (IoT), machine learning (ML) and augmented reality (AR) are shaping demand in the real estate market.

6.2 New demand

6.2.1 Adaptability and flexibility

Nowadays, the resilience of living space and its ability to adapt to the changing needs of users has become an important factor to consider during the journey in search of residential space.

Life is changing rapidly, and needs are constantly changing, so people are looking for a space that adapts to their life stages. They need small spaces that do more. Flexibility has become one of the top priorities for users and architects face great challenges in meeting all users' needs. The design should be highly effective to provide multifunctional and universal solutions in small apartments.

When consumers talk about flexibility, they do not just focus on furniture and space, but also on diversity of types of users. A flexible space must adapt to different users and be able to adapt to the change over time in the users' lifespan and the family life cycle.

Time is the fourth dimension of space and it is an important factor when talking about resilience, the home needs to be changed in no time. Take the example of the businessman's apartment in Monte Carlo, designed by the Lazzarini Pickering studio (Bell & Godwin, 2000). However, not only the walls are movable, but also the furniture is an integral part of it and its fate changes depending on the situation. The table turns into a cupboard, cupboard changes into a screen, screen into the door. Everything is designed in a simple and economical style, requiring no time to keep everything in order. This space adapts to the modern way of life.

Location is also a significant factor for many users who do not have a permanent place due to the nature of their business. Nowadays, the portable home that can be carried or moved on its own has become a popular solution for these people. Take, for example, the "Loftcube" designed by Werner Aisslinger, which consists of flexible interior spaces including sliding walls that can divide the space according to users' needs in addition to multifunctional furniture.

To be able to compare homes, a degree of flexibility should be considered, and which depends on two factors, the first being the ease with which user can make changes, and the second being how quickly the changes can be made. Of course, these parameters depend on the size and type of the building. Below is a brief diagram showing different type of flexibility.

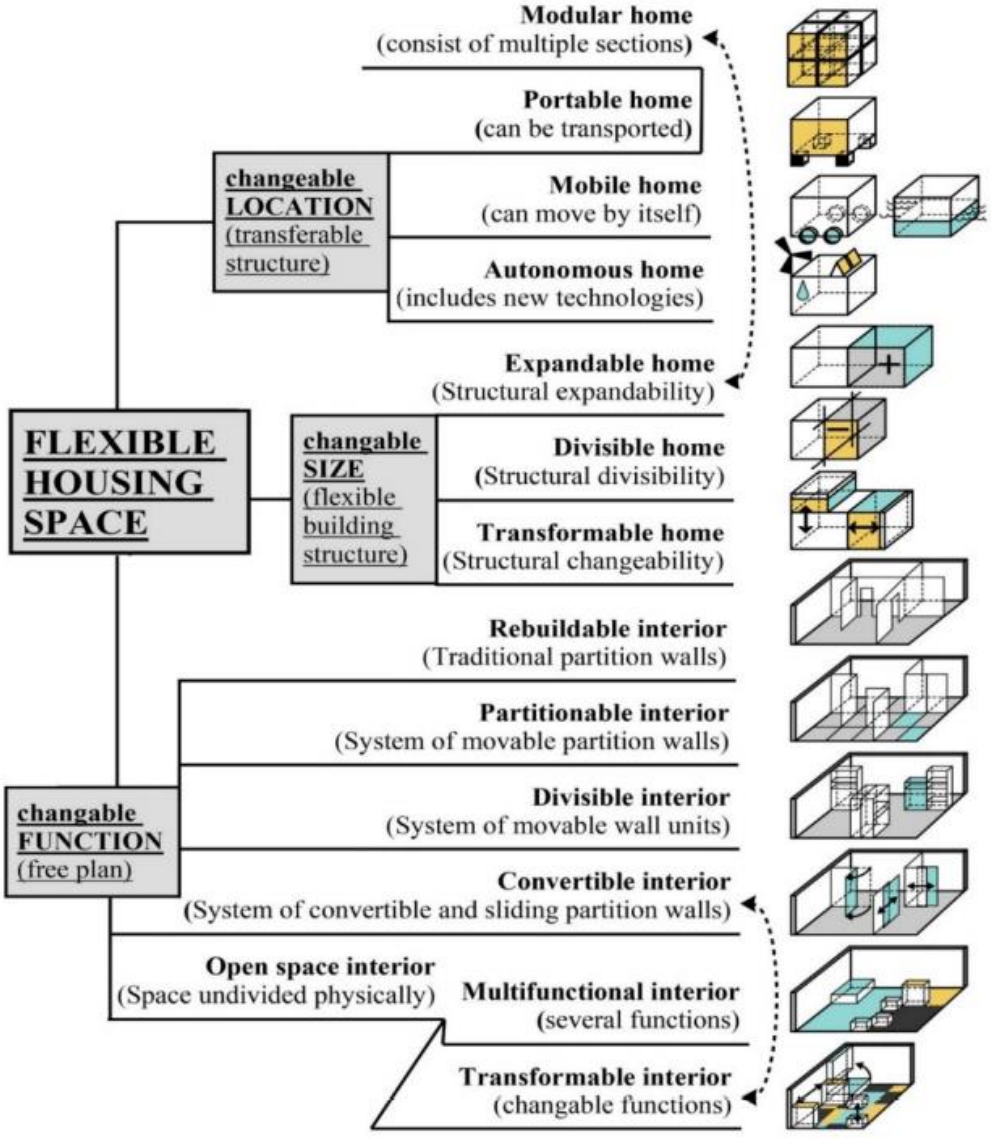


Figure 15-Flexibility systematics-types of flexibility depending on the nature and scale of changes. (Magdziak, 2019)

A flexible and adaptive space has always been a concept in the architectural field over time and the development of this concept has always been a response to the need for changes in the user lifestyle and the continuous development and growth of urban cities. Mobility exists in our daily activities, more and more users are engaging their smart and mobile technologies in those activities like reading emails on the way to work, storing data in a virtual cloud, holding virtual meetings, engaging virtual activities online or even studying with e-learning platforms. Hence, mobility of objects is not something new to users and the mobility of residential space is just another step in the same direction.

Life transformations are more common nowadays especially with the development of technologies and the affordability of smart devices that can support architectural concepts related to flexible space and which can provide a lot of benefits to users such as:

• Adaptation of space to the user needs and preferences

• Adaptation of the same space to different numbers of users.

• Adaptation to the family life cycle.

• Adaptation to the needs of elderly and disabled people.

• Adaption to the functionality and usage of space.

• Taking into consideration Time the fourth dimension of architecture.

• Reducing the usable size by relying on transformation and shift in functions.

• Autonomy, mobility, and individualization of a residential unit.

• Application of modular and prefabricated solutions.

The flexibility of residential architecture is reflected in the possibility of making easy and quick changes in the division, expansion, and arrangement of the space, as well as the possibility of reducing the size without limiting its functions (Magdziak, 2019). Thanks to these characteristics, a flexible and adaptive housing structure conforms to the assumptions of inclusive, affordable, and accessible design and the idea of sustainable development.

Before considering any changes, users should consider trying to adjust these changes in the earlier stage of the project because the influence factors on cost over the whole life cycle of a property can be extremely high during the utilization phase. Below a graph from introduction into FM by (Redlein, Inroduction into FM, 2018) shows how the degree of the influence is remarkably high while the cost of change is extremely low in the project development phase and vice versa in the utilization phase.

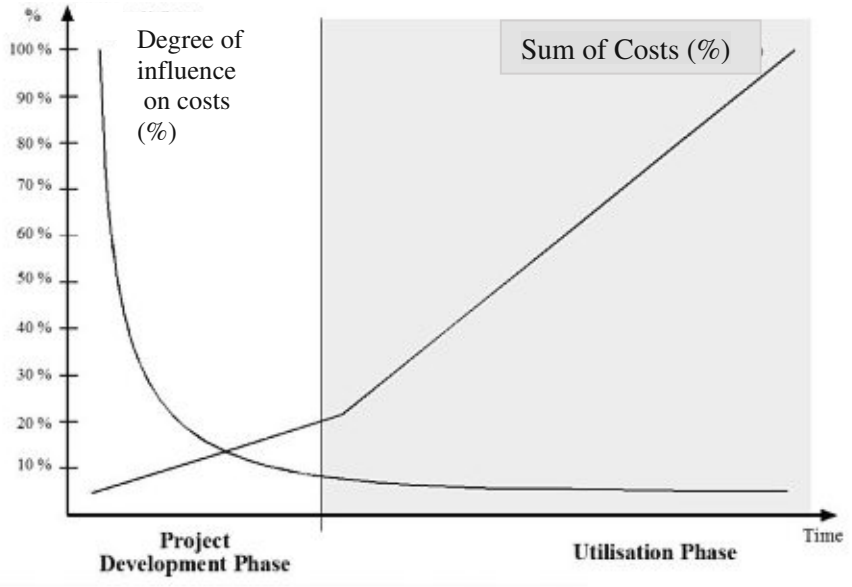


Figure 16- Influence factors on costs over the whole life cycle of the real estate property (Redlein, Inroduction into FM, 2018)

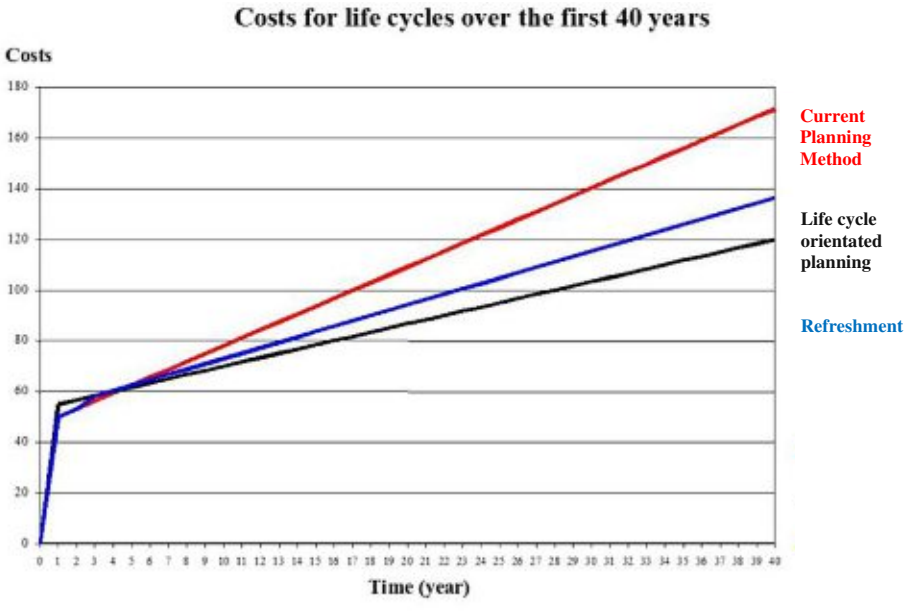


Figure 17- Construction Costs and operation costs of buildings (Redlein, Inroduction into FM, 2018)

6.2.2 Customization

Product customization is the key to offer each customer a passionate and committed journey in finding a tailored solution to his or her needs, which can drive customer loyalty and increase customer satisfaction.

However, how can customization be applied in a residential space?

Customization of residential space is a challenge to architects because it is not easy to apply an adjustment to an existing space. Therefore, the customization of building type and architecture plans must be done before the start of construction work, in the design phase and when the cost of modification is exceptionally low compared to the construction phase.

Not to mention that technologies have enhanced the idea of customization especially now with all the developed programs that can provide a 3D model to users where they can feel the space even before the start of constructions. These features have helped many people not related to the field of architecture to feel involved in the design stage and to customize their own spaces according to their needs only with simple and easy-to-use tools.

In addition to the structure of the buildings, the personalization of the furniture and interior plays an important role. Many production companies like Ikea have an easy-to-use augmented reality app where user can personalize his own furniture and virtually place it in his apartment to see if it is suitable before ordering it.

Things are moving very quickly, and many suppliers are turning to demand markets. One model for all is no longer a valid option for clients. People are looking for products that are adaptable to their preferences, and they are more willing to buy personalized products because they feel more engaged and satisfied.

Finally, the value and future of any element resides in the ability to customize and allowing your customers to customize their experience is a smart way to stand apart from the competition. After all, who knows what they need, better than the customer themselves?

6.2.3 Social Hub – Co-living

Co-living as a modern consist of sharing a house between several persons, this model became popular due to the factor of growth in urbanization rates, lack of affordable housing and change in interest in lifestyle. Living in a co-living environment brings many opportunities such as culture, social interaction, cost reduction, flexibility, ease, accessibility and usability for the person as opposed to conventional living choice.

Much as co-working gave rise to community-based workspaces, co-living is doing the same for living spaces. Both models exploit and gain advantages from the shared services and space. Usually, the benefits of these models translate into reduced staff costs and more short-term liabilities compared to the conventional model.

Nowadays people are tending to work remotely or to become freelancers; rural areas are reconfigured to accommodate the shifting of populations; space is evolving to receive digital nomads who keep switching their homes reckon with their lifestyle; live-work hub are merging in the society. Co-living is a great solution for people who are following that trend like the remote workers, digital nomads, business traveler, cost conscious and community seeking.

Co-living keep client connected convenience, the popularity of co-living has been bolstered by the "subscription economy" as more, and more consumers are intrigued by bundling living amenities like utilities and Wi-Fi. Co-living offers everything from the necessities to kitchen appliances, furniture, and even towels. Researchers expect the rise of Move-in ready concepts like San Francisco's Starcity that allows resident to arrive with nothing but a suitcase.

Co-living market performance today clearly shows high demand and high occupancy of existing product, metrics that will continue to spur further development and investor interest. Current product also reveals a significant premium on rents per square foot for co-living units than for conventional apartments, 32% to 38%, according to a recent study by CBRE and Common (CBRE, 2020).

6.2.4 Green building & sustainability

The concept of green building is an alternative effort that aims to reduce the impact of CO2 emissions. Understanding green residential is about reducing the consumption of energy, water, and natural resources. The awareness of global warming has become an important factor for users and many of them are looking to achieve a zero-energy building where the total amount of energy consumed is equal to or less than the amount of renewable energy created on site using modern technologies such as heat pumps, insulations, and solar panels.

Although constructing houses accredited as Leadership in Energy and Environmental Design (LEED) requires much more investment and obligations compared to the conventional houses, customer see the added expense as a valuable investment for a cleaner, ecofriendly and sustainable home. In addition, those extra costs can pay for themselves over time in energy savings (Zachery, 2016).

Yet the question remains: in an era where homebuilding costs keep rising, why are consumers looking to spend more instead of seeking ways to trim costs.

Innovation is driven by emerging technology and changing societal perceptions.

Green technology in particularly new trends and smart devices plays an important role in sustainability and energy efficiency since they support process of co2 emissions and reduce impact on the environment.

Green technology relies on motion detectors, RFID readers and other sensors to track and monitor a building's occupancy, so whenever an area is unoccupied, green technology will automatically turn off the lights and adjust HVAC systems. Building owners can realize as much as 30% savings in their energy expenses by eliminating unnecessary energy use in this manner (Tunnicliffe, Davies, & Kingsland, 2019).

The top sustainable constructions technology in market are solar power, biodegradable materials, green insulation, smart appliance, cool roofs, sustainable resource sourcing, electrochromic smart glass, water efficiency technologies, sustainable indoor environment technologies and many more.

Green Houses Add Value

Green homes have become the new normal and, in the future, most buildings are expected to have certified energy as per directive imposed by the government. So why not to start from now! Green homes will be easier to sells specially that in the future part of the home-buying decision may be calculating the cost of bringing a traditional home up to green standards (Zachery, 2016).

Increasing home value is a major key driver of home improvement, so why not invest in it if the return on investment is going to be greater in the future. Not forgetting that millennials, which represent a large percentage of new demands, are more interested in eco-friendly home and want to be more connected to nature.

Green Houses for a healthier lifestyle

According to (Zachery, 2016), more than 80% of home builders report that consumers will pay higher prices for healthier green homes regardless of the local market. Particularly as the home-buying segment of the population ages, health and healthy living become concerns that are more prominent. The desire to live in a healthier environment, therefore, continues to push the green home movement.

Green homes are more than just energy efficient and are built in a sustainable way. According to Rick Fedritzi, president of the USGBC, "homes touch nearly every aspect of our lives". LEED became one of EU most significant green building initiatives, LEED certified residential designs are not important just because they increase energy efficiency but also, they can promote to a healthier indoor environment by increasing the flow of fresh air, supporting ventilation system, and reducing airborne toxins. LEED certifications made up 4% of all sustainable commercial building certifications in Europe in 2014, this scheme is the most popular in Germany, Sweden, Finland, Spain and Italy (EU Commission, 2014).

Finally, faced with the evolution of our lifestyles and technologies, in addition to the rise in stone prices, environmental concerns and new urban logics, the design in real estate market have changed. The existing operators, long hesitating to change, had no other choice but to adapt to changes in demand.

6.3 Artificial intelligence

AI-based innovation will lead to 11.3% growth in German GDP by 2030 (PWC, Artificial Intelligence in Real Estate, 2018). The RE industry will not be spared, Software algorithms will adapt more and more and evolve into areas that are more complex. In the end, systems can dramatically reduce incorrect decisions due to a lack of data. AI is a powerful tool that will shape the future through its ability to learn, analyze, plan, process and self-correct.

According to CB Insights article on the future of housing, here is a list of some innovative AI-based solutions that are starting to be part of the future demand in the US residential sector (CB Insights, 2018).

6.3.1 3D Printing house

In the past, the idea of printing a house was far from the reality, but nowadays the idea of 3DP (Three-Dimensional Printing) has become the most promising solution in construction. Together with innovative materials and green buildings, 3D printed houses have opened a new field in housing, especially when it comes to reducing waste and improving safety on constructions sites.

Technology is disrupting many industries and real estate is one of them. 3DP is considered as innovative and cost-effective solution in the real estate market due to its ability to reduce resources such as labors, materials, and logistics and to give the client the freedom to design and customize their own space. The most important features to the 3DP are individualization and customization, which means a mass production without producing identical items.

Figure 18- First 3d printed house (Quartz, 2017)

3D printing is a game changer and companies need to take advantage of it to promote for a sustainable, fast, flexible and energy efficient solution. Compared with the traditional construction method, the SWOT analysis of 3DP technology is analyzed, as indicated in Figure 19 below, helped in discussing the strength that a country can capitalize on in the use of 3DP (McAlister & Wood, 2014).

SWOT breakdown of 3DP technologies

STRENGTH	WEAKNESS
• Increased Flexibility in Design • Joint connections are reduced • Reduction in waste of building materials • Condensed supply chain • Negates dedicated tooling • Improved cost associated with labour • Easy market entry	• Materials are limited • Cost • Speed and Volumes • Strength • Usability • Lack of Control over Printers
OPPORTUNITIES	**THREATS**
• Building products can be customized • Encourages small production • Improved testing of products • New jobs are created • Manufacturing process is encouraged • Undesirability is eliminated • Increased innovation	• Copyright & ethics • Consumer rights • Frivolous printing • Job losses (traditional)

Figure 19- SWOT of 3DP technologies (McAlister & Wood, 2014)

As mentioned in the SWOT analysis, 3DP promotes for a sustainable, fast, and long-term solution to address housing deficit. Sustainable solutions in the RE sector should include effective time, cost and quality as well as other innovation, environmental protection and customer satisfaction.

As real estate market continues to innovate, 3D printed houses are becoming more sophisticated and accessible. With powerful benefits and cutting-edge projects, the question is not whether 3D printing is an efficient construction technology. Rather, it is the best way to implement technology to solve the construction industry's biggest concerns.

6.3.2 Self-building house and pop-up system.

Self-building houses are perfect solutions to design and implement user own space tailored to his preferences, lifestyle and needs. There are numerous of solution in the market like mobile house, counterbalanced house, foldable and expandable house.

Tenfold engineering has created an innovative solution of a mobile and unfolded house where the first part is closed for transportation and the second is open for use. The technology behind it is to use hinges to counterbalance the weight of the house without using any machines just by adopting an intelligent design. This innovative solution allows to unfold the house and to move to another location, it be and smart way to transform the utility of a space.

The potential uses of the mobile, unfolding technologies is in disaster relief architecture, to respond to changing circumstances and populating unused space.

Figure 20-Unfolding stages of a House Skeleton (Ten Fold Engineering, 2017)

The House skeleton is not the only part of the building that is unfolding, even partitions and furniture are also subjected to be unfolded such as kitchen, bathroom, bedrooms, and worktops. Thus, the advantage of using the technology also with the interior is to transform the use of space and adapt the functions of the space in an easy way and according to the needs of users.

Figure 21-Unfolding stages of interior partitions (BBC, 2019)

The big advantage of this system lays on the ability to use a smaller amount of space for a boarder range of purposes since the kitchen can become a living room or a living room can become a bedroom.

Figure 22-Same room, different functionality (BBC, 2019)

The world is on a fast pace, everything is evolving around us and the key thing with the city is that it is full of people with changing needs, changing environments, and changing circumstances, so building can adapt to need are going to be the drivers of the future.

6.4 Internet of things (IoT)

The IoT is a network of devices such as sensors, appliances and all equipment that can be connected to a network and can send and receive data. The IoT assists the facility manager in building's monitoring by keeping tracking the devices installed in that building.

As mentioned in figure 23, IoT is involved in different sectors and industries, and the implementation of all these devices is important to support the facility manager in his core business and his daily activities of monitoring, operating, and maintaining the quality functions of the facility.

The present IoT applications (residential areas, vehicles, infrastructure, and commercial building) are just about to merge, which will make the transformation of IoT more and more important (Redlein, Inroduction into FM, 2018).

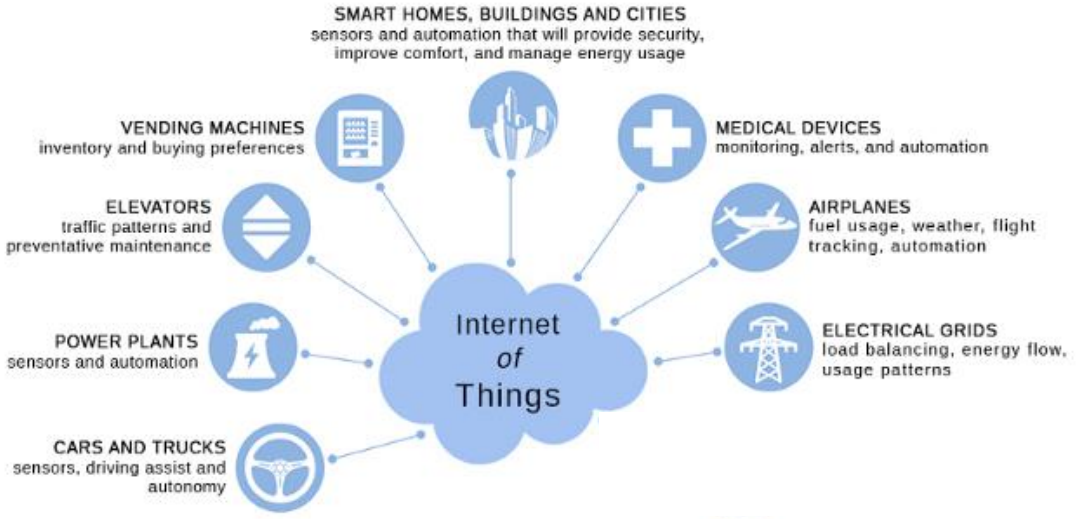


Figure 23- IoT application (Automated buildings, 2018)

In addition, by mitigating barriers of place and time, IoT offers the opportunity of many applications that would have been impossible to achieve without the integration of these devices which bring many benefits to the users such as security, space management, air quality monitoring, way finding, fire and life safety, vibration sensing and energy efficiency.

So why not to turn your building into a smart building?

6.4.1 Smart home

The Smart Homes Market was valued at USD 79.13 billion in 2020 and expected to reach USD 313.95 billion by 2026 and grow at a CAGR of 25.3% over the forecast period 2021 - 2026 (Mordor Intelligence, 2020)

Why the increasing of this demand on smart home technologies?

Artificial intelligence and smart tools are merging in our lives, devices have become cheaper and affordable. People have started not only to accept these tools in everyday life, but also to trust them with their valuables data and confidential information.

Not to forget that many millennials are penetrating the housing market and since this generation has grown up with the development of technology, they feel more reliable and connected to smart devices. Millennials tend to look for what is cheap, fast, and convenient and for them technology is not a complex system at all, and they feel integrated in the world of IoT. Thus, these generations are behind the increase in demand for smart homes.

IoT growth predictions tend to show buildings as a key component to the predicted exponential growth of connected devices. (Memoori, 2016) The reason behind this exponential growth in smart home is related to the added value to a building after integrating the smart devices.

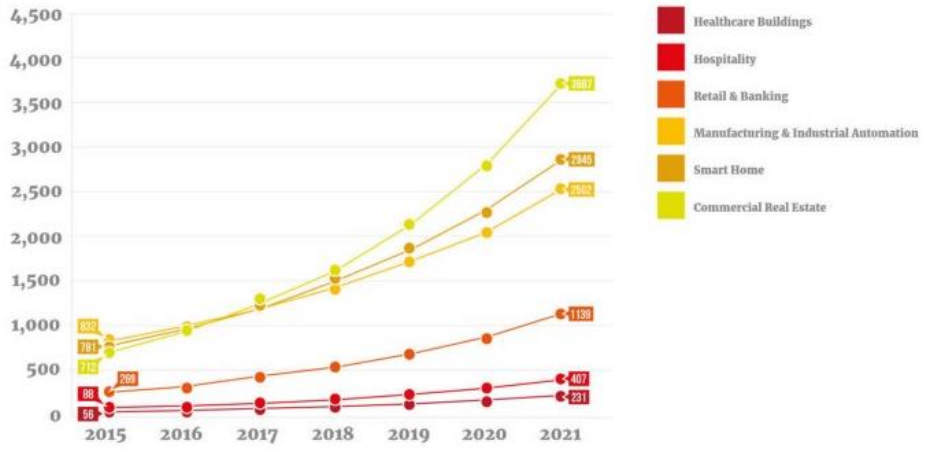


Figure 24-Growth in smart building connected devices over time per millions of devices (Automated buildings, 2018)

According to Blue speed, a specialized agency in home and business automation through smart technology solutions, here are the greatest advantages of IoT in smart home (Blue Speed, 2016).

6.4.1.1 Occupant comfort

Many buildings remain firm in their primary design, which may be outdated and inconvenient for their users. Recent analyses have shown that most buildings do not adhere to occupant comfort standards (ASHRAE 55). IoT brings comfort to the users by monitoring the light, temperature in the room and many other functions that promotes the interests on demand for such smart homes.

6.4.1.2 Maintenance

Many devices are sensible in a building and in case of breakage can lead to massive property damage if the source of the problem is not immediately resolved. In addition, a malfunction in one of the devices could endanger the safety and health of users in some important facilities such as clinics and hospitals. Here is the role of IoT to support the maintenance team by focusing on the preventive maintenance plan and reducing the possibilities of corrective maintenance by predicting errors before they occur or by notifying maintenance team in case of breakage.

6.4.1.3 Energy consumption

Buildings are responsible of 40% of co2 emissions and many remain inefficient. Users became more aware about green building, climate change and the reduction in energy consumption that is why they are demanding now for LEED certificate before purchasing any house. Here IoT helps buildings to operate better and support them in energy consumption by saving energy on HVAC, lighting, water consumption. For users IOT become a valuable eco-friendly solution specially for the millennials which value more green products and services.

6.4.1.4 Security

According to an article published by Reuters, the global connected home security systems is predicted to rise by more than 27% over the 2017-2021 period. The fact that with IoT security becomes an integrated option in smart homes allowing the possibility of locking doors remotely, instant access to cameras, connecting alert systems to motion detectors and detecting any intrusion into smart home.

6.4.2 Virtual projection and augmented reality

Virtual projection provides a solution to overcome the limited screens and offer a smart and an interactive environment to the users. Using the augmented reality people now can feel the space and identify their preferences by interacting with the virtual model.

By virtual projection users are not only limited to a virtual tour or a 3D model that can pop up in front of users, but virtual projection also allows user to interact with furniture and offer the opportunity to change colors according to the user's preferences.

Augmented reality and Virtual tours allow real estate company to establish a smart marketing campaign and promote to their project even before execution as the buyer can experiment the space. In addition, the advantages of virtual tours are to save time and costs for both agents and buyers and enhance the journey of finding a perfect space.

Figure 25- Augmented reality in real estate (Tocci Bulletin, 2016)

Nowadays, augmented reality is driving the construction industry and helping contractors, designers, agents, and event buyers to have a better experience throughout the project. Augmented reality allowed users, just by using their mobile phones, to pop up a 3D model that appears from a 2D drawing and walk around inside the model.

6.4.3 Smart furniture

Furniture is a valuable equipment for making a space feels like a home, it adds space comfort, elegance, and visual weight. For decades, furniture has been a static thing that users cannot interact with but now with the tremendous revolution of technology-driven things, users have access to many smart furniture that can make homes look smarter.

Interior design is a way to showcase users' preferences and creativity in their home, but the renovation or redecoration takes a lot of time and budget and it is a complicated process. Nerveless, in the future, renewal may be available daily. With the introduction of new tools in the market, smart materials will be available that can change color, textures, and the functionality of the furniture.

Here is an example of a smart sofa that can convert into single or double decker bed. This type of furniture can be remarkably effective in a small apartment where space is limited with a possibility of changing the functionality of the room.

Figure 26- Flexible Furniture's (Home Designing, 2020)

6.4.3.1 *Interactive walls*

Interactive walls are the new generations of walls that can be connected to IoT and modified with smart devices to suit users' desire.

These walls can change their colors to match the surrounding furniture; they can provide information and can be sensitive to touch.

Figure 27-Interactive wall (Chandler, 2017)

6.4.3.2 Smart mirrors with AR virtual wardrobe functions

Smart mirrors an AR-based virtual fitting solution with a real-time try-on solution. Using a smart mirror, customers can try a dress, shirt, or any other piece of clothing on their virtual models displayed in the mirror. This interactive mirror helps the user to try on the outfit and check if it fits them without worrying about the long fitting process. It is amazingly simple, just select the outfit on the screen and voila.

Figure 28-smart mirror with AR virtual wardrobe function (Gupta, 2018)

The future functions of the smart mirror are to import the user's clothes into the mirror database and keep updating the data to provide precise capabilities to the users and increase their satisfaction. This is another reason why users demand all this virtual reality devices in their home.

6.4.3.3 Smart and solar windows

Smart windows are a new trend in demand for residential spaces that includes technology that allows glass to go from transparent to translucent and create adaptive building envelopes to support energy dissipation. According to the US Department of Energy, inefficient windows can be responsible for more than 25% of the energy costs of heating / cooling a home. Smart windows can reduce cleaning costs by incorporating a self-cleaning system that keeps surface clean and free from dirt. Thus, many property holders are using smart windows for these and other purposes.

Figure 29- Smart windows (Poljak, 2020)

Smart windows provide the possibility to significantly reduce energy costs and maintain the temperature in a building, which means smaller volume for HVAC units. Smart windows can also be converted into solar windows where they can collect and store energy from daylight or indoor lighting and generate electricity to power lighting, computers, mobile devices, and many house appliances.

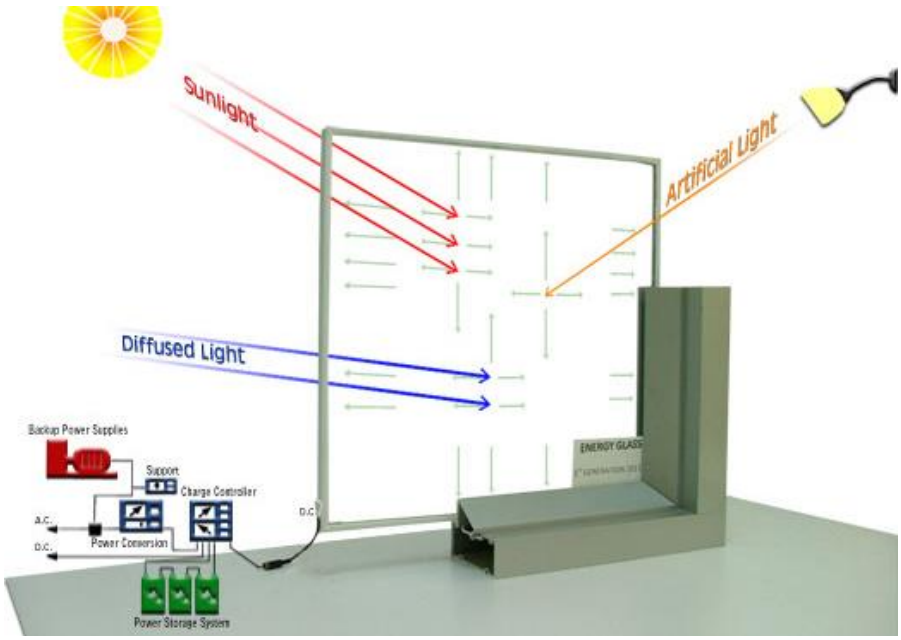


Figure 30-Solar windows scheme (Cost of Solar, 2014)

6.4.3.4 Holographic TV

Holographic television (TV) or display are the next future, with emergence of new technologies such as augmented reality, mixed reality, and virtual reality there is a chance that holographic TVs could become a feature of living rooms in the future. This new technology tool is based on light diffraction to create a virtual 3D image where the user can see it from all angles.

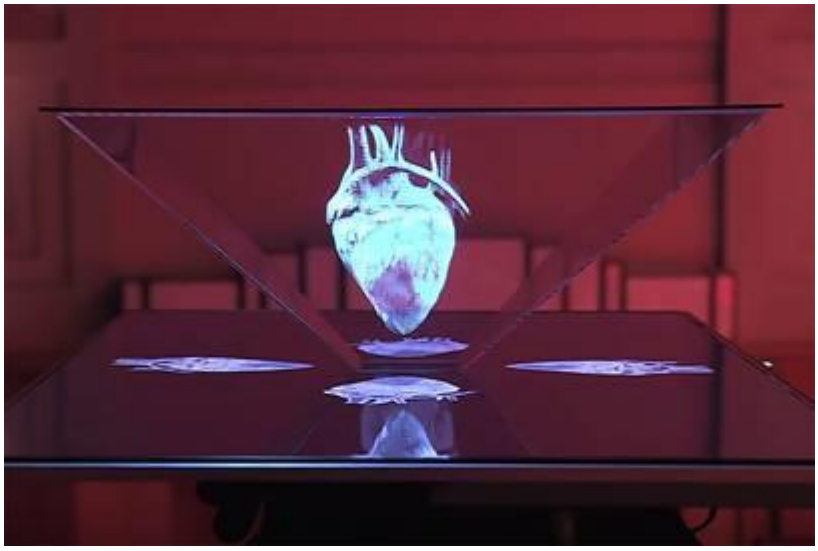


Figure 31- Holographic TV (Heathman, 2016)

6.4.3.5 Smart kitchen

The future is moving into a world in which machines are no longer just going to be collecting information, or even kind of helping user analyze that information, but they will be able to act on user's behalf. Various innovative tools invade kitchens to accompany users in daily activities such as cooking, shopping cart and many more. By integrating artificial intelligence and machine learning into kitchen appliances and furniture, it becomes easier to control the daily consumption and food waste.

Another example is the smart fridge that can synchronize with mobile devices, smartwatch, or Fitbit to provide user with a healthy nutritional plan based on calories burned during the day and according to user's health and fitness goal. Alternatively, taking the example of smart microwave, which can scan different type of food via a bar code and download the correct cooking time.

Future demand in the kitchen will be for gadgets like Smart Garbage that can create a shopping list by monitoring what items are thrown into the trash.

Figure 32- Smart Garbage (Cooper, 2016)

The cupboard and refrigerator can also be fitted with sensors to track your daily consumption, and by combining all data from all smart devices, the kitchen can estimate the number of calories consumed daily. Additionally, users can share their data with the grocery store to support automatic delivery or algorithms that predict new products that may be of interest to users.

Figure 33-Smart fridge (Petit, 2020)

As the kitchen appliances are embedded with sophisticated intelligence, what will really transform, potentially, user experience of the kitchen is when these different devices start to become connected to each other. Taking the example of a smart mixer connected to e-recipes and which communicates with the refrigerator to check the availability of ingredients or even order the ingredient needed to complete the required recipe.

7 Future Services

It is already known that the outsourced facility service industry is huge in the EU: the outsourced facility service (FS) industry counts more than 14 million people in the EU (Redlein & Stopajnik, Current Labour Market Situation and Upcoming trends in the European Facility Services Industry, 2017) and according to Redlein, an analysis on the impact of digitalization on differents tasks, occupations and industries shows, that the FS industry will be more affected than other industries. Therfore service providers shall be aware and ready to implement digitalization in their processes.

7.1 Trends and Statistics on home services

The global home services market is expected to grow 18.91% per year from 2019-2026 (Verified-Market-Research, 2021). The home services consumer journey often begins online (Derek, 2021).

Ratings and reviews are two of the main important metrics for consumers before booking a service with service providers. 86% of consumers read reviews of local business, this include 95% of which are 18 to 34 years old (Murphy, 2020). The fact that young and educated potential consumers praise a lot of research to study the loyalty and satisfaction of existing consumers and rely on ratings and comments to trust suppliers. However, it is not simple to pick up the trust of consumers and according to Murphy, the number of reviews and ratings is particularly important because consumers read at least 10 reviews online before feeling confident in a local business and 57% of them will use the services if they have 4 stars or more. Therefore, service providers should have a strong review management strategy in place to ensure and maintain a good star rating and high degree of consumer confidence.

Service providers need to know how to provide consumers with an enjoyable purchasing journey and how to meet consumer expectations. 80% of customers say the experience a business provides is just as important to its products and services, while 65% of consumers cut ties with a brand due to a poor single customer service experience (Kihn, 2020).

According to Derek's study, 55% of consumers search the internet for a service before they make an appointment. The most in-demand services are mobilization, pest control, locksmith services and lawn care.

Figure 34-Shoppers that ran a search before booking an appointment (Derek, 2021)

Mobile searchers are growing fast, and many words are searched on Google repeatedly and developed very quickly. Among these words “HVAC repair”, “Landscaping near me”, “plumbers near me” and “roof companies”.

Figure 35- Fast growing search terms (Derek, 2021)

Digital marketing is especially important for the companies to reach potential customers, and the more a company name appears in a search engine the more potential customers it can attract. Most home service condo nots do not know what they need or where to ask for a service, so they probably do not have a company in mind when they start looking for a service, which gives service provider companies the opportunity to attract these reluctant researchers.

Figure 36-Percent of consumers that did not have a company in mind when searching (Derek, 2021)

An interesting study by ComScore on US market (Goodman & Licciardi, 2013) found that mobile devices have the highest percentage of searches resulting in a product being purchased within 24 hours. The fact that mobile searchers are more serious and ambitious to purchase the product, they are always looking for what is simple and convenient for them and now with easy access from the mobile phone, customers can purchase services from anywhere with just a few clicks. Therefore, service providers should not only develop their websites to be more readable on customers' mobile devices, but also develop user-friendly mobile applications for consumers.

Figure 37-Searches resulting product purchase per devices (Goodman & Licciardi, 2013)

7.2 Categorization of home service demand.

The home service market can be classified into three categories: 1-Home improvement spending; 2-Home maintenance spending; 3- Home emergency spending (Home advisor, 2020).

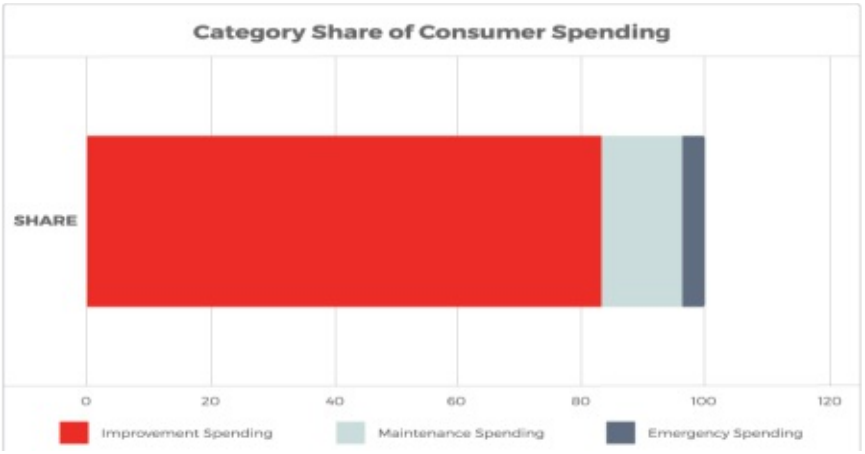


Figure 38-Category share of consumer spending (Home advisor, 2020)

Home improvement, which accounts for 83% of the service demand in the US market and the most in-demand service. Home improvement and renovation is a strong requirement for a better lifestyle from interior design to aesthetic design such as landscaping and outdoor works.

Home maintenance, which accounts for 12% of the demand for services, is also essential to adapt systems and appliances to seasonal changes. Preventive home maintenance such as the irrigation system, HVAC cleaning, home cleaning and landscape cleaning is particularly important to maintain all systems in a residential space to continue to function properly and reduce the costs of repairs caused by an emergency accident.

Home emergency, which accounts for 5% of service demand, is the service that consumers use as a last resort when a breakdown or accident occurs in their home causing major damages such as a broken hot water pipe, a blocked fan coil or roof leakage.

While home improvement gets more of the attention from the consumers, maintenance and emergency services are no less important on a fundamental level. Regular home maintenance support in protecting and preserving the value of consumer's assets. Homes are often the largest financial investment Americans make in their lives, and

maintenance of our homes is especially important to protect our financial investment, especially since emergency repairs can be awfully expensive and cannot be ignored.

7.3 Relationship tied to the macroeconomic business.

While considerably less volatile than home building or home sales, home services also have a relationship tied to the macroeconomic business cycle, with elements that move in correlation with upturns and downturns, as well as those components that act counter cyclically. (Home advisor, 2020)

Because of the upward and downward effects, the home services market has some distinct economic attributes that serve as counter cyclical buffers during the economic downturns.

	Downturn Anti-Cyclical Effects	**Downturn Cyclical Effects**
Service Providers	Lower interest rates in response to negative cycle's makes capital investments cheaper for professionals investing in their business.	More price sensitivity among existing consumers makes bidding more competitive and jobs less profitable.
	Less competitive labor markets reduce the cost of subcontractors and laborers.	Greater uncertainty for business investment means less hiring of subcontractors and investment in new capital equipment.
	As consumer demand softens, companies invest in driving new demand through marketing	Fewer customers overall as some consumers lose discretionary income or their homes.
Consumers	Less likely to replace equipment, increase need for preventative maintenance.	Less home movement and job mobility lowers moving related home services activity.
	Lower interest rates in response to negative cycles makes project financing easier.	More discretionary time may lead to higher rate of do-it-yourself homes task.
	Less likely to move to a new home which lead to an increase need for remodeling.	Less discretionary income for remodeling and maintain activity means less spending on these categories.

7.4 Demand for services per generation

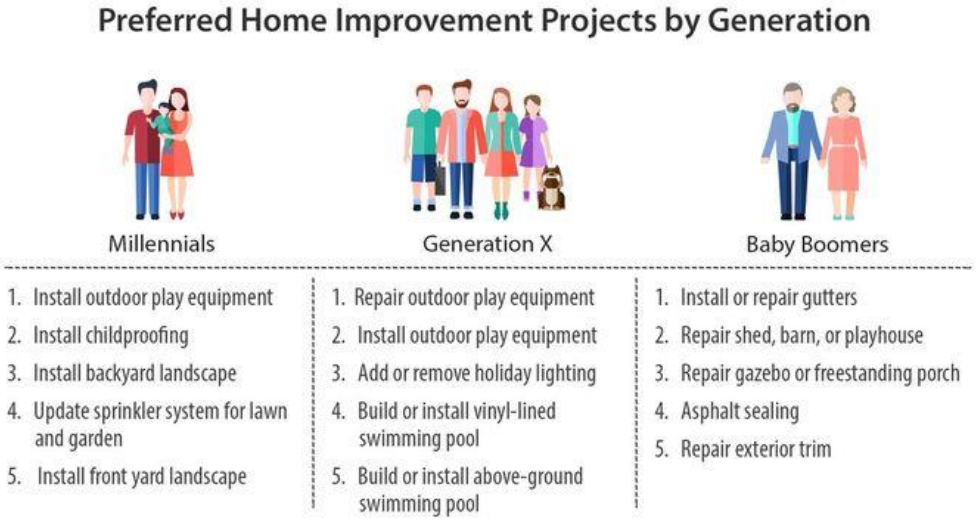


Figure 39- Preferred home improvement projects by generation (Venteira, 2017)

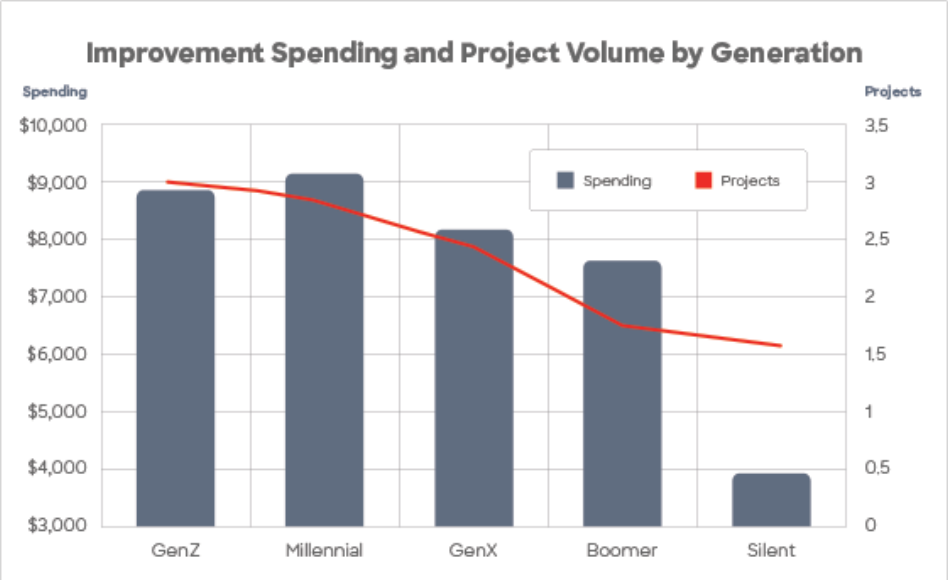


Figure 40- Improvement spending and project volume by generation (Home advisor, 2020)

Figures 39 and 40 reflect the diversity between each generation in their vision of renovating and improving their home. The extent to which each generation views their renovation projects as optional decreases directly with age and the number of projects accomplished. The younger generation are more motivated to improve their home, which is reflected, by the double number of projects compared to the older generation. The fact that when considering the cumulative stages of life (Marriage, children, etc.) it makes sense that older generations are less motivated toward renovation compared to the younger generation.

7.5 New Services

The human being has never stopped searching for what is new and suitable for him. It is his instinct to continue to evolve while seeking for tools or services to better achieve his goals. Nowadays, technology is merging with services as smart homes are about to become the new norm.

All aspects of our lives are changing in response to the rapid new wave of technology that will change and transform our daily activities and our demand for services. Besides basic services like cleaning, gardening, security etc., people started to search for different services according to their needs.

At present, the world is witnessing a huge shift in home ownership that will have a major impact on the service market, and this shift in ownership will affect the future demand for services as the new wave of consumer preferences of millennials are no longer the same as those of the generation of parents. Millennials are more willing to look for instant on demand-service because they want everything done quickly and with less bureaucracy.

According to a research by Donal Brown on the business models for residential retrofit in the UK, below is a list of services that users need to be offered at their home, some of which are basic services and are already available in the market, but there are many other services that anticipate the future (Brown, 2018).

7.5.1 Procurement

Many homeowners have had the experience of renovating their apartment at least once in their life, and they know how stressful it can be when planning. Many of them also encountered many problems in their apartment, which required the immediate intervention of specialists and the purchase of certain items. Although this problem is important, many try to avoid it due to lack of resources or they do not have the patience to look around experts or suppliers.

It is not easy to find a plumber, electrician, bricklayer, or carpenter and all the work needed to renovate an apartment or fix a problem. Therefore, the user needs assistance in the purchasing phase and to be directly connected to these resources. Today, with the advantages of digitization, people have access to various innovative applications

where they can contact not only suppliers but also enthusiast's handyman in one place and solve their problems in a smart way.

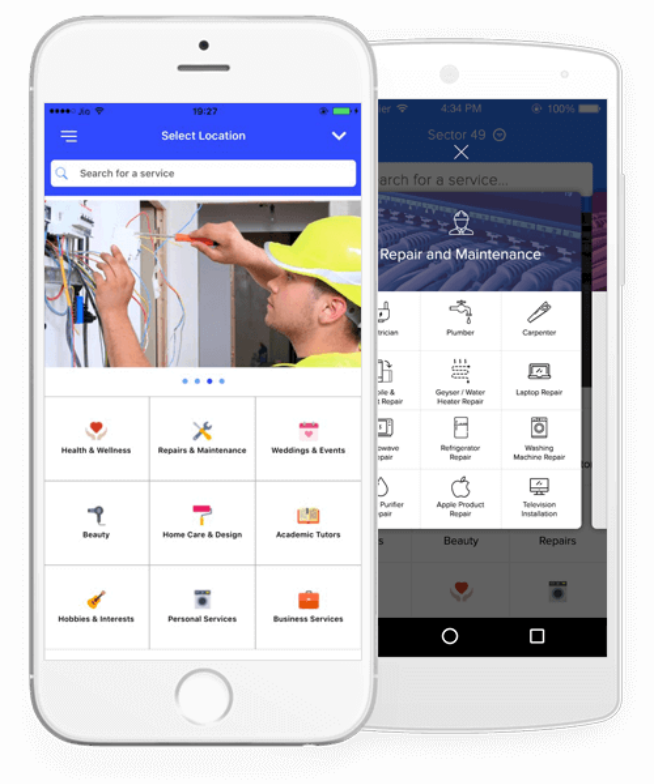


Figure 41- Procurement assistant mobile application (Space-O Technologies, 2019)

Technology is changing rapidly the service market, and, in the future, it is foreseen the implementation of voice recognition technology to request any service and quotation for any encountered problem. Simply by taking a voice memo, a picture or even a video and sending it to any service provider, user will get quotation, method statement on how to solve their problem and all details with one click.

Service providers who seize the opportunities that technology brings to the market will provide faster and more accurate quotes to customers, a stronger lead for their business, and ultimately greater profits for their businesses.

7.5.2 Modernization (life cycle analysis)

Life cycle cost analysis (LCCA) is now a common request from users before purchasing any space, as the decrease in LCC will produce beneficial results for users. LCCA identify all cost from purchase until disposal, and these costs are determined by year and discounted to present value.

Nowadays many investors required LCCA to determine if this is a good business or not before signing the contract. Same goes for the seller/buyer, as having an efficient LCCA can increase the potential to sell/buy properties.

76% of projects life cycle costs are based on operating costs while only 24 % are during the planning and construction phase (Redlein, Inroduction into FM, 2018). Users should therefore emphasis more on how to cut down the operating costs by consulting an energy auditor.

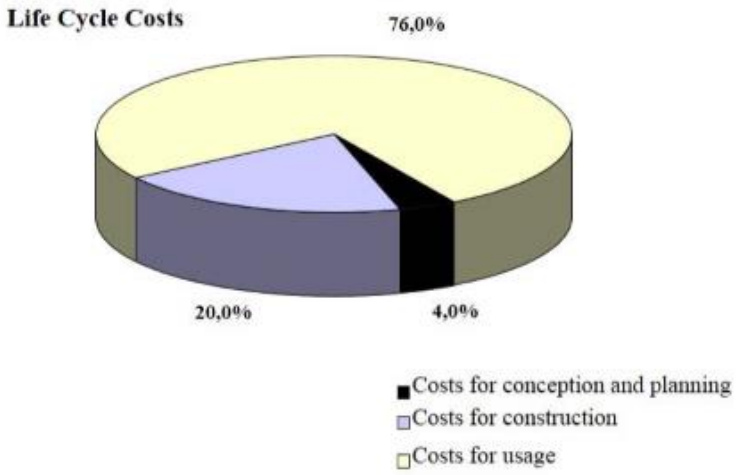


Figure 42- Life Cycle Costs (Redlein, Inroduction into FM, 2018)

7.5.3 Virtual support

With consumers searching for everything online these days, having a professional portfolio that showcases the skills and expertise of service providers will foster the probability of being contacted first by many new customers.

A helpful instructional video or tutorial that supports customers diagnose a problem they are facing can reduce costs and save time for both parties. In addition, these virtual tools may increase the likelihood that customers will purchase the service from the advertising company to solve their complex problem or even increase the chances of purchasing different services for other issues that customers will face in the future.

7.5.4 Energy auditing

People are becoming more eco-friendly and more aware of the environment, sustainability, and green buildings. Therefore, they plan further to reduce carbon dioxide emissions, obtain energy efficiency certification, and comply with the new directive imposed by the government. That is why they are looking for an energy auditor to try to reduce energy consumption and lower energy bills.

The importance of an energy audit is to assess the space and identify potential energy efficiency measures from external and internal perspectives. Auditors identify user concerns and needs, perform inspections, analyze data, study behavior with weather, occupancy, and operation time, assess potential for energy savings, and check thermal bridges, leaks in or out of the house and mechanical / electrical equipment.

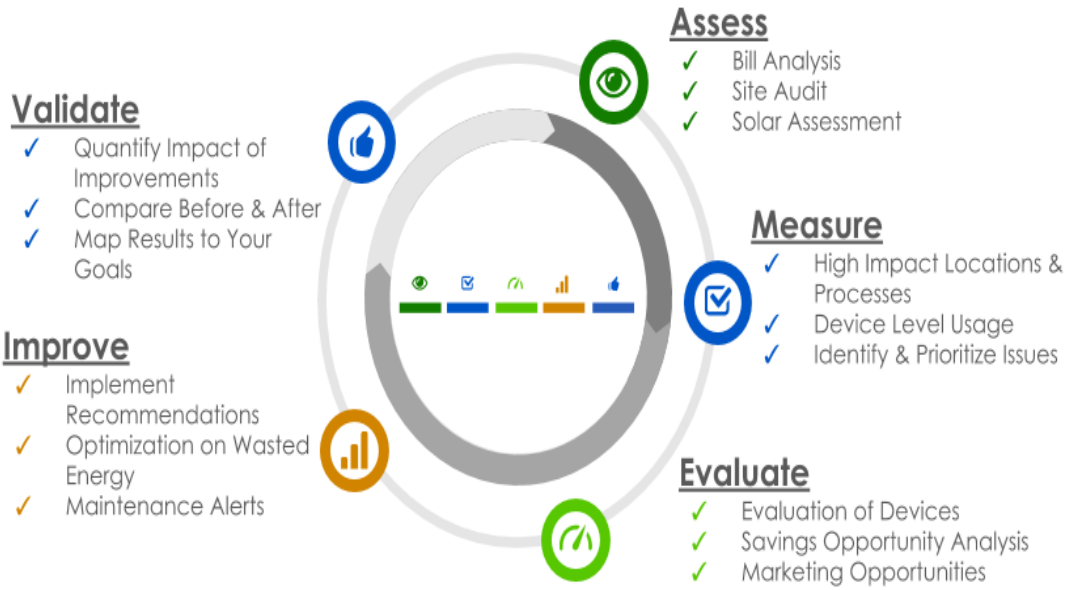


Figure 43-Energy Audit process (Naya Energy, 2018)

7.5.5 BMS

Building management system (BMS) is an innovative system that control home appliances from smart devices like keypad, notebook, or even mobile devices.

BMS provides lighting, heating, cooling, water consumption, energy consumption, and air and ventilation control. BMS also allows multiple devices to be controlled and managed simultaneously to optimize and reduce energy costs.

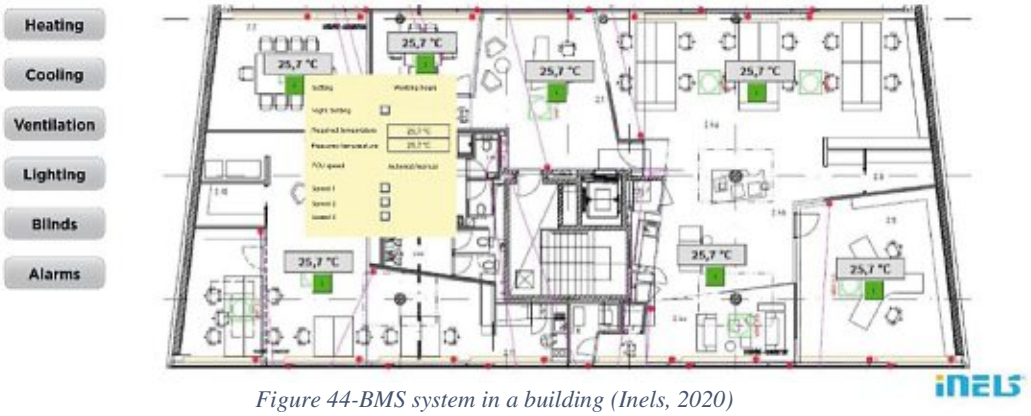


Figure 44-BMS system in a building (Inels, 2020)

Today BMS is indispensable parts of smart buildings where HVAC, elevators, escalator, alarm systems are constantly monitored. BMS connect all devices using a Building automation and control network (BACnet) interface that enable devices to communicate using common protocol network and share data (Redlein & Höhenberger, Digitalisation. In: Redlein, Alexander (ed.): Modern Facility and Workplace Management, 2020).

The advantage of BMS is that continuous data monitoring and rapid response to problems can save about 20% to 30 % of energy and maintenance costs by optimizing resource users (King & Perry, 2017).

Finally, IoT will continue to gain importance, memory is getting cheaper; the number of sensors is increasing. However, it is essential that not only data be collected, but that it is also used meaningfully. Millions of readings do not constitute an energy management system. Initially they only cover the first step, energy consumption monitoring. Only the interpretation of the values and taking the necessary steps lead to meaningful application (Redlein, Inroduction into FM, 2018).

7.5.6 Household management

Household management refers to various number of tasks associated to the operation of a property on a daily basis (Beers & Thomas , 2005) such as housekeeping, mobile service, shopping service, food preparation, cobbler services, massage, laundry, relocation and move management, kids care, pets care, mail, concierge, reception, supervision of mental retardation, access for people with disability, medications control, nursing care, transportation assistance, maintenance assistance, financial assistance, gardening, pest control, etc.

Today's society is no longer like the society of the past. Everything has changed: men and women reach a higher level of education and invest more time in their work and careers. Here is the role of a facilities management company to provide users with services that they can outsource to their home due to lack of experience or maybe lack of patience and time.

The demand for household management is much greater in a single household than in a double or family apartment. The fact that most of the single household are people who have left their homes for education or career purposes. These people may not have knowledge of household management and are constantly on the lookout for such services to help them carry out beneficial daily activities while focusing on their studies or work.

It is foreseen in the big city, where big companies and big universities are founded, the demand on household will keep increasing with the immigration of millennials towards those cities, especially since most of the millennials are not experts in household activities (Beers & Thomas , 2005).

Along with what the statistics have shown in the driver of the housing demand chapter, the world is heading toward an aging population as the number of old people will increase considerably. Moreover, as expected, seniors will need pretty much the same services that millennials need in terms of home care. (Mace & Rabins, 2006) Thus, service provider should be aware on how to tackle in advance the demand of this group of users and gain their trusts.

7.5.7 Property management services

Property managers represent the holistic approach of active, result oriented and operative financial manager of a real estate according to the goals of owners, as the property manager takes over the tasks of the owner on a trust base (Redlein, Inroduction into FM, 2018).

Property management services support home sellers to promote their properties and reach a wider audience. The main tasks related to property management are to evaluate real estate, determine accurate rental rates, prepare, and market properties for rent, create custom advertisements, screen potential tenants, prepare legal documents for the tenant to move in, draft rental agreement, collect rent, track late rents, provide advice on legal disputes, conduct periodic inspections, advise the landlord about financial payments, preserve property and landscapes, and support the tenant relocation process.

Property management services are required from both owner and tenant side, but most commonly, property manager support the owner by being responsible of the property and make sure to operate it according to the client needs. After all, he is the single point of contact for the tenants of the serviced properties.

Figure 45-role of property manager (Pioneer Enterprises, 2017)

7.6 Community and infrastructure

Building a strong community is no easy task and relies on various aspects including a lot of communication skills, design implementation, integration, and appropriate infrastructure.

The residential development are results of social and economic activities. The significance of infrastructure in a residential development cannot be overemphasized, as it is critical for its success (Hardekar & Chakraborty, 2018) and infrastructure can be explained as the facilities, structures, equipment, and similar physical assets; that are important for people to thrive as individuals and participate in the economic, political, civic, household, and other roles in ways critical to their own well-being and that of their society (Beeferman & Wain, 2016).

The demand for housing is increasing all over the world and leading to the need for new services and new housing developments. Therefore, a successful competitive market is one that provides tenants with not only internal services but also external services as renters tend to research the surrounding areas before deciding to relocate and even begin to survey the area before starting their journey to find their perfect space.

Most of the users tend to create a checklist where they can check if the listings meet their requirements. After completing the checklist, they begin to prioritize their preferences and evaluate the listings to make the final decision.

External services can be grouped into two categories, the first one concerns the community and the service it provides to tenants, and the second one concerns the owner of propriety and the service he provides to tenants.

7.6.1 Community services

Of course, prioritizing preferences differs from the type of user, whether single, married, or with a family, but the basic list of preferences and service required remains the same and shared between different users.

Users prefer to have a property close to public transport, school, hospital, playgrounds, restaurants, cafes, fitness center, health club, car wash and even be in an area with shared cars, bikes, and scooters.

Tenants are also looking to form a community with their neighbor and increase communication between them; new trends are emerging today such as mobile application that connects tenants of the same building with each other so that they can practice more social interaction and where they can feel belonged to a community. These apps help tenants plan and book community services, improve communication between them, and create a community where they can exchange knowledge and organize social events such as meet-ups, sports lessons, educational events, etc.

Figure 46- Community services – (Mcdonald, Bailie, & Michel, 2016)

7.6.2 Property services

On the other hand, tenants are also looking for a property that can provide them with many services such as event room, conference room, gym or sport room, meditation and health room, music room, children playground, bike room, garage, car charger, games room and many more.

7.7 Bundled services.

Users are always looking for what is cheap and convenient, and many find bundling services to be very efficient as they initially reduce service costs, they are tailored and responsive to user needs and they save time and communication, as consumers have only one single point of contact for many services.

7.7.1 Type of bundled services

As for the service provider, bundling service has the advantage of price discrimination, cost reduction mechanism and means of entry deterrence, to promote for a new service. Below is a list of the different kind of bundle strategy (Stremersch & Tellis , 2002).

- Price bundling – Sell of two or more products as a discount package without any product integration.
- Product bundling – Merge and sell of two or more products at any cost.
- Pure bundling – Strategy in which the company sells the package only and not the products separately.
- Mixed bundling – Strategy in which the company sells both the package and products separately.

The researchers suggest that the choice between two strategies – pure and mix bundling – depends on the so-called reservation price (also walk-away price), which is the highest level of prices accepted by the consumer (Ferrer , Mora , & Olivares , 2010).

7.7.2 Main factors of package attractiveness

According to study by (Lipowski, 2021), exploratory factors analysis identifies four main factors of package attractiveness:

1. Lower price
2. Benefit from the services.
3. Independence
4. Price promotions.

These factors support the strategy of increasing the attractiveness of the service packages. For example, for some people, a lower commitment to a supplier is more valuable than a lower package price especially for yearly commitments.

7.7.3 Future of bundled service

Lipowski's study shows in the figure below that service provider loyalty is related to the degree of services usage within the package (Fig. 47). The more users use services packages, the less likely they are to switch providers. Therefore, service providers should not bundle their services into a package that users may not need, as this will lead to an increase in customer dissatisfaction.

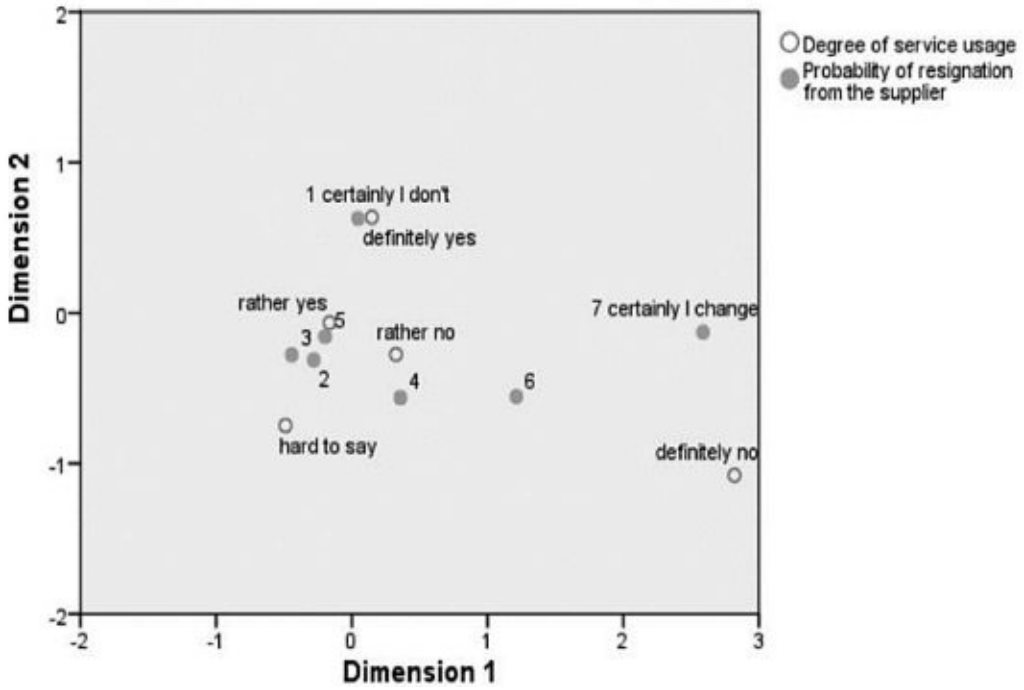


Figure 47-Propensity to services churn and the extend of using service package (Lipowski, 2021)

User loyalty is also related to contract length (Fig. 48), and Lipowsky's study shows that the tendency to drop services is high between the first and second year because most contracts are signed between one and two years and customer cannot terminate the contract during this period. After two years, the probability is low again and customers are more satisfied as a degree of trust is built between customers and service providers.

Figure 48- Propensity to service churn and time using service package (Lipowski, 2021)

It is particularly important for service providers to prepare a marketing strategy and provide customers with attractive offers and useful bundled services, that they are sure customers will use them before the end of the two-year contract term to gain back customer loyalty and satisfaction.

Finally, bundled services are especially important not only for promoting a product or attracting potential customers, but they can also play an essential role by gathering data from users, such as their preferences, and forming a solid database for a recommendation system capable of predicting future demands of users.

8 Prediction of demand

Business strategies and decisions rely on certain assumptions about markets and customer behavior. Nowadays with all the emerging technologies, Machine Learning methods can be applied in interpretation of big data, continuously computing and training models of a certain domain to provide a prediction system.

During the last few decades, with the rise of YouTube, Amazon, Netflix and many other web services, recommender systems have taken more and more place in our lives, from e-commerce (suggest to buyers' articles that could interest them) to online advertisement (suggest to users the right contents, matching their preferences), recommender systems are today unavoidable in our daily online journeys (Rocca, 2019).

Another way to approach the customers is to provide them with valuable recommendations. To understand this methodology, we will consider the example of Netflix recommendations strategy.

So how YouTube, Netflix and amazon know what user want to watch? Moreover, how to apply those ideas in real estate market for what consumer want to buy?

8.1 Recommendation systems

A recommender system, or a recommendation system, is a subclass of information filtering system that seeks to predict the "rating" or "preference" a user would give to an item.

Recommendation system are machine-learning systems to help the user discover new products and service. According to a study done by McKinney's on Netflix, 75% of the watched movies comes from the company's recommender system.

8.2 How does it work?

First, the system starts to place all the users or group of users on a side and the product or services in the other sides. Secondly, it creates a connection between users and the items, this relationship can be a positive relationship if the users like the items or negative relationship if the users dislike the product.

However, how to generate those links between users and items?

The relationship could be deducted from the users' behavior or feedback.

There are two categories of feedbacks:

Explicit feedbacks: this feedback can be collected when a user give a like or dislike to an item or when the user give some ratings. For example, liking a furniture or rating an apartment online.

This method is accurate, but it takes an effort from the users to provide the system with his thoughts and usually less people are doing that effort.

Implicit feedbacks: which is based on the user behavior and request less effort from the users. This method consists of observing the interaction between users and the items. For example, how many times user searched the items, how many times user entered the website, how long the users are watching the advertisement and if user watched the advertisement till the end, or on which minute the users stopped watching the advertisement, tracking location to provide a reasonable offer near workplace or to eliminate offers in other regions.

The figure 49 illustrate an example of three users and their relationship with the provided service. From the data collected, user A is interested in Pest control but not in gardening while user B is only interested in cleaning and User C is interested in gardening but not in Pest Control.

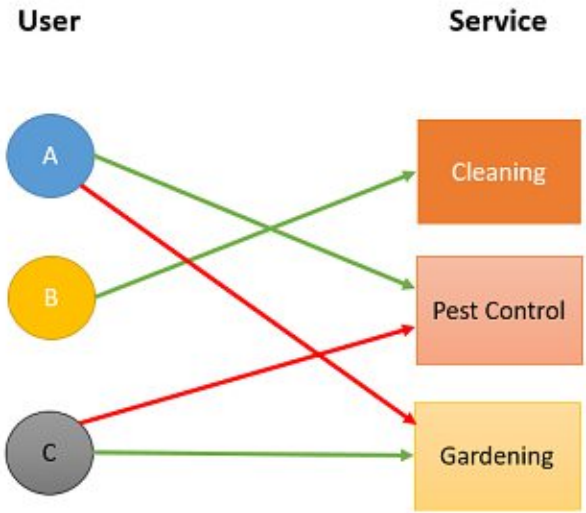


Figure 49-Relatiionship user & items

The implicit and explicit feedbacks are a valuable input to start mapping and linking users to items but some information is still missed. Back to our example, it was not possible to identify if User A or User C are interested or not in cleaning, or if User B is interested in Pest control (Fig. 50).

Therefore, after collecting the data and making all possible connections, the recommender system begins to play a significant role in filling missing information and associating users with items that they do not share with any connection.

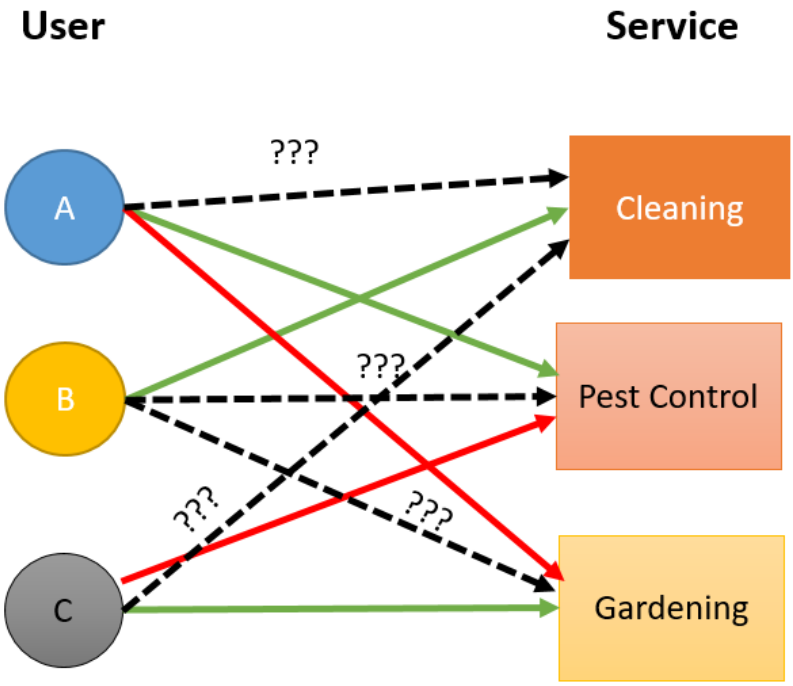


Figure 50- Recommender system role

8.3 Candidate generation overview

Candidate generation is the second step in the recommender system after establishing the connection between users and items.

The most common candidate approaches are content-based methods and collaborative methods.

8.3.1 Content based.

Content-based approach is to check the similarity between items liked by a user and to recommend new items similar to what the users has already like.

The algorithms behind this approach are based on users' preferences since what the user liked in the past; he most probably will like it in the future.

For example, if a user like a service like cleaning provided by SIMACEK (Austria's largest private sector provider of integrated infrastructure services.) he will most probably will like another service like gardening provided by the same company.

Here comes the role of machine learning to identify users' preferences and to suggest new items/services, which might be, unforeseen by the users.

In content-based approaches, a profile is created for each items and users then a key word representing the items/users is listed inside their profile for better tracking. Key words could be location, type of accommodation, age of users, and type of users…

Taking the example of gardening, the key words might be garden, family, house, nature, ground floor, single dwelling, pets, mountains, Vienna.

Figure 51- Items Profile

Figure 52- Users Profile

Same for the users, key words can be listed under their profile like cleaning with Simacek, house, BBQ party, pool, 30 years old, married with family, nature lover, Vienna.

After filling the profile of users and items, the recommendation system can now generate the missing link between users and items by matching the profile users with the profile items. For example, now it is possible to recommend gardening to user B as many attributes in profile B matched with the attributes in profile Gardening.

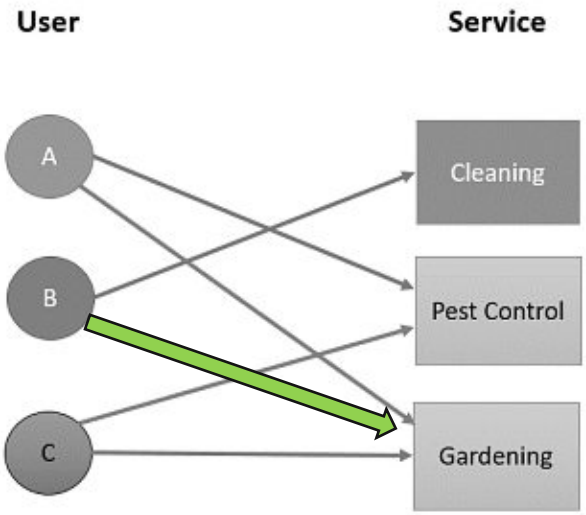


Figure 53- Content Based recommendation

Control based is a simple tool that does not require data about the users because the data is collected automatically from users' behavior. The advantage to this method is the ability to offer customized recommendation based on user needs with less information. In addition, this model is very efficient because it targets specific users rather than a mass population and it offers potential users with useful items.

The disadvantage to this method is that machine learning can be efficient if only good engineering teams are behind it. In addition, the model has a bit of limitation since it is based on the exiting interest of users.

8.3.2 Collaborative Filtering

Collaborative filtering approach is based on the idea if two users they liked before the same things, then they have the same preferences and they belong to the same group. In that case, if one of the users in this group liked new things there is a big possibility that the other users in the same group might like it since they share same preferences. Therefore, the idea behind this concept is to use similarities between users and items simultaneously to offer recommendations.

In the more general sense, collaborative filtering is the process of filtering for information or patterns using techniques involving collaboration among multiple agents, viewpoints, data sources, etc.

There are several types of collaborative filtering systems, however many common systems follow these 2 steps:

1. Look for users who share the same rating patterns with the active user (the user whom the prediction is for).
2. Compute a prediction for active user from the rating provided by likeminded users in the first step.

Looking at the example in figure 54, if two users A & B purchased both gardening and cleaning services, thus they are part of the same group and they share the same preferences. If user A decided to purchase a new service like pest control the recommendation system will automatically generate a recommendation to all users sharing with user A the same group. Therefore, User B will automatically get an advertisement or a recommendation about pest control services.

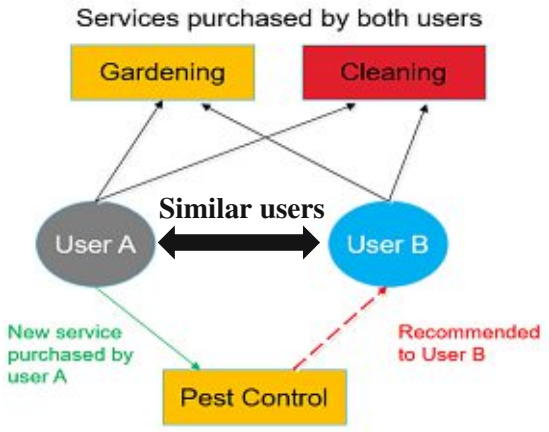


Figure 54- Collaborative filtering example

Opposite to the content-based approach of using profile and key words, the collaborative filtering is based on the embedding space as an abstract representation common to both items and users, in which it is possible to measure similarity or relevance using a similarity metric so-called factorization matrix.

Factorization matrix role is to put the user and items in a table or matrix. The users are listed in rows and items in columns as illustrated in the figure 55. Once the headers are filled, the system starts to fill the cases with the rating of users from one to five taken from the implicit or explicit feedbacks of users (one is the lowest ranking and five is the highest).

	Cleaning	Mail	Pest control	Deep Cleaning	Gardening
User A	3	1	1	3	?
User B	1	?	4	1	1
User C	3	1	1	3	4
User D	?	3	5	4	5

Figure 55- Factorization Matrix without prediction

Normally there will be some empty cases (green cases in the figure above) which cannot be filled due to the lack of data. Here comes the role of the recommendation system to predict the rating and fill the blank using the collaborative filtering methods. If the rating in theses empty cases is high (3, 4 or 5) then the recommendation system will propose these items to the corresponding users.

Otherwise, if the rating is low (1 or 2) then the recommendation system assume that the users will not be interested in those items and they will not be recommended to them.

This filtration method is very efficient since it is targeting only the people who might be interested in the product and in this way, they can reach a better target of users and achieve a better marketing campaign. To achieve the best results, it is imperative to integrate machine learning into the process as shown on the following pages.

	Cleaning	Mail	Pest control	Deep Cleaning	Gardening
User A	3	1	1	3	4
User B	1	?	4	1	1
User C	3	1	1	3	4
User D	?	3	5	4	5

Figure 56- Factorization Matrix with prediction for users, first example

Machine learning plays in important role in the factorization matrix by analyzing the table and trying to establish connection between users and items. For example, looking at users A & C, it is possible to deduct that they share the same thoughts and if user C is interested in a new item, user A might be also interested. Here the recommendation system will fill the missing case for user A under item "Gardening" by rating 4 same as what was given by user C (Fig. 56). Since the predicted rating by the system is 4, which is a high rating, then the user A will get a recommendation regarding Gardening services.

	Cleaning	Mail	Pest control	Deep Cleaning	Gardening
User A	3	1	1	3	4
User B	1	2	4	1	1
User C	3	1	1	3	4
User D	4	3	5	4	5

Figure 57-Factorization Matrix with prediction for users, second example

Another example, a relationship between users B, C &D were detected since the rating of user D is equal to the sum of rating B and C. So, if user B is interested in pest control and user C is interested in cleaning, then it is possible to recommend to user D both pest control and cleaning services. In the example above (Fig. 57), the system can predict that User D rating for cleaning should be 4 by adding up 1 and 3 respectively the ratings of user B and C. The system can also predict that the rating of user B for mail services should be 2 by deducting rating of user D from user C. In this case, mail services will not be recommended for user B because it is poorly rated.

On the other hand, relationship is not created by analyzing and comparing only the users, also machine learning studies the items and compare the columns to find similarities.

	Cleaning	Mail	Pest control	Deep Cleaning	Gardening
User A	3	1	1	3	4
User B	1	2	4	1	1
User C	3	1	1	3	4
User D	4	3	5	4	5

Figure 58-Factorization Matrix with prediction for items

In the example above (Fig. 58), a similarity can be detected by comparing the first item (cleaning) with the 4th item (Deep cleaning) therefore if a user is interested in cleaning the recommendation system will automatically recommend him deep cleaning services.

Finally, the collaborative filter is an interesting feature to recommend and provide offers for users and the advantage of this method is that operator does not need any basic knowledge because everything is done automatically. In addition, this approach can provide users with recommendations they did not thought they exist. Nevertheless, the disadvantage is for the fresh new items, which is hard to allocate them in the matrix factorization since there, are no rating attributed to those items.

8.4 Prediction of demand

The benefit of recommender system is not only to predict users' interests but also to predict users demands and to recommend customized items for them in advances. Recommender systems also assists in the development of enterprises involved in e-commerce but first to achieve good results, the enterprises should understand and analyses external environment like user behavior and adapt their internal organization such as their marketing plan according to the market. Not to forget the importance of machine learning to handle and collect big data received as a feedback from the users and maintaining updating those data for a better comprehensive of users' preferences, which lead to a better position in the fierce of the e-commerce completion.

9 Phase after Covid-19

How life will be after the Covid-19 outbreak? Everyone agree that the live after the Covid-19 will never be the same as before. Many things will change like our values, habits, lifestyle, office, social relationship, and our homes will change due to this pandemic wave, but how?

Figure 59- Life after covid-19 (IKnowledge Team, 2020)

The concept of new housing is more prominent now in people's minds, what was previously in mind is not the same as today; people are thinking about different perception and different ideas for the future of the residential sector. Their main goal now is to focus on how to protect their families and be in a safe environment. Many have gone through difficult times in their apartments for months without going out, knowing that they were in prison of their choosing. As a result, many ideas and images of house stereotypes are now shattered in the minds of users.

The disruption not only affected the users but also the designers and the investors. They stand up to significant challenges, as user demand has been disrupted from what was perceived and planned. Designers need to adapt their plan and act quickly to incorporate user requirements into their models so that they can deliver better offer for the new demand. In this chapter, the author will dive deeper and talk about the impact of Covid-19 on future residential demand and services.

9.1 Impact of Covid-19 on Real estate Market

The Covid-19 pandemic marked an unprecedented turning point for 2020, causing a wave of disruption in work-life balance. People have changed the way they work and their lives overnight and are finding that many potential changes can occur in different industries.

According to Savills study, Covid-19 has a significant negative impact on the private sector and private businesses. The rapid evolution of the epidemic from a health emergency to a global economic crisis has affected the real sector and imposed high risks on financial systems.

Covid-19 has played an important role in shaping and redesigning user preferences and demand. In fact, the virus has disrupted the normal life due to all the regulations imposed by the government. In addition to the fear that is spreading among people concerning their health and which has created a sort of perturbation in their lifestyle, behavior, attitudes, and priorities. During the lockdown, people began to appreciate their values and reorient their demands towards what is mandatory to survive the outbreak and protect their homes from the virus. Figure 58 present the impact of COVID-19 on user demand in various industries.

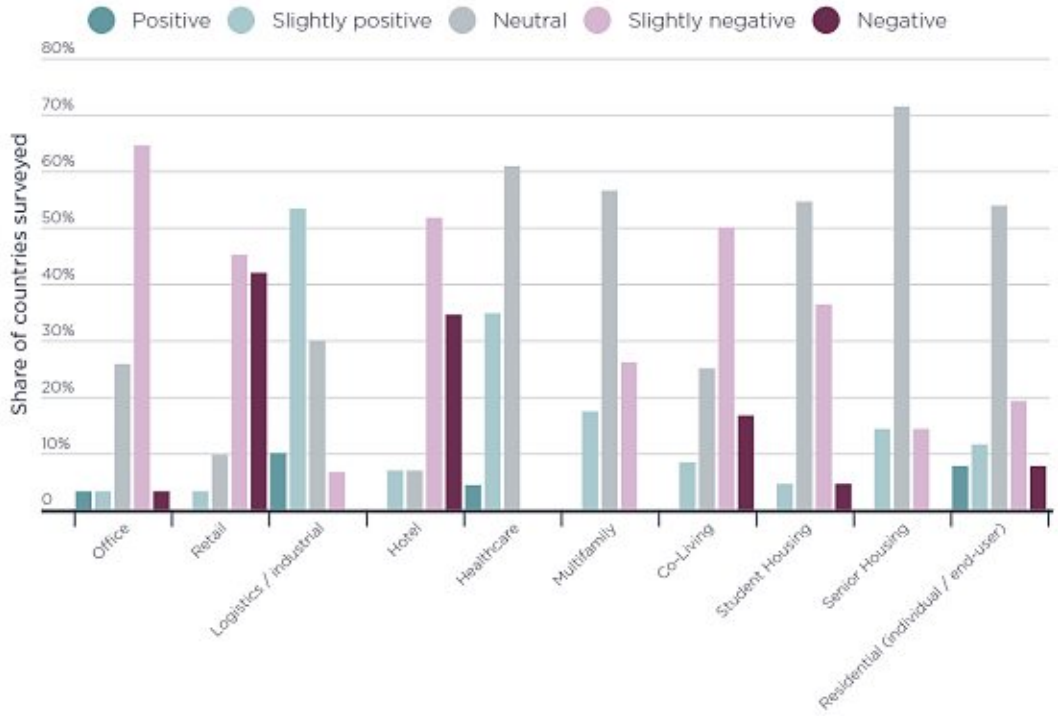


Figure 60- Long term Impact of Covid-19 on occupier demand (Savills, 2020)

9.1.1 Office and retails

As shown in the statistic from Global Sentiment Survey of research head in 31 countries around the world by (Savills, 2020), most of the sector has been affected by the pandemic, especially offices, retail companies and hotels.

9.1.1.1 Offices

In the long term, Covid-19 will have a slight negative impact on 65% of office demand and this may be explained by the possibility of working from home and the lower occupancy rate in the office, which will motivate the facility manager to re-evaluate the office function, optimize the space used and reduce the rented square meter. Teleworking has proven to be amazingly effective even for companies that were far from the idea of remote working. Besides, the shift to home office has had a major impact on the demand for office space as more and more people will demand to stay at home or at least a hybrid office model even after the pandemic is over.

9.1.1.2 Retails

For the retail sector, 87% of countries see a negative or slight negative impact on investor demand. The fear of the new lockdown is reflected in the users' position to invest in their businesses, especially in the restaurant sector one of the most affected by the pandemic. In addition, the retail industry has had to deal with government-imposed restrictions and to remain closed over an extended period and even after the restrictions are lifted, it must implement numerous safety and social distancing protocols and reduce the occupancy rate of shops that also affected their business. That is why retailers are focusing more on taking quick action to reduce the impact of their loss and convert their physical footprint into a digital platform, which will lead to lower demand for retail space.

9.1.1.3 Hotels

As is the case for the hotel sector, 85% of countries see a negative or slightly negative impact on investor demand due to the low rate of domestic and foreign tourism driven by the government regulations to close all hotels and other forms of accommodation during the lockdown. In addition to many other regulations such as border closures, reduction of air navigation, closure of tourist sites, restaurants, parks, shopping centers and all social events and activities.

9.1.2 Residential

9.1.2.1 Multifamily

The impact on the institutional residential sector is not as severe as the retail and office sectors and this is clearly reflected in the graph, 55% of countries do not foresee any impact on investor demand in this sector while that 27% expect a positive impact. Demand for residential space will continue to increase, as the outlook for multi-family homes is positive.

According to (Savills, 2020), institutional investment in residential assets has grown by nearly 50% over the past five years and it is becoming mainstream. Of course, design is essential to adapt to new demand, for example by re-balancing private and communal space in the communal living sector (which was based on the smallest individual unit and largest community area). Likewise, for the process, new use methods and techniques, such as improved quality and the emergence of cleaning must be implemented.

9.1.2.2 Co-living

As for the co-living sector, 67% of countries see a negative or slightly negative demand due to imposed social distancing and reduced social interactions. Co-living is a modern form of community living that is popular in cities with high rents and it became popular due to the shift in user's behavior in the past few years toward community and sustainability. Co-living focus on hospitality model by creating an active community between tenants and offering a private bedroom with many-shared space in the house, thus the fear of being infected by the virus may increase due to the lack of privacy and high exposure with flat mates.

9.1.2.3 Student Housing

The student-housing sector has grown concurrent with the higher education sector in recent years due to the increase in international programs and the number of international students. Unfortunately, the epidemic has had a major disruption to the education system, which led to a negative impact on the demand for student housing as the examinations have been postponed, the education system has shifted to online learning, and Erasmus or foreign students have been forced to leave campus and return home.

The economic downturn also plays an important role, as many students have been affected by the economic situation, which has reduced the ability to obtain a higher education degree abroad. Marcus Roberts, President of Europe Operational Capital Markets, said: “Regional centers closer to the international student market, such as Malaysia and the United Arab Emirates, could benefit, together with some of the lower-cost European destinations. In Germany, for example, tuition fees are negligible for both international and domestic students".

9.1.2.4 Senior Housing

Senior’s housing has proven its resilience in the face of the new challenges of the epidemic and the graph shows that the epidemic has no impact on the demand for elderly housing due to demographic foundations. People have changed their lifestyles; they eat healthier and exercise more. As a result, life expectancy is surging, and the number of seniors will continue to surge.

9.1.2.5 End-User residential sector

According to the graph, the researchers found that the impact on the residential sector is varied and more or less neutral. The fact that people are now confined in their apartments without being able to move around and prefer not to invest in the housing sector or change their lifestyle, thus the impact of Covid-19 for them is neutral to the demand in the housing sector.

However, for other end users who had been stuck in the city for some time, they began to rediscover their preferences and found that they needed to move to a nearby rural area where they could connect with nature and be able to do their business from home with limited access to their offices.

The increase in the number of homeworkers has a direct and significant impact on the future demand of the residential market. People have discovered new values and needs that were not relevant to them before the pandemic but are now their top priority. The new demand will be highlighted with a dedicated office station, access to private or public outdoor spaces and the digitization of the rental or purchase process. As home office increases, researchers expect demand to increase in rural areas since Covid-19 has substantially increased the attractiveness of prime properties in village and country locations (Savills, 2020).

9.1.3 Austrian Market

The Austrian government is taking many measurements to contain the virus and to limit its spread and so far, it is hard to assess the impact but for sure, there will be certain effects on short, mid, and long term on the Austrian real estate market (EY, 2020). The Austrian Traded Index (ATX) has recorded strong fluctuations with historical lows and brought uncertainties to potential investors, as the central banks are cutting key interests rates even more sharply and the mortgage rates increase. Human needs and values have been shifted and the use or function of properties changed. Level and continuity of the rent become essential components of the market value of a property.

The housing market, compared to commercial market, is a crisis resistant market as demand for housing is a less dependent on the economic situation. Therefore, the intensity of long-term impact is expected to lower in residential market than in the office or retail market. However, on short and midterm, demand for luxurious property will drop due to the slump in the stock market.

Several procedures can be implemented to alleviate the recession in the housing market like deferments of payment given by banks, lower the interest rate to ensure a steady demand for home ownership, encourage homeowners and Non-profit housing companies to reduce the rent.

For the construction industry, challenges are coming ahead due to several scenarios like lack of skilled workers and travel restrictions, which result a shortfall at work, or downtime on the construction site, delayed commissioning and unresolved claim situations entail the risk of protracted legal disputes, or uncertainties to meet project goals or even postponement and cancelation of tendered projects.

9.1.4 British Market

For England, the scenario is the same, given the severe restrictions on the workforce; it becomes difficult to achieve many goals and objectives, especially when the COVID-19 disrupts the construction industry and the government's plan to build around 300,000 homes per year. According to Savills estimates (Greenwood, 2020), around 170,000 homes will be built in 2020, 57% of the government target. This

deviation is due to reduction in capacity of the construction company during the lockdown period.

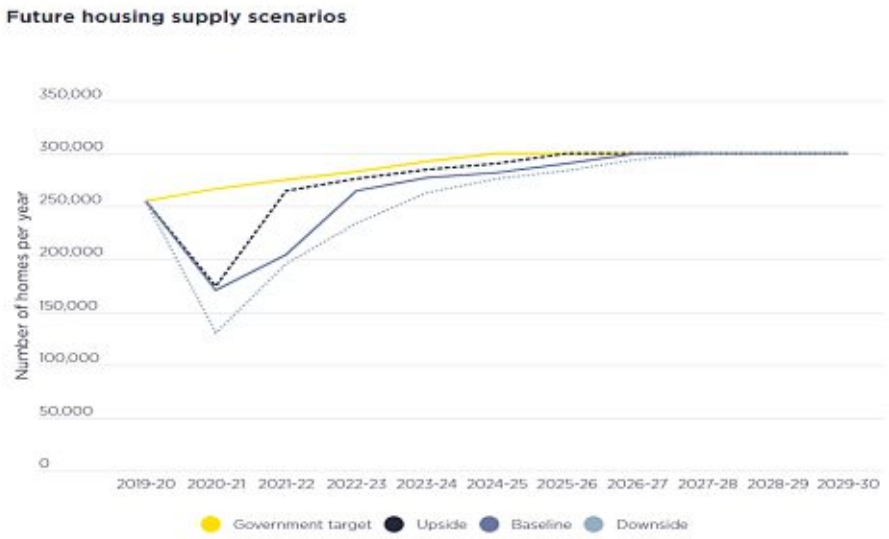


Figure 61- Future housing supply scenarios (Savills, 2020)

The graph shows that the gap in housing supply during 2020 due to the epidemic where England faces three recovery scenarios to compensate for the supply deficit.

- Baseline scenario: Assuming the economy will bounce back in 2021.
  Expected recovery for year 2020 in year 2023.

- Upside Scenario: Assuming Medical advances to support rapid economic bounce.
  Increase of supply from 57% to 69% in 2020.
  Expected recovery for year 2020 in year 2022.

- Downside Scenario: Failure to control the virus and Economic downturn.
  Decrease of supply 51% to 44% in 2020.
  Expected recovery for year 2020 in year 2024.

According to the base scenario and over the next five years, 15% less housing will be built (9% for the upside scenario, 23% for the downside scenario) compared to the number that would have been delivered without the disrupting caused by Covid-19. However, it all depends on growth in the construction sector for rent, affordability of houses, support for the sale of new private buildings, the digitization of operations and technological development in the healthcare sector.

9.2 Future demand on residential space after Covid-19

9.2.1 Impact on home search process

According to survey conducted by the national association of realtors (NAR, 2020) on 3,121 members, most of their businesses are to examine buyer and seller behavior during a pandemic in residential sector. 40% of potential buyers postponed the process for a few months, 18% had to cancel the process due to the insecurity of their job position, 10% relied on virtual communication, 6% decided not to purchase indefinitely while 18% were unaffected by the pandemic.

The Covid-19 virus has changed consumer behavior as people become more sensitive to investing their money because they do not know what the future holds after the pandemic. This fear of the unknown is reflected in the chart below, where 65% of buyers stopped or postponed home search activities during the pandemic.

These numbers are expected to be lower after the outbreak ends and it is imperative that real estate companies be well prepared to anticipate and respond to the next wave of demands, considering the future needs of consumers to secure their position in the competitive market.

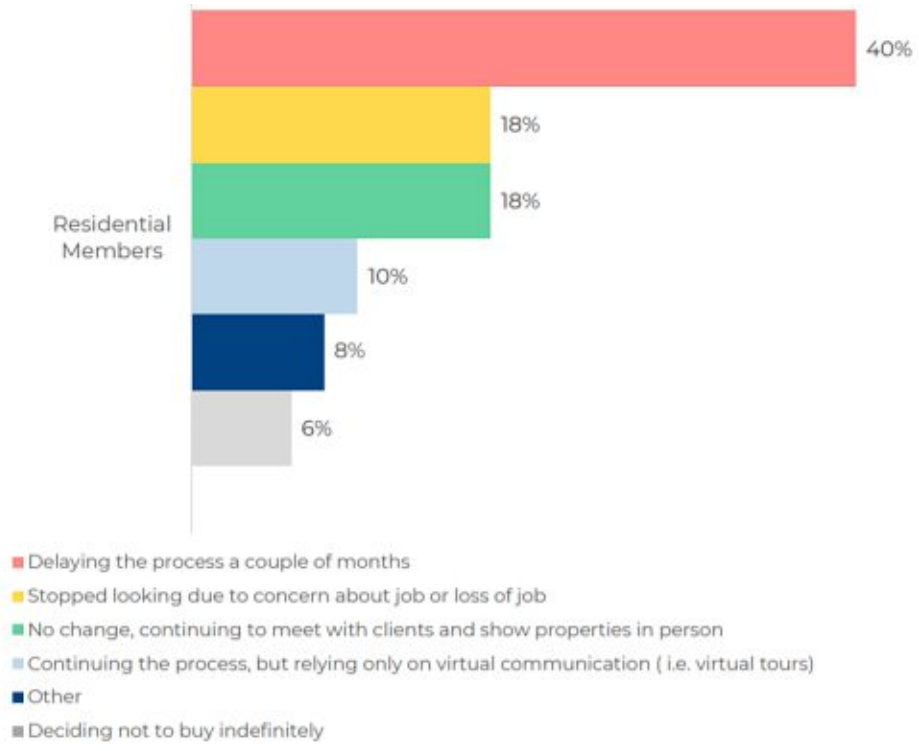


Figure 62- How Covid-19 Changed buying a home process. (NAR, 2020)

9.2.2 Impact of Covid-19 on home features

Everyone agree that life after Covid-19 is not what it was before and that companies must be careful trying to anticipate the future as people would not expect their habits and values will change someday. Fortunately, humans are very resilient and ready to adapt to any changes and conditions that disrupt their lives.

During the pandemic, people have successfully converted their residential space into a larger living space, like transforming their living room into a work area, study area, and even a fitness area. The need to quick adaptation of space according to the instantaneous function will have big consequences on the future features of residential space, as shown below.

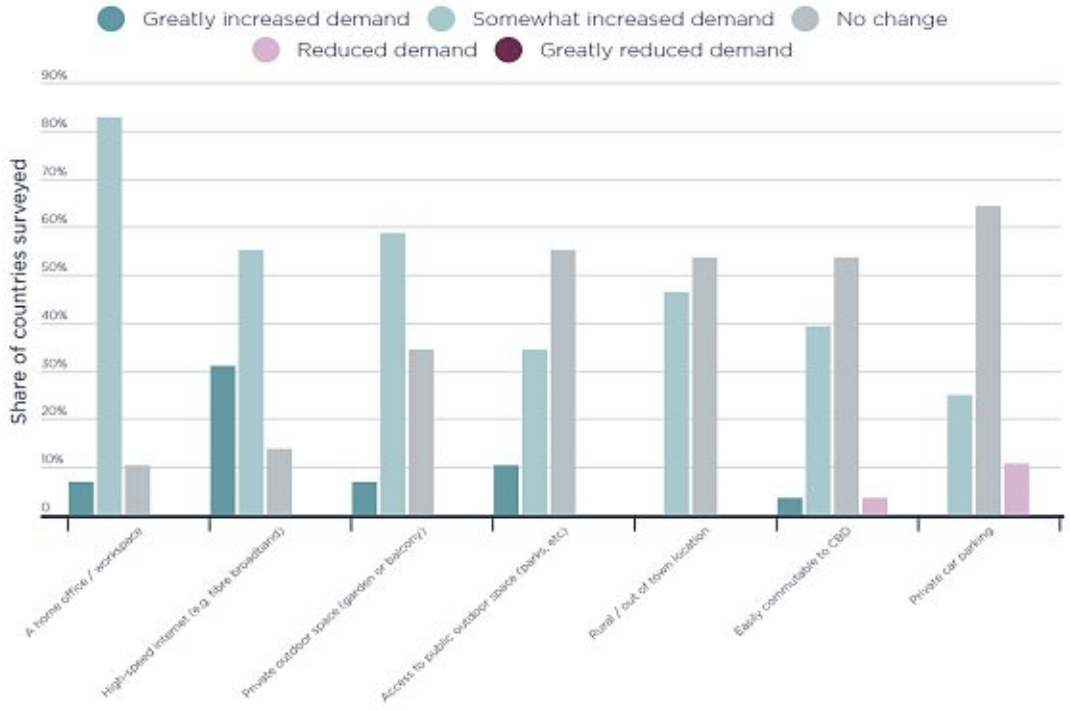


Figure 63- Impact of Covid-19 on home features after pandemic has passed (Savills, 2020)

The residential sector will witness an increase in demand for various home features as people begin to reassess their preference and to prioritize their demands. According to (Savills, 2020) researchers expect a 90% increase in demand for home office space and an 86% increase in demand for high-speed internet, which should be expected as more than 50% of the population are carrying on their works from home. This shift in demand is the result of a change in the behavior of users as they found out that a good home office infrastructure is one of their top priorities to be able to work from home.

Additionally, studies show that people want to connect with nature and access private or public outdoor spaces or even to relocate to a rural area with the ease of access to central business district (CBD). This shift in demand is the result of a reassessment of people's values after they were locked up during the confinement period in their city apartment with limited access to the outside world.

Therefore, it is especially important, during the pandemic, to consider the future demand of users and to reshape the design of the apartments according to their new preferences as their demands will shape the future of RE market.

9.2.3 Reconfiguration of apartments

Demand will increase for properties with space to work and relax, as will technology in the home buying process. Apartments are ideal for bringing people together as they can share common areas and enjoy common space, but nowadays it is all about separating people from one another. Due to the Covid-19 pandemic, people are practicing more social distancing, but this does not mean cutting off contact between them, but only keeping a limited physical distance between them. (Hunter, 2020)

The challenge in the coming years for designers and developers is to create an innovative solution to transcend this delicate line of physical distance and address all the new health concerns. Designers also face another challenge in creating an indoor space where the user can experience and hold onto the outside world even when isolated.

So, what will be the future of apartments?

9.2.3.1 New demand

Developers consider many changes especially at the design stage, where the possibility of modification does not have a significant impact on the construction cost, unlike in the post-construction stage. Below is a list of potential changes that could invade the residential space. These changes are related to financial means, type of building, target users and the market as mentioned in Brad Hunter's article on New Health-Driven trends in apartment design and development (Hunter, 2020).

- Co-working spaces and in-unit home offices for people practicing home office.
- Upgrade the filters in the AC unit to filter out airborne microorganisms.
- Usage of material with Antimicrobial surfaces.
- Have a private entry for deliveries or a cleaning room at the entrance featuring antiseptic dispensers for guests and delivery.
- Reduce contact with the surface and upgrade all touch buttons to touchless functions, especially for doors and elevators, by using Radio frequency identification (RFID) chip in home keys, which can control different objects through the electromagnetic fields (EMF).
- Glass partition in common area to create private zone and physical shield while keeping the idea of open space view.
- Accessible garden and terraces on the roof
- Separate fitness unit.
- No more common laundry and equip all unit with a laundry machine.
- Incorporate a lighted staircase to stimulate use instead of an elevator.
- Bigger balconies to stay connected with outdoor.
- Installation of water supply point at the balcony to motivate people to start small gardens and to grow plants or food ration.
- More natural lighting and usage of high-tech lamp, which produces an UV radiation to kill bacteria and viruses.
- Flexibility, room that can be configured in different ways.
- Reconfiguration of floor plans and abandonment of the open space idea. The latest trend was to have an open floor plan where the entrance, kitchen, dining room and living room all come together in one large room. The pandemic has prompted designers to rethink this layout because it is not a good solution to prevent bacteria from dispersing inside the house. The new plans should provide a separate entrance room where people can leave their clothes, shoes, and grocery bags outside of the living space.
- Energy backup plan as the building must be autonomous in electricity and water and be independent of external sources in the event of a complete shutdown.

- Increase sustainability by installing water treatment tanks to recycle drinking water or a sewage treatment plant to treat wastewater and reusing it in an irrigation system or flushing system.
- Energy saving and the use of heating systems like chimneys, fuel generator and fuel boiler which can be a backup or an alternative for heating sources. In addition to the environmentally friendly systems like solar panels or geothermal wells that use the constant ground source temperature of the earth to heat and cool an apartment.

9.2.3.2 House not apartments

The function of the house has changed for many decades over time. Initially, the idea of having a house was an important role in providing shelter from dangerous animals and inclement weather. Then people started to build fortresses made of stones and used as a safety shelter to prevent attack from any enemy. Over the last decade, people have tended to buy houses in the city and enjoy the view from their High-rise tower and all the infrastructure and services the city can offer better than a small village like hospitals, schools, universities, and offices. Today, it is not like yesterday, people are looking for a home that can protect them from any viruses and where they can enjoy social distancing and social isolation without being always worried.

High-rise towers ideally were a nice idea to group many people in one plot especially for developed and densely populated urban areas. Unlike single-family and low-rise houses, apartment blocks can lodge more residents per square meter and reduce the cost of municipality fees. However, social distancing, hygiene and intensive cleaning were not playing an important role in these buildings. Nowadays, due to the covid-19 epidemic, many regulations are imposed on enforcement and people are more oriented to stay away from others and to reduce physical contact with people and objects such as handles, buttons and knobs with which they used to have daily contact with them.

Due to the forced lockdown, people's values have changed, being isolated in a house without a balcony or not being able to walk outside on the street has led people to reassess their values and to prioritize them. Living away from their desk or their children's school or their favorite's restaurant has become less important than having an accessible playground where children can play, and people can enjoy their outdoor hobbies or even take a short walk-in nature. This pandemic was a wake-up call for

people to be more connected to nature and to rethink about the precious values given by nature. Finally, the idea of a house has become more than just a summer place as people try to escape from urban chaos or from a hectic day at work.

The future concept of home is a retreatment place from virus or a place to quarantine in a safe and nurturing environment.

9.2.4 Home as the new office

Covid-19 has brought unprecedented challenges on different level and people were forced to switch to home office for their own safety. For many people, the option to work from home was not a subject of discussion with the employer as shown in the chart below, before April 2020, only 17% of the population in the United States of America (USA) was working 5 days from the home, this number increased to 44% during the pandemic (Roddy, 2020). In addition, according to a McKinsey study, the demand on home office will increase as 80% of those surveyed said they liked working from home, 41% said they were more productive than before and 28% said they were the same (McKinsey, 2020).

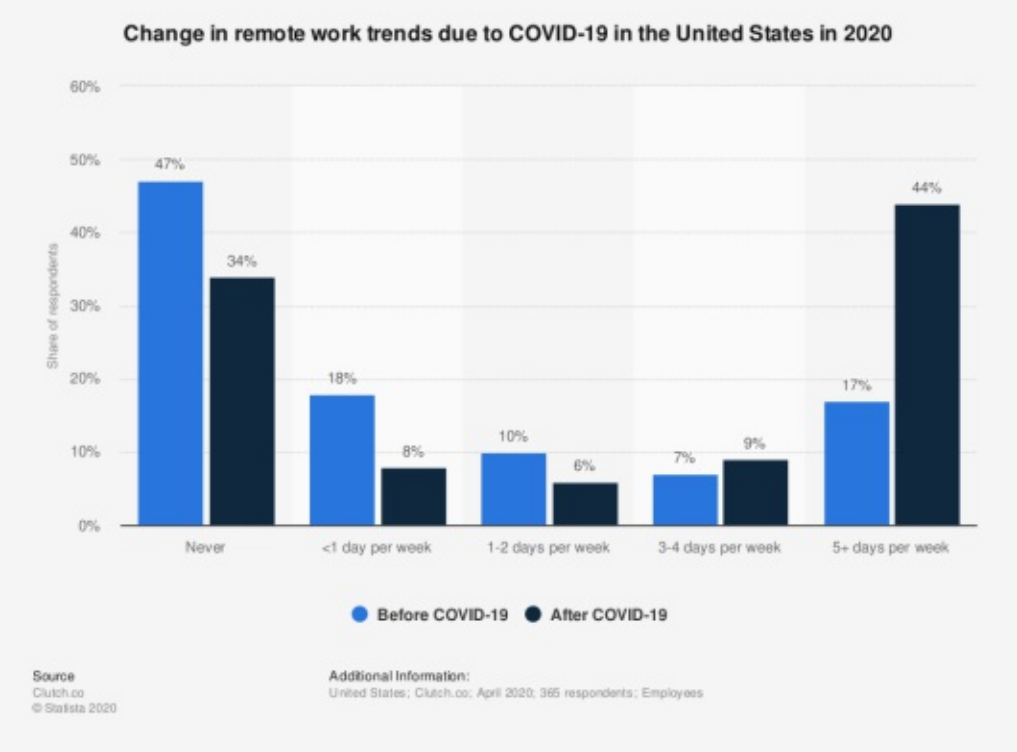


Figure 64- Change in remote work trend. (Statista, Change in remote work trends due to COVID-19 in the United States in 2020, 2020)

9.2.4.1 Home Office in Austria

Austria has also witnessed a shift toward home office module, many employees had to leave their offices empty and switch to a part time of full-time teleworking. As of April 2020, the number of employees working from home increased from 15 % to 45 % in Austria according to the survey conducted by Das Österreichische Gallup-Institute on 665 employees between 20 and 65 years old. (Köninger, 2020).

Wirtschaftsforschungsinstitut (Wifo) also conducts research on the type of work and the number of employees who conducted professional activities from home. According to the 2015 Labor Force Survey for Statistics in Austria, 13% of the working population used to work part time home and the home office were more available in the communication, informatics, and education field.

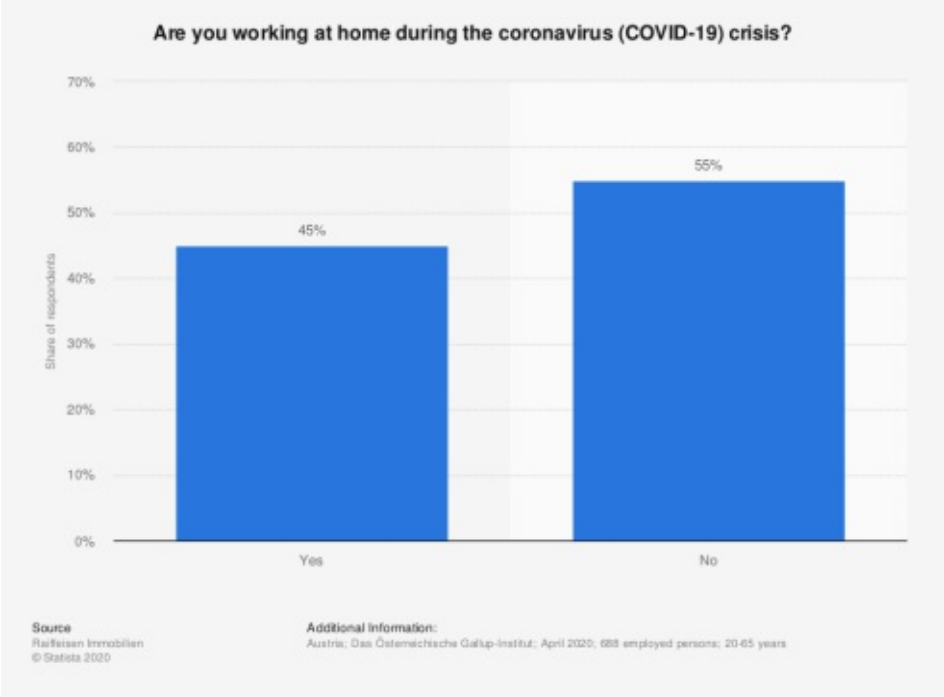


Figure 65- Home Office in Austria. (Statista, Working from home during the coronavirus (COVID-19) in Austria in 2020, 2020)

9.2.4.2 Home office Potential

Home office can be an alternative solution in professions, which are mainly focused on non-manual activity without permanent and personal contact with customers, while this is rarely, for professions with an emphasis on manual activity.

According to Wifo, there is huge potential in a home office and 45% of all self-employed such teachers can work from home. Referring to calculations based on figures taken from the 2019 Microcensus Labor Force Survey of Statistics to study the Austrian labor market and explore the segmentation of market according to type of occupations by genders, 47% of women versus 43% of men can work from home in non-manual activities. The fact that women's jobs are more related to bureaucratic, communicative, and non-manual activities (Wiener Zeitung, 2020).

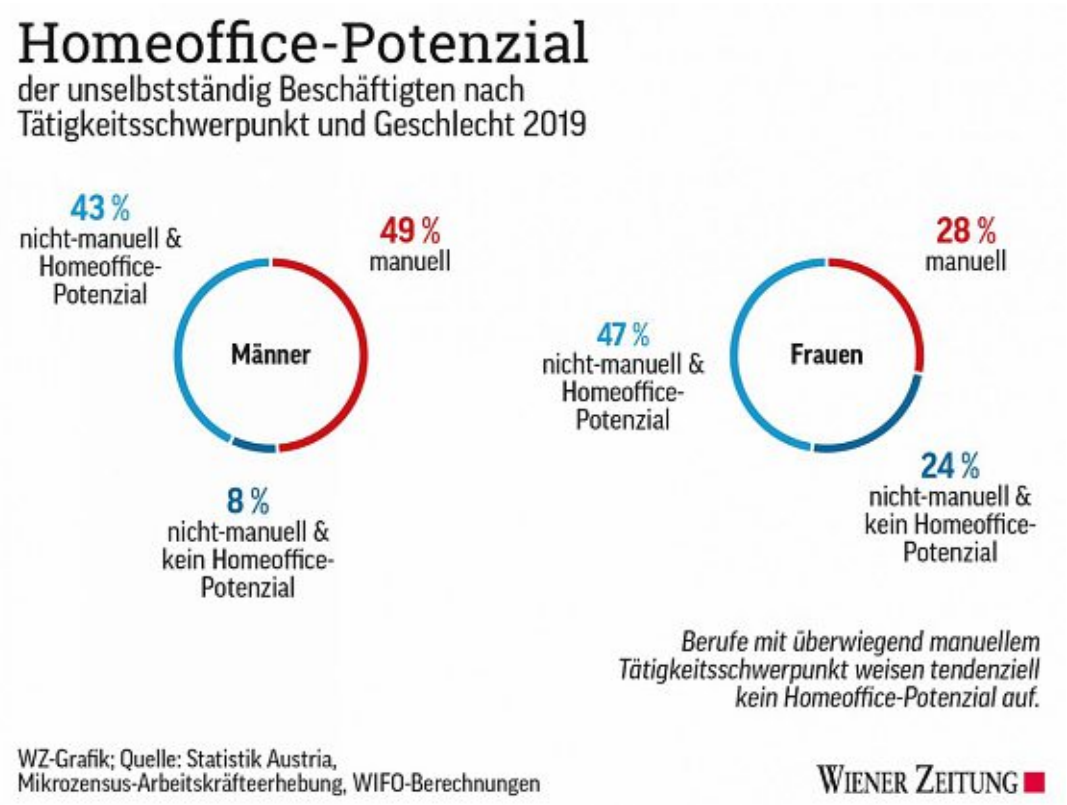


Figure 66-Home office Potential (Wiener Zeitung, 2020)

9.2.4.3 Changing into home office Process

Home office has become an effective tool for companies to ensure their business continuity during lockdown. Under these circumstances, the point of view of many employees have been contradicted based on fundamentals issues such as their family situation, lifestyle, and the nature of their work.

Many people enjoyed working from home and they were very satisfied since they became more flexible, felt more comfortable at home, saved commuting time, cut chit chat conversations with their colleagues, increased their productivity, and finished their stack work. While others found it an unpleasant journey and a hectic turn as they had to create a space in the apartment for their office, move their big screen to their home, get distracted from different family members, they had to find time to cook instead of buying meals from the canteen and cut down on social interaction with their colleagues which reduced their satisfaction and productivity factors.

The move to a home office was not a difficult task for Austrian. According to the survey (Statista, How hard did you find the change to home office during the coronavirus (COVID-19) crisis?, 2020) of 506 people working from home in Austria, only 14% had difficulty moving to the home office during the coronavirus. While 25% did not have any difficulties at all.

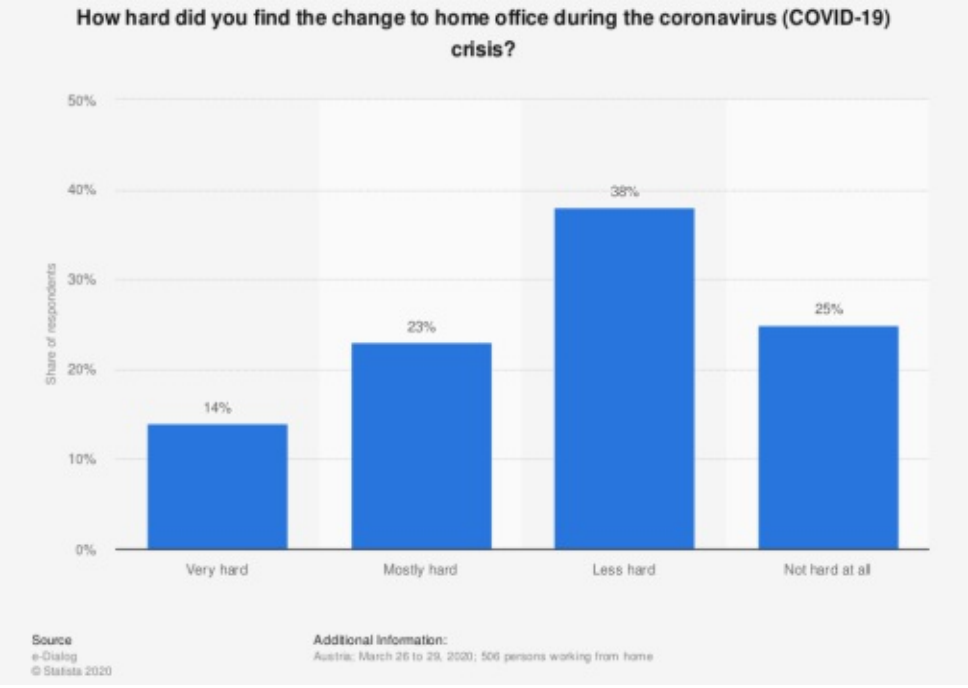


Figure 67- Change to home office process (Statista, How hard did you find the change to home office during the coronavirus (COVID-19) crisis?, 2020)

9.2.4.4 Increase Number and demand on home office.

Working from home presents enormous challenges for many people. For example, when the apartment is too small for more than one office station, when the washing machine or sound of kids at the background forces people to drop the video conference, or when the Wi-Fi connection is very weak due to users' overload at the same time and many other challenges.

Working from home has become a new trend in business life; the latest information published by the US Census Bureau found that in 2017, 5.2% of all American employees worked from home. That is a significant jump from the 3.3% reported in 2000. Therefore, the demand for an additional room to undertake professional works is redefining the way architects design rooms and influencing how realtors market homes with dedicated office space. Mainly this demand is driven by millennial and boomer buyers seeking for a home office.

Before Covid-19, working from home was not an option for many people, and they had nothing but the fact that the employer would not agree on flexible terms even if it were legal to ask, but during the lockdown, people were forced to stay at home and home office became the new norm.

In the United Kingdom (UK), half of the British workforce are now working full time from home (Vizard, Evans, & Ainslie, 2020). However, what will happen after the restriction is lifted?

Many employees are waiting to come back to the office and resume their normal professional life, they want to attend physical meeting, have their chatting around the coffee machine, take advantage of many services the company provides in the workplace and enjoy social interactions with their coworkers.

Nevertheless, there will also be people who do not want to come back to the office and prefer to stay in the home office. Especially in the case of people who are not used to change and who cannot easily get out of their comfort zone. For these types of people, it has taken a lot of time to adapt to the new way of working, and they are afraid to switch again their lifestyle and step out of their new comfort zone.

According to the latest Research conducted by Opinium among a nationally representative sample of 2,002 UK adults between 9th to 14th April 2020, they found that 44% of UK employees are planning to request for a new teleworking agreements or permanent flexible working agreement once lockdown is lifted (Hansen, 2020).

The change in people's behavior is the reason behind this shift in demand for home office, as the employees have discovered their new values and found out it is particularly important to prioritize family and health and put them first while keeping a balance with their professional career to achieve a better work-life model.

Opinium research also shows that:

- 12% are willing to work 2 days a week from home till it is safe to go back to office.
- 10% are willing to work one day from home.
- 10% they are willing to work 3 days from home.
- 8% the wish to continue the trend post-lockdown and work permanently from home.

According to a research conducted by Pure Profile among 100 Human resources (HR) Directors in the UK in 2020, HRs are predicting that the number of teleworkers will increase by 45% which means 70% of total workforce will be work with a hybrid and flexible agreements.

However, this situation is also a challenge for business owners, as office space is a major cost factor. Therefore, they should think carefully about how to optimize the office spaces, especially when most of the employees are working remotely and the occupancy rate is exceptionally low compared to the pre-pandemic situation.

Many factors influence employees' decision to stay at home office even after the restrictions are lifted. People want to re-evaluate their values and priorities for the future, and many have found that they are spending a lot of time and money commuting, that they are more productive at home, they want to stay connected with their families, they are worried about the pollution and they want to be healthier.

Here are the most ten reasons, according to Direct Line Life Insurance, why employees plan to require flexible work agreement after covid-19.

Reason	Percentage of people who list this reason	Number of people who list this reason
I can save money on travelling and other associated costs like coffee and lunch	31%	4.1 million
Coronavirus has proven that I can work from home effectively	28%	3.7 million
It has made me realize I spend too much time commuting	23%	3.0 million
I want to spend more time with my children	22%	2.9 million
I am more productive when working from home	19%	2.4 million
I want to spend more time with my spouse / partner	18%	2.4 million
It is better for my health in terms of pollution levels	17%	2.2 million
I want to spend more time with my parents / grandparents / broader family	15%	1.9 million
I want to spend more time exercising and becoming healthier	15%	1.9 million
It has made me realize I spend too much time at work	15%	1.9 million

9.2.4.5 Room layout for Home office

Workstation planning will be taken more seriously and with more attention. The spatial organization will change, and the idea of a workplace will no longer be considered as dining table or a small bureau with a light source and a chair in the corner or under the stairs. The new trend is to bring your spiritual office home. Therefore, people should arrange a separate room with comfortable furniture and good office infrastructure to accommodate their work.

Can any room fit to be a home office? Christine Drimalla, a Baird & Warner broker says, “They want to be in sunlit spaces with plenty of natural light where they can access the rest of their home. I hear from buyers all the time they want an office on the main floor so they can quickly go to the front door or kitchen when needed”.

People nowadays are searching for a flexible floor plan and multifunctional rooms, which can be adapted according to their needs. Here some type of some new trends in home office.

9.2.4.5.1 Hub Home-Office

Some people prefer to prioritize their family, especially if they do not mind working in a noisy and distracting atmosphere, so they seek an office centralized within the house to keep their eyes on children or to be near kitchen and toilette facilities.

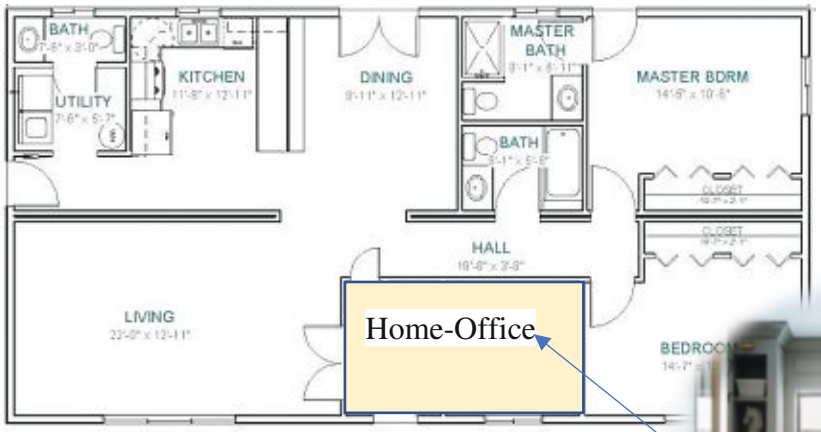


Figure 68- Hub Home-office floor plan

Figure 69- Idea of Hub Home-Office (Houzz, 2020)

9.2.4.5.2 Loft as Home-Office

Another group of people is seeking for a quiet and noise free areas where they can concentrate on their work such as basement, loft, or a secondary bedroom. These areas should be away from rooms associated with concentration-busting bustle.

Figure 70- Loft as Home Office (Johnson, 2020)

Figure 71- Bedroom as Home Office (Houzz, 2020)

9.2.4.5.3 Guest room as Home-Office

The idea of a guest room is to transform an office into a guest room and not the other way around. Many people have a guest room that is empty most of the time, so why not redesign that room as an office and add a typical sofa to welcome visitors.

Figure 72- Guest room as Home Office (Block, 2018)

9.2.4.5.4 Natural Light

According to the National Sleep Foundation, (Figueiro, 2017) the sleep health book highlights the importance of daytime light exposures and its link with productivity and sleep health. The basis of the study was to compare a team of workers who enjoy the sun and a second team sitting in a windowless room. The results revealed that the first team, exposed to natural light, were more productive and reported better quality of sleep than the second team.

Getting good natural light is one of the factors to increase productivity, increase alertness, reduce eye fatigue, and reduce energy consumption. Therefore, it is particularly important to choose a sunny room in which to do your work.

9.2.4.5.5 Furniture

Lot of people are perplexed as to why it is necessary to choose the right place for the home office, the color of the walls, the type of lighting, or even the furniture. Well, because everything we do in our home office has an impact on us.

It is important for people to invest in their home office equipment as most of them spend most of their days sitting in the home office and using the wrong equipment will not only affect the posture of the human body but also its mood and productivity.

Comfort is vital and choosing the right furniture can promote a better and healthier work environment. Just as having colorful furniture can spark people's enthusiasm and increase their productivity, take the example of smart and flexible furniture, which can also be beneficial as it offers multiple functions and facilitates storage.

Figure 73- Idea of flexible Home Office (Clearwater, 2012)

Figure 74-Multifunction and smart Furniture (Atelier Opa, 2020)

Many factors like circumstances, means, availability and affordability interfere during the home-office design process, but it is very essential to take this process seriously and invest time and money in the home office as our home is our new office nowadays.

9.3 Future demand on home services after Covid-19

Demand for household services has also had its share of the damage caused by the coronavirus. Under these difficult circumstances, consumers abandoned many services, and the service provider was forced to shut down during the lockdown period partially or even completely. On the other hand, many other services have developed and have seen an increase in demand for specialized services related to hygiene and health. So, what are the impacts of Covid-19 on the services market and the new demands for services during this pandemic?

9.3.1 Impact of covid-19 on services.

Covid-19 has been a huge challenge for all industries that rely on personal interaction, and the first month of the pandemic has caused a lot of suspicion, confusion, and uncertainty in the home service industry. In no time, consumers and service providers were mandated to change their behaviors, adapt to new social distancing rules, and wear the required personal protective equipment (PPE). Covid-19 has created a tailwind for e-commerce companies, although other businesses, such as sit-in restaurants, have seen dramatic declines (Jobber.Academy, 2020).

As the chart shows, the vat quarter-on-quarter turnover diffusion indices were negative for services and construction in the first quarter of 2020. However, where do home service market fit into the equation?

Figure 75-Turnover diffusion indices per industry (HM Revenue and Customs, 2020)

9.3.1.1 Home service business growth

Home service, which includes gardening, home cleaning, sanitary works, and other home-based contractors' businesses, has experienced steady growth in recent years.

In USA, home services grew by 12% in 2018 and 11% in 2019. By comparison, the GDP of USA grew by 2.9% in 2018 and by 2.3% in 2019.

The remarkably high growth of the home services category among other businesses indicates the health of these businesses and their importance to boost the economy.

The start of 2020 was a good year for home services, with a 13% increase compared to the same period in 2019 (Fig. 76 & 77). However, in March 22, the COVID-19 epidemic has spread to the United States, and this growth has seen a sharp decline.

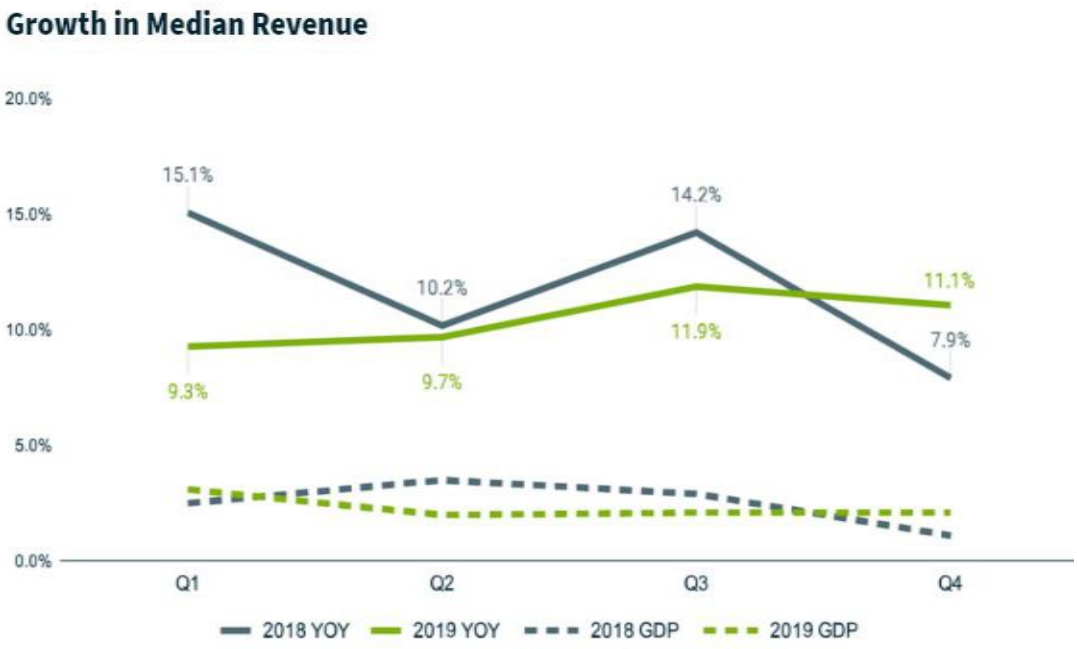


Figure 76- Growth in Median revenue of home services business in 2018 & 2019 (Jobber.Academy, 2020)

9.3.1.2 Home Service revenue recovery

By the end of March 2020, all the services provider company had to shut down completely their physical operation and the damaged occurred behind this shutdown were clearly reflected in the median revenue as a drop of 30% were witnessed after March. Experts finds it is early to be optimistic, but they foresee signs of strong recovery underway for home services market.

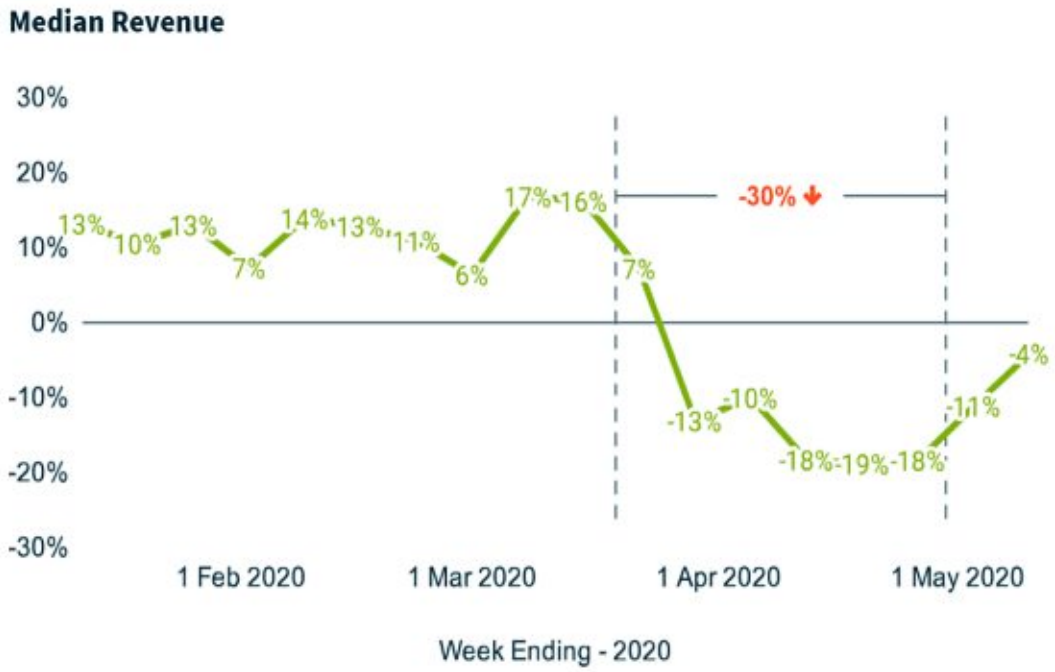


Figure 77- Growth in Median revenue of home services business in 2020 (Jobber.Academy, 2020)

9.3.1.3 Impact of Covid-19 on cleaning services

The cleaning business, including window washing, carpet cleaning, pressure cleaning and all related residential and commercial cleaning services grew rapidly in early 2020. However, in March, because of a lack of understanding of essential services and knowhow to provide safe services to consumers, many cleaning companies saw an increase in cancellations in both regular and newly scheduled business. This shift in demand resulted in a 35% drop in revenue compared to 2019, with residential cleaning hit the hardest as it fell 45%.

From May, the cleaning business started to pick up again as many service providers shifted their businesses to align with the new demand that arose during Covid-19 and which focuses on disinfection and sterilization services.

Other companies started to raise awareness between their employees and consumers and resorted new methodology to ensure employees and consumers safety, such as wearing full PPE when providing cleaning services or booking services when the household is away from home.

Service providers are working hard to overcome the hurdle imposed by the coronavirus, and these strategic changes paint a promising picture for the recovery.

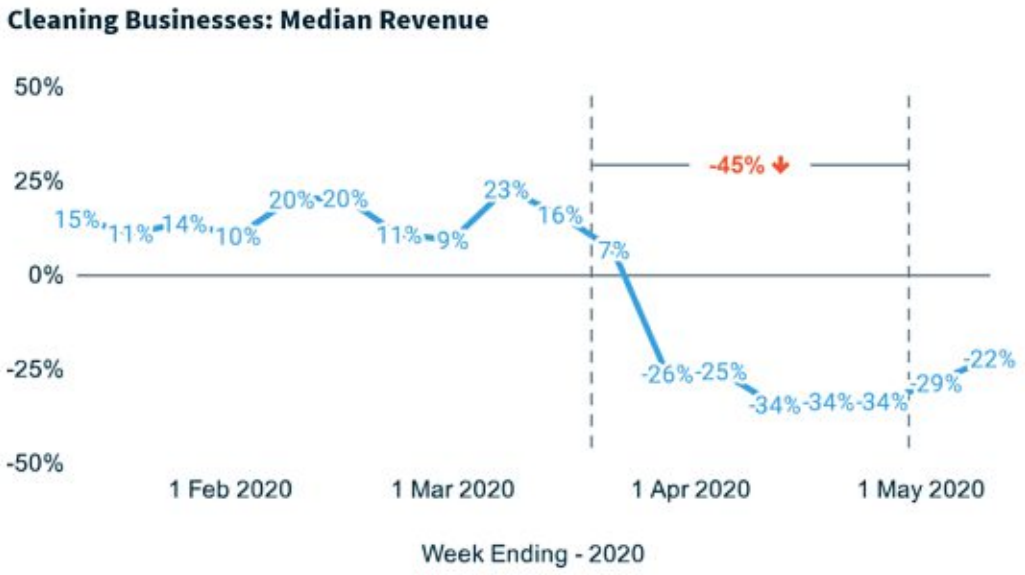


Figure 78- Growth in Median revenue of Cleaning services in 2020 (Jobber.Academy, 2020)

9.3.1.4 Impact of Covid-19 on contracting services

The impact of Covid-19 on outsourced services such as construction, HVAC, plumbing, electrical and finishes has been much less than on cleaning services. The fact that most service providers continued to work part-time and quickly adapted their procedures to meet the social distancing requirement. Not to mention that construction services were deemed essential for many consumers, which brings a great advantage to service providers.

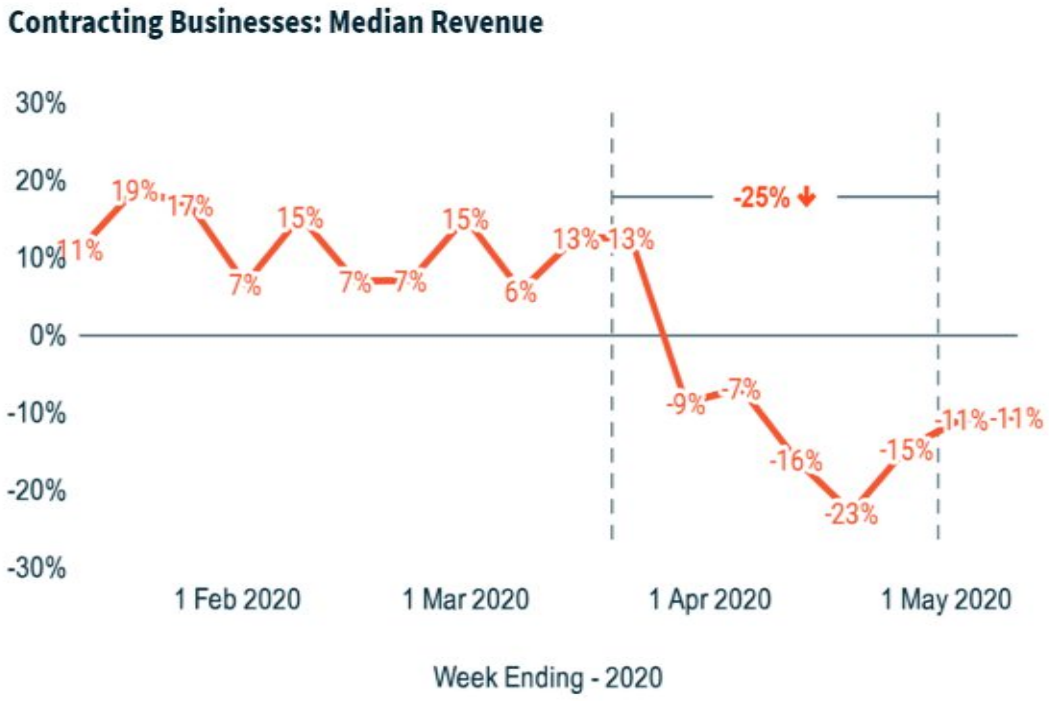


Figure 79-Growth in Median revenue of Contracting services in 2020 (Jobber.Academy, 2020)

Despite these relative advantages, contracting demand has decreased during the pandemic by 25% compared to 2019. Nevertheless, researchers are expecting a speedy recovery as people begin to appreciate their properties, understand the importance of preserving and maintain their buildings and to invest more in their tangible assets.

9.3.1.5 Impact of Covid-19 on Green services

Green services such as landscaping, gardening, tree care, lawn care and all related outdoor services, respond differently to the pandemic and fared well compared to other home service sectors.

Spring is the busiest season for this business. In addition, while the world has slowed down in recent weeks, Mother Nature has not. Besides the seasonal need for these services, green businesses typically operate outdoors, where social distancing rules are easy to follow.

Figure 80-Growth in Median revenue of Green services in 2020 (Jobber.Academy, 2020)

Despite the decline in demand for green services, it is clear that service providers have missed their opportunity caused by the COVID-19 pandemic, especially in the spring when green businesses generate most of their revenue. Without this seasonal bump, companies in the green industry might need to branch out into new services or get year-round work to make up for the long-term economic loss.

9.3.2 New demand for services

The Covid-19 period is an exceptional time and life, as we know it is completely different, from the way we work to the way we interact with our friends and family. Even services and our consumption have changed dramatically. However, once this crisis recedes, what will the "new normal" in services look like?

9.3.2.1 Virtual Tour

Covid-19 has forced people to stay in their homes and not go out, and many potential buyers have not been able to visit and assess properties even though the picture says a thousand words. However, "images can also tell a thousand lies" (warns Lejeune) as many tricks and programs available now in the market can be used to edit and refine photos easily.

Therefore, digital solutions such as virtual tour or 360-degree view can be implemented to help customers in their home buying journey. The virtual visit is an innovative solution to visit real estate while respecting the guidelines of social distancing. According to a National Association of Realtors survey, 64% of real estate agents reported they had seen home sellers stop holding open houses, and 29% said they had seen sellers disallow in-person tours (NAR, 2020).

9.3.2.2 Protection with contingencies

Travel restriction plays a big role in preventing customers from visiting any of the listings, where they end up relying on a 3D virtual tour or even published photos to assess and rate the space. To protect the right of customers, especially for people who live abroad and move to a new location, the offer must be contingent on a home inspection, which gives them a way out of the deal if a professional inspection reveals any major problems with the house.

9.3.2.3 Digitalized Paper works

Customers want a smooth and comfortable journey with no stones blocking their paths. Digitally signing documents has become a natural new thing as people sign various invoices using smartphones, tablets, and laptops from anywhere without printing or scanning documents. The digital signature would make the home-buying process easier while respecting social distancing regulations.

9.3.2.4 Bacteria's control

People are becoming more aware of their health and this degree of sensitivity varies from person to person depending on age, condition, or immune system. Covid-19 has been a major driver for the boost in demand for anti-bacterial services such as surface treatment; disinfection and sterilization; steam cleaning and deep cleaning to keep germs at bay and to provide a safe environment.

9.3.2.5 Air quality

Nowadays, controlling the air temperature is no longer enough, a new attribute for air has been added due to covid-19, which is quality! New sensors should be implemented to read and control the air quality if it is clean and virus free. In addition, to achieve better air quality, HVAC units should be fitted with appropriate filters so that the outside air is properly filtered.

9.3.2.6 Other services

Covid-19 brought wider demand for specific services some of which were not on users' agendas and some of which users were not even aware. Beside the services list above user are demanding for more services in different field such as health, hygiene, and home office.

Consumers have started to invest more in their health, which has led to increased demand for water quality by implanting a water quality sensor to notify the user of any contamination, instant home medical assistance, elderly care and many more.

Hygiene was also not a top priority for users before covid-19, but now users are starting to invest more in cleaning services such as ultrasonic cleaning of devices and to integrate new technologies to reduce surface contact by using voice commands (Alexa, Siri, etc.) to control lighting, HVAC, and many other devices.

The rise of home offices was also a trend during Covid-19 and consumers began to require several services to make working from home easier, such as courier services, delivery services, catering services., office infrastructure services (IT support, Wi-Fi, mobile, etc.) shuttle service to work, childcare services and document printing services.

9.3.3 Covid-19 shifted the spending to the home.

2020 was looking to be a strong year for home service investment even before the COVID-19 outbreak. (Micetich, 2020) with average spending in the USA increasing 45% from 2019. This boost in home spending is due to two factors: the first is the increased demand for Home services where people spend more time at home and discover forgotten projects like cleaning, landscaping, and maintenance, and the second factor is the increased inventory and manpower prices because of the pandemic's initial outbreak.

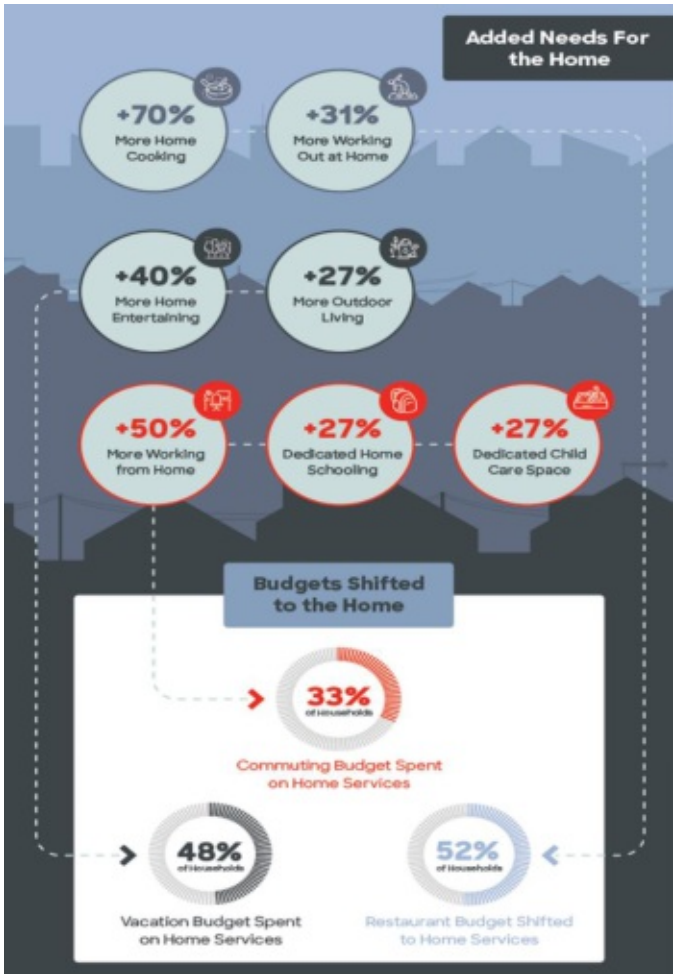


Figure 81- Covid-19 shifted spending to the home (Home advisor, 2020)

Industries are witnessing a big shifting range of needs for households because of coping with COVID-19. 70% more home cooking; 31% more workout at home; 40% more entertainment needs; 27% more outdoor living needs; 50% more working from home; 27% more home schooling and childcare space. There was a major change in consumption habits as a result of this, with 33% changing commuting budgets, 48% shifting holiday budgets, and 52% turning restaurant budgets towards home services.

10 Conclusion

Home keeps evolving through time, not only in concept, size, and design, but also in terms of features and services that are driven by many internal and external factors to meet the needs of users in a certain period. As seen in chapter 5, the supply market should always be ready to respond to any shift in demand to keep up the smooth flow of economy and equilibrium of market. Microeconomics speaking, many trends are taking a part to influence the new demand such as demographics, life expectation, family structure, urbanization, and consumer trends. In the decades to come, we can potentially expect to see an increase in demand for senior housing driven by the aging population. In addition to a shift toward shared space and services such as co-living and serviced apartment driven by the millennial generation.

Significant technological advancements will present both benefits and challenges for the production of smart homes, in which even more tasks that today rely on the user's decisions and behaviors will be automated. The future house will have many features such as flexibility and adaptability, allowing for simple reconfiguration of rooms and improving functionality of space. It is also envisaged for possible improvement of material buildings to be lighter, allowing easy and fast movements.

As seen in this paper, the remarkably high growth of the home services category among other businesses indicates the health of these businesses and their importance to boost the economy. The home services consumer journey often begins online were ratings and reviews are two of the main important metrics for consumers. Digital platforms become powerful tools as it turns out that mobile devices have the highest percentage of searches resulting in a product being purchased. Therefore, service providers should incorporate user-friendly digital platforms in their business and have a strong review management strategy in place to ensure and maintain a good star rating and high degree of consumer confidence. At the end, having a professional portfolio that showcases the skills and expertise of service providers will foster the probability of being contacted first by many new customers.

Moreover, the paper reveals that not only do Millennials become homeowners quickly; they also spend more on renovations than any other generations. Nowadays, the world is witnessing a shift in demand for services as the new wave of consumer

preferences of millennials are no longer the same as those of the generation of parents. Those demand emphasis on modernization, procurement, household management, property management services, energy auditing, BMS, BIM and virtual support. Besides, the demand for bundled services has become a trend. Users are always looking for what is cheap and convenient, and many find bundling services to be very efficient as they initially reduce service costs, tailor to their needs, and save time, as consumers have only one single point of contact for many services. Service providers should always bear in mind that loyalty is related to the degree of use of the services that make up the package and the duration of the contract. A good marketing strategy that provides customers with attractive offers and useful bundled services before the end of contract term is the key to gain back customer loyalty and satisfaction.

In this paper, the author draws on recommender system importance as business strategies and decisions rely on certain assumptions about market and customer behavior. Nowadays, with all the emerging technologies, Machine Learning methods are supporting the recommender system to predict users' demands and to recommend customized items for users in advance. Recommender system also assists in the development of enterprises involved in e-commerce. Nevertheless, to achieve good results, the enterprises should understand and analyses external environment like user behavior and adapt their internal organization such as their marketing plan according to the market. Not to forget the importance of machine learning to handle and collect big data received as a feedback from the users and maintaining updating those data for a better comprehensive of users' preferences, which lead to a better position in the fierce of the e-commerce completion.

The paper emphasis on Covid-19 pandemic as it marked an unprecedented turning point for 2020, causing a wave of disruption to the work-life balance. During the lockdown, people began to appreciate their values and re-orient their demands towards what is mandatory to survive the outbreak and protect their homes from the virus.

The housing market, compared to others, is a crisis resistant market as demand for housing is a less dependent on the economic situation. Therefore, the intensity of long-term impact is expected to be lower in residential market than in the office or retail market. The main impact of Covid-19 on the residential sector can be summed up by delaying or postponing the purchase/leasing process and reduction of demand for

apartments, co-living models, and students housing. The new demand will be highlighted with a dedicated home office station, access to private or public outdoor spaces, mobile houses, and relocation to rural areas. The challenge in the coming years for designers and developers is to create an innovative solution to transcend this delicate line of physical distance and address all the new health concerns. Designers also face another challenge in creating an indoor space where the user can experience and hold onto the outside world even when isolated.

Users' perspective on their home has changed dramatically in the wake of Covid-19. In fact, after spending more time at home and discovering forgotten projects, people have shifted their spending toward home improvement services (cleaning, contracting, and landscaping) as the pandemic increased their need for home office, consumers began to require several services to make working from home easier, such as courier services, delivery services, catering services., office infrastructure services (IT support, Wi-Fi, mobile, etc.) shuttle service to work, childcare services and document printing services. Moreover, people began to concern about their health, resulting an increase in the demand for deep cleaning, bacteria's control, air quality and filtration, autonomous delivery, digital services and virtual platforms. Also, People began to appreciate their properties, understand the importance of preserving and maintain their buildings and to invest more in their tangible assets. The State of Home Spending reflect that homeowners are using their home more and more and it has become an even greater factor in their quality of life. For all these reasons, the outbreak of COVID-19, colliding with long-term demographic trends, combined to make 2020 the year of the home.

To this end, there are options for further research in this field. The long-term effects of the COVID-19 pandemic on real estate and home service businesses have yet to be seen. Given that at the time this paper was written, it was during the pandemic period, it would be interesting to analyze the change in demand for space and services after the end of Covid-19 and obtain concrete figures. But thinking ahead considering on a regular basis how the homes will need to change to accommodate the demands that can already be seen coming is a good way to ensure that industry is not taken by surprise.

Bibliography

Atelier Opa. (2020). Architectural Furniture. Retrieved from https://www.atelier-opa.com/kenchikukagu2008.html - accessed on : 25/11/2020

Automated buildings. (2018). IoT for Smart Buildings Isn't What You Think It Is. Retrieved from http://automatedbuildings.com/news/feb18/articles/iotforall/180116105505iotforall.html - accessed on 15/12/2020

BBC. (2019). The houses that build themselves. Retrieved from https://www.youtube.com/watch?v=phJNZRr8Qoo - accessed on 10/10/2020

Beeferman, L., & Wain, A. (2016). Infrastructure : Defining Matters. Harvard Univeristy. Retrieved from http://www.law.harvard.edu/programs/lwp/pensions/publications/INFRASTRUCTURE%20DEFINING%20MATTERS%20FINAL.pdf - accessed on : 05/07/2020

Beers, M., & Thomas , T. (2005). Merck Manual of Geriatrics, 3rd ed. *Whitehouse Station, NJ: Merck*, pp. 118-126.

Bell, J., & Godwin, S. (2000). The transformable house. *Architectural Design Series, volume 70,WileyAcademy*, pp. 52.

Block, P. (2018). The Perfect Pair: How to Create a Guest Room/Home Office Combo. *Small Biz Daily*. Retrieved from https://www.smallbizdaily.com/perfect-pair-create-guest-room-home-office-combo/ - accessed on 25/11/2020

Blue Speed. (2016). THE 7 GREATEST ADVANTAGES OF SMART HOME AUTOMATION. Retrieved from https://bluespeedav.com/blog/item/7-greatest-advantages-of-smart-home-automation - accessed on : 24/01/2021

Brown, D. (2018). Business models for residential retrofit in the UK. Retrieved from https://link.springer.com/article/10.1007/s12053-018-9629-5 - accessed on 15/02/2021

Buwog, E. (2020). *First Vienna Residential Market Report.* Retrieved from http://residentialmarketvienna.at/links/pdf/BUWOG_WMB20_EN.pdf - accessed on 17/01/2021

CB Insights. (2018). The Future Of Housing:. Retrieved from https://www.cbinsights.com/research/future-of-housing/ - accessed on : 28/11/2020

CBRE. (2020). The Rise of Co-Living. *Innovation watch*. Retrieved from https://www.cbre.us/-/media/cbre/countryunitedstates/media/images/multifamily/innovation-watch/co-living/021420_innovationwatch_january-2020-fw.pdf - accessed on 14/01/2021

Chandler, J. (2017). Interactive wall in Storyhouse Chester. *Libraries Taskforce*. Retrieved from https://www.flickr.com/photos/135302410@N02/33880266884/ - accessed on : 10/10/2020

Clearwater, F. (2012). The Ultimate Two-in-One Furniture - Desk by Day, Bed by Night. *PRWEB*. Retrieved from https://www.prweb.com/releases/2012/8/prweb9809835.htm - accessed on : 22/10/2020

Cooper, D. (2016). Smart trash can helps educate reluctant recyclers. *Engadget*. Retrieved from https://www.engadget.com/2016-10-13-smart-trash-can-helps-educate-reluctant-recyclers.html - accessed on : 15/02/2021

Cost of Solar. (2014). Solar Panels. *The fact about solar Savings*. Retrieved from https://www.costofsolar.com/see-thru-solar-transparent-solar-windows-generate-electricity/ - accessed on : 10/10/2020

Derek, A. (2021). 28 Statistics Home Services Marketers Need to Know in 2021. *Dialogetech*. Retrieved from https://www.dialogtech.com/blog/home-services-search-stats/ - accessed on : 5/3/2021

Equality and Human Rights. (2016). *Working Better: Fathers, family and work – contemporary perspectives*. Retrieved from Equality and Human Rights

Commission Research summary 41: https://www.equalityhumanrights.com/en/publication-download/research-summary-41-working-better-fathers-family-and-work-contemporary - accessed on : 17/12/2020

EU Commission. (2014). Energy - LEED. *European Commission*. Retrieved from https://ec.europa.eu/energy/content/leed_en#:~:text=The%20LEED%20scheme%20has%20been,Building%20Council%20in%20the%201993.&text=In%202014%2C%20LEED%20certificates%20accounted,%2C%20Finland%2C%20Spain%20and%20Italy. - accessed on : 10/12/2020

EU Construction Sector Observatory. (2019). Housing affordability and sustainability in the EU. Retrieved from https://www.buildup.eu/sites/default/files/content/ecso_ar_housing_affordability_2019.pdf - accessed on : 15/7/2020

EY. (2020). COVID-19 impacts on the Austrian Real estate market. *EY Austria*, pp. 1-6. Retrieved from https://assets.ey.com/content/dam/ey-sites/ey-com/de_at/topics/covid-19/covid19-impacts-real-estate-market-austria-final.pdf?download - accessed on : 10/02/2021

Ferrer , J., Mora , H., & Olivares , F. (2010). On pricing of multiple bundles of products and services. *European Journal of Operational Research, Vol. 206*, pp. 197.

Goodman, E., & Licciardi, J. (2013). ComScore , inc. *Search Strategies for Smartphones vs. Tablets*, pp. 35-40.

Gough, O. (2017). Half the workforce to work remotely by 2020. *Small Business*. Retrieved from http://smallbusiness.co.uk/half-uk-workforce-remotely-2020-2540827/ accessed on : 2/12/2020

Greenwood, L. (2020). What impact will Covid-19 have on future housing supply in England? *The Savills Blog*. Retrieved from https://www.savills.co.uk/blog/article/301680/residential-property/what-impact-will-covid-19-have-on-future-housing-supply-in-england-.aspx - accessed on : 10/02/2021

Gupta, J. (2018). How Virtual Mirror Technology Will Change the Way You Shop. *QUYTECH*. Retrieved from https://www.quytech.com/blog/how-virtual-mirror-technology-will-change-the-way-you-shop/ - accessed on : 10/10/2020

Hansen, R. (2020). What is the future of work? *Oxford HR*. Retrieved from https://oxfordhr.co.uk/2020/07/28/what-is-the-future-of-work/ - accessed on : 20/01/2021

Hardekar , D., & Chakraborty, S. (2018). *role of infrastructure in the success of a residential development.* pp. 1-18.

Heathman, A. (2016). BBC builds a 'holographic' TV to see how we may watch shows in the future. *WIRED*. Retrieved from https://www.wired.co.uk/article/bbc-holographic-tv - accessed on : 10/10/2020

HM Revenue and Customs. (2020). Value Added Tax returns. Retrieved from https://www.gov.uk/government/organisations/hm-revenue-customs - accessed on : 10/02/2021

Home advisor. (2020). Home Service Market Report. Retrieved from https://www.homeadvisor.com/research/reports/market/#ixzz6l4Sz2CQI - accessed on : 20/01/2021

Home Designing. (2020). Space Saving Beds & Bedrooms. Retrieved from http://www.home-designing.com/2014/04/space-saving-beds-bedrooms - accessed on : 10/10/2020

Houzz. (2020). Home Office Idea. Retrieved from https://www.houzz.com/photos/home-office-ideas-phbr0-bp~t_732?fi=80 - accessed on : 22/11/2020

HSO. (2020). *workforce to work remotely by 2020*. Retrieved from https://www.hso.co.uk/leased-lines/technology-news/homeworking-news/50-ofuk-workforce-to-work-remotely-by-2020 - accessed on : 15/01/2021

Hunter, B. (2020). New Health-Driven Trends In Rental Apartment Design And Development. *Forbes*, pp. 1-5.

IAAC. (2017). LIVING: CONSIDERATIONS FOR A SELF-SUFFICIENT BUILDING. *Institute for advanced architecture of Catalonia*, pp. 1-15.

IKnowledge Team. (2020). Life After COVID – 19 Pandemic. *Aegon Life*. Retrieved from https://www.aegonlife.com/insurance-investment-knowledge/life-after-covid-19/ - accessed on : 22/11/2020

Inels. (2020). BMS – Building management system. Retrieved from https://www.inels.com/bms-%E2%80%93-building-management-system - accessed on : 26/11/2020

Integral.co.at. (2020). Austria sinus-milieus 2020. Retrieved from https://www.integral.co.at/images/sinusmilieus_gr.jpg - accessed on : 10/01/2021

Jobber.Academy. (2020). Nine charts that show covid-19's impact on home service businesses. Retrieved from https://academy.getjobber.com/covid-19-impact-on-home-service-businesses - accessed on : 10/02/2021

Johnson, N. (2020). Home Office Design Throughout the Years. Retrieved from https://www.nevillejohnson.co.uk/home-office-design-throughout-the-years/ - accessed on : 10/01/2021

Kaznatcheev, A. (2019). Local maxima and the fallacy of jumping to fixed-points. Retrieved from https://egtheory.wordpress.com/2019/03/29/fallacy-of-fixed-points/ - accessed on : 8/7/2020

Kihn, M. (2020). Global Appliances Manufacturer Connects Data To Engage Customers and Build Brand-Loyalty. Sales force. Retrieved from https://www.salesforce.com/blog/category/marketing/ - accessed on : 20/01/2021

Kimberly, A. (2020). Shift in demand curve. Retrieved from https://www.thebalance.com/shift-in-demand-curve-when-price-doesn-t-matter-3305720 - accessed on : 15/11/2020

King, J., & Perry, C. (2017). Smart building: using smart technology to save energy in existings building. *American council for an Energy -Efficient economy*, pp. 46.

Köninger, M. A. (2020). Wohnen in Zeiten von Corona. Raiffeisen Immobilien. Retrieved from https://www.raiffeisen-immobilien.at/storage/uploads/35174398-bdc4-4e3a-b670-a3d75ae8cc94/PI_Wohnen-in-Zeiten-von-Corona_inkl-Umfrage.pdf - accessed on : 20/10/2020

Ladle, T. (2017). Flexible Working Statistics. Retrieved from https://www.powwownow.co.uk/smarter-working/flexible-working-statistics-2017 - accessed on : 15/10/2020

Li, H. (2014). The Effects of Demographics on the Real Estate Market. 22. Retrieved from https://core.ac.uk/download/pdf/46712962.pdf - accessed on : 15/10/2020

Lipowski, M. (2021). Service Bundling from the Perspective of the Customer. Retrieved from Pobrane z czasopisma Annales H - Oeconomia http://oeconomia.annales.umcs.pl - accessed on : 20/02/2021

Mace, N., & Rabins, P. (2006). *The 36-Hour Day: A Family Guide to Caring for People with Alzheimer Disease, Other Dementias, and Memory Loss in Later Life, 4th ed. Baltimore.* MD: Johns Hopkins University Press, pp. 105-115.

Magdziak, M. (2019). Flexibility and Adaptability of the Living Space to the Changing Needs of Residents. *IOP Conference Series: Materials Science and Engineering, 471*, pp. 6. doi:10.1088/1757-899X/471/7/072011.

McAlister, C., & Wood, J. (2014). The potential of 3D printing to reduce the environmental impacts of production ECEEE. *Industrial Summer Study Procspp*, pp. 213 – 221.

Mcdonald, E., Bailie, R., & Michel, T. (2016). Development and trialling of a tool to support a systems approach to improve social determinants of health in rural and remote Australian communities. *The healthy community assessment tool*, pp. 8.

McKinsey. (2020). Reimagining the office and work life after COVID-19. Retrieved from https://www.mckinsey.com/business-functions/organization/our-insights/reimagining-the-office-and-work-life-after-covid-19 - accessed on : 12/11/2020

Memoori. (2016). The Internet of Things in Smart Commercial Buildings 2016 to 2021. Smart Buildings. Retrieved from https://memoori.com/portfolio/internet-things-smart-commercial-buildings-2016-2021/ - accessed on : 10/12/2020

Micetich, M. (2020). State of Home Spending Report. *Home Advisor*. Retrieved from https://www.homeadvisor.com/r/true-cost-report/#ixzz6l4SX6WaV - accessed on : 25/11/2020

Mordor Intelligence. (2020). Smart homes market - growth, trends, covid-19 impact, and forecasts (2021 - 2026). Retrieved from https://www.mordorintelligence.com/industry-reports/global-smart-homes-market-industry - accessed on : 10/02/2021

Murphy, R. (2020). Local Consumer Review Survey 2020. *Birght Ideas*. Retrieved from https://www.brightlocal.com/research/local-consumer-review-survey/ - accessed on : 02/02/2021

NAR. (2020). Economic Pulse. *National Association of Realtors*, pp. 6. Retrieved from https://cdn.nar.realtor/sites/default/files/documents/2020-05-18-nar-flash-survey-economic-pulse-05-22-2020.pdf - accessed on : 08/11/2020

Naya Energy. (2018). *The Difference Between an Energy Audit and Energy Management.* Retrieved from https://nayaenergy.com/difference-between-energy-audit-and-energy-management/ - accessed on 04/02/2021

OECD. (2011). The future of families to 2030. *International Futures Programme - OECD 2011*. Retrieved from https://www.oecd.org/futures/49093502.pdf - accessed on : 10/02/2021

Petit, H. (2020). Samsung and LG face off with smart fridges that 'scan your food' and suggest meals. *The Sun*. Retrieved from

https://www.thesun.co.uk/tech/10664947/samsung-lg-smart-fridge-suggest-meals/ - accessed on : 08/01/2021

Pinkasovitch, A. (2020). Introduction to Supply and Demand. Retrieved from https://www.investopedia.com/articles/economics/11/intro-supply-demand.asp - accessed on : 07/10/2020

Pioneer Enterprises. (2017). A Complete List of Property Management Services. *Landlord Solutions*. Retrieved from https://www.landlordssolutions.com/a-complete-list-of-property-management-services/ - accessed on : 17/12/2020

Poljak, M. (2020). The Pros and Cons Of Smart Glass (Smart Windows). *The Home Hacks DIY*. Retrieved from https://www.thehomehacksdiy.com/the-pros-and-cons-of-smart-glass/ - accessed on : 10/10/2020

PWC. (2018). Artificial Intelligence in Real Estate. Retrieved from https://www.pwc.de/en/real-estate/digital-real-estate/artificial-intelligence-in-real-estate.html - accessed on : 15/01/2021

PWC. (2020). Emerging Trends in Real Estate. Retrieved from https://www.pwc.at/de/publikationen/branchen-und-wirtschaftsstudien/pwc-emerging-trends-real-estate-europe-2020.pdf- accessed on : 15/01/2021

Quartz. (2017). A San Francisco startup is 3D-printing entire houses in just one day. Retrieved from https://qz.com/924909/apis-cor-can-3d-print-and-entire-house-in-just-one-day/ - accessed on : 23/01/2021

Redlein, A. (2018). Inroduction into FM. *Retrieved From the lecture of Professor Redlein during the facility management MBA program 2018-2020 at TU WIEN, pp. 1 - 50.*

Redlein, A., & Höhenberger, C. (2020). Digitalisation. In: Redlein, Alexander (ed.): Modern Facility and Workplace Management. *Springer Nature Switzerland AG 2020*, pp. 190-210.

Redlein, A., & Stopajnik, E. (2017). Current Labour Market Situation and Upcoming trends in the European Facility Services Industry. *IFMA Foundation* , pp. 34-42.

Redlein, A., & Stopajnik, E. (2020). Facility Management: An Important Industry Sector. In: Redlein, Alexander (ed.): Modern Facility and Workplace Management,. *Springer Nature Switzerland AG 2020*, pp. 140 - 162.

Redlein, A., Höhenberger, C., & Turnbull, P. (2020). Workplace Management. In Redlein, Alexander (ed.): Modern Facility and Workplace Management. *Springer Nature Switzerland AG 2020*, pp. 185-222.

Rocca, B. (2019). Introduction to recommender systems. Retrieved from https://towardsdatascience.com/introduction-to-recommender-systems-6c66cf15ada - accessed on : 10/2/2021

Roddy, S. (2020). Team Culture During the COVID-19 Pandemic: New Data. Clutch.co. Retrieved from https://clutch.co/hr/resources/team-culture-during-covid-19-statistics - accessed on : 12/02/2021

Savills. (2020). *The Future Impacts of Global Real Estate.* Retrieved from https://www.savills.com/impacts/market-trends/the-impact-of-covid-19-on-real-estate.html#residential - accessed on : 25/11/2020

Space-O Technologies. (2019). Want to Develop Online Home Service Platform? 6 Powerful Features to Make a Successful Handyman App. Retrieved from https://www.spaceotechnologies.com/handyman-app-development-features-startups/ - accessed on : 2/12/2020

Spaulding, W. C. (2020). Demand. *This Matter*. Retrieved from https://thismatter.com/economics/demand.htm - accessed on : 7/8/2020

Statista. (2020). Change in remote work trends due to COVID-19 in the United States in 2020. *Economy & politics*. Retrieved from https://www.statista.com/statistics/1122987/change-in-remote-work-trends-after-covid-in-usa/ - accessed on : 15/02/2021

Statista. (2020). How hard did you find the change to home office during the coronavirus (COVID-19) crisis? *Economy & politics*. Retrieved from https://www.statista.com/statistics/1116615/coronavirus-covid-19-home-office-change-austria/ - accessed on : 15/02/2021

Statista. (2020). Working from home during the coronavirus (COVID-19) in Austria in 2020. *Economy & politics*. Retrieved from https://www.statista.com/statistics/1116599/coronavirus-covid-19-home-office-austria/ - accessed on 15/02/2021

Stremersch, S., & Tellis , G. (2002). Strategic bundling of products and prices: A new synthesis for marketing. *Journal of Marketing Vol.66*, pp. 57.

Tauber, M., & Feldkamp, D. (2019). Building the Housing of the Future. BCG. Retrieved from https://www.bcg.com/publications/2019/building-the-housing-of-the-future - accessed on : 15/11/2020

Ten Fold Engineering. (2017). Ten Fold Technology : Future of Mobile Dwelling. Retrieved from https://www.youtube.com/watch?v=o8G9gF1K6WQ - accessed on : 09/10/2020

Tocci Bulletin. (2016). Augmented Reality in the AEC Industry. Retrieved from https://www.tocci.com/2016/08/augmented-reality-in-the-aec-industry/ - accessed on : 10/12/2020

Tunnicliffe, A., Davies, R., & Kingsland, P. (2019). *Design and Build Review.* Retrieved from https://designbuild.nridigital.com/design_build_review_april19/the_rise_of_green_technology_in_construction - accessed on : 22/11/2020

Urban-Hub. (2020). Mixed-use buildings: make the most of your building. Retrieved from https://www.urban-hub.com/buildings/mixed-use-buildings-for-diversified-sustainable-sites/#:~:text=A%20mixed%2Duse%20building%20aims,building%20or%20a%20small%20area - accessed on : 28/12/2020

Venteira, S. (2017). Millennials vs. Boomers: Why Some Home Improvements Are So Much Hotter Than Others. *Realtor*. Retrieved from https://www.realtor.com/news/trends/home-improvements/ - accessed on : 30/10/2020

Verified-Market-Research. (2021). *Global Home Services Market By Deployment , By Repairs & Maintenance, By Home Improvement Type, By Geographic*

Scope and Forecast. Retrieved from https://www.verifiedmarketresearch.com/product/global-home-service-market-size-and-forecast-to-2025/ - accessed on : 02/02/2021

Vizard, T., Evans, T., & Ainslie, D. (2020). Coronavirus and the social impacts on Great Britain. *Office for National statistics*. Retrieved from https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/datasets/coronavirusandthesocialimpactsongreatbritaindata - accessed on : 15/02/2021

Wiener Zeitung. (2020). wiener zeitung. Retrieved from Per Schleudersitz in die digitale Welt: https://www.wienerzeitung.at/nachrichten/wirtschaft/oesterreich/2058225-Per-Schleudersitz-in-die-digitale-Welt.html - accessed on 22/01/2021

Zachery, A. (2016). Why Green Houses Are in Demand. Retrieved from GoPrime: https://goprimenc.com/why-green-houses-are-in-demand/ - accessed on 14/11/2020

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