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REAL ESTATE INNOVATION: THE FUTURE OF REAL ESTATE PLATFORM MODELS AND THE ROLE OF THE BROKER

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Abstract

The residential real estate industry is lacking behind technological innovation. Brokers need to adapt to dynamic, technology-centered environments. Innovation and retraining are firms' best chance of survival. This thesis addresses the European market's attractiveness and analyzes the industry's most important technological trends. Further, the role of intermediaries is discussed and related to modern digital platforms. By assessing the platform model landscape in Europe, it is attempted to provide an outlook on the broker's role. While brokers may achieve reintermediation through marketplaces or Multiple-Listing-Services, disintermediation is expected if For-Sale-By-Owner or hybrid brokerages continue to grow.

Keywords: Digital Platforms, Disintermediation, Reintermediation, Real Estate Brokerage, Electronic markets

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1 Introduction

While other industries saw major disruptions due to technological advancements, the real estate (RE) industry has so far been slow to innovate (Tawania and Rao 2020). According to Ullah et al. (2018), the industry is five years late on technology innovation. However, although RE has been slow to keep up with the times, the next wave of technology disruption is expected to have a significant impact on how the business is conducted. The business environment is getting aggressive, and customers are becoming more demanding as the digital transition progresses (Schwager and Meyer 2007).

The objective of this paper is to first comprehend the need for innovation in RE and ultimately understand what these key innovations will be. For the purpose of this research, the focus will be on the residential RE market in Europe. In the group contribution an overview of the European industry, analysis on past trends impacting RE and an exploration of the next wave of technological disruption are presented. A special focus will be given to future platform models in RE and three specific innovations impacting the industry in the near future, which will constitute each member's individual contribution to this thesis. These innovations include Virtual Reality (VR), Augmented Reality (AR), Internet of Things (IoT), and Blockchain & Smart Contracts. Individual contributions provide a general overview of respective innovations, their importance, applicability, and potential impact.

This paper addresses an important issue for European RE industry stakeholders and future market entrants. As new technologies start disrupting the industry, it is important for companies and agents to understand how their business will be impacted and where their focus should be. While these technologies are vital for the industry's growth, they can also represent a challenge for businesses that are reluctant to innovate (Tawania and Rao 2020). Therefore, an increased concern must be given to the understanding of the next big disruptions shaking the industry. Real estate players should know how to take advantage of these in order to achieve business

development, satisfy customer demands and stay competitive in the fierce business environment (Grant and Cherif 2016).

2 Literature Review

2.1 Real Estate History

Floyd and Allen (2002) define real estate simply as the "land and things attached to it". The term covers any property that is willing to be bought, sold, rented, or exchanged for other goods or services (Graaskamp 1981). Throughout time, real estate has been influenced by changes in economics, politics, demographics, and technological advancements.

At the end of the 18th century began one of the most influential revolutions of modern times, the first Industrial Revolution. Production processes became mechanized, leading to the mass production and opening the door for other industries to follow their lead and increase productivity (The Economist 2018). Technological advancement allowed for a relatively better standard of living and increased labor productivity, which led to growth and prosperity in European countries (Maddison 1995). Within the first decades of the 20th century urbanization accelerated and created the need to build collective spaces in the cities, such as factories, hospitals, schools, housing blocks (Britannica 2020). Innovative construction techniques and materials were developed such as reinforced concrete, steel frames, curtain walls, or ribbon windows (RIBA 2021). Thus, architectural functionalism was born. It is based on an innovative concept that tries to join the form of a building with its specific function, thereby minimizing costs and presenting great sobriety and volume in buildings (Craven 2018).

In 1914, World War I began, and the growing prosperity slowed. Economies contracted and the Gross Domestic Product (GDP) of Western European countries declined and did not return to pre-war levels until a decade after the war began (Maddison 1995; Edelstein and Edelstein 2020). Many countries changed their borders and vast landscapes were damaged (Smith 2021).

While the war brought destruction, industrialization continued to grow, and new jobs were created to rebuild cities and repair infrastructure (Eichenberg 2019).

After the war, parts of Europe experienced a period of relative prosperity. In 1933, the Charta of Athens was agreed upon. It aimed at separating working districts from living districts, ultimately leading to the concept of car-friendly cities, and fundamentally reshaping the physiognomics of European cities (Rubin 2009). The period of relative prosperity ended with the start of World War II 1939. The death toll was estimated to be around 39 million, double the estimates for the First World War (Maddison 1995). The constant ground fighting and bombing led to the destruction of RE and many people were forced to leave their homes (Kesternich et al. 2012). After the war ended, the United Nations (UN) was formed to restore peace and prosperity (UN 2011). As had been the case since the mid-1800s, most jobs and educational institutions were located in major cities. Modernism continued to impact city landscapes and functionality as urbanization increased the demand for affordable housing in the suburbs (Vidal-Abarca et al. 2016; Craven 2018).

Between 1945 and 1975, pressured by the UN and weakened by the war, European countries left Africa and Asia in a process called decolonization. This process continued to stimulate the construction of houses to accommodate people returning from those colonies (Peralta 2019; Getachew 2020). Nowadays, there is still migration from rural areas to urban areas and buildings continue to adapt to the new necessities while integrating new technological advancements (Vaisi 2012).

2.2 Industry analysis

Within the industry analysis, the macroeconomic development of the European Union (EU) is analyzed to assess its market attractiveness. Moreover, real estate types are divided into four

segments: Office, Retail, Logistics, and Residential. Finally, the competition in the European RE brokerage market is scrutinized to understand industry pressures.

2.2.1 Macroanalysis

From a chronological perspective, it is essential to understand the factors responsible for the growth and decline of the European economy, as they correlate with the ups and downs of the housing sector (Martins et al. 2021). For instance, after each major economic downturn, Europe shows a sharp recovery, with each country having its specific demand characteristics. In recent decades, the demand for RE in Europe has been on the rise, changing dynamics of house prices, supply, and demand (CaixaBank 2020). Affected by economic growth, this demand led to changes in property prices, homeownership rates, and various monetary policy changes. A discussion of these aspects from a macroeconomic perspective is presented below. These different characteristics contribute to the focus of this paper on Europe.

Economic History of EU

Between 2000 and 2007, most European countries experienced slow growth in house prices. Some countries even experienced negative growth, such as Germany and Portugal. The countries that experienced high growth rates during this period, e.g., Latvia and Spain, grew due to monetary policies that lowered interest rates (Martins et al. 2021). These monetary policies facilitated purchasing a home with much lower down payments. After the global financial crisis (2008) and until 2012, Europe experienced slow growth in economic activities. After the European debt crisis in 2012, the European economy recovered well and even continued to grow (Deloitte 2021). This growth continued until the recent economic disruption caused by the Covid-19 pandemic, resulting in a worse economic situation of declining GDP then the 2008 financial crisis. The damage control process has forced governments and European Central Bank (ECB) to print money and make various fiscal changes that have been

leading to recovery in several countries. According to CaixaBank (2020), the higher employment rate over the last decade, combined with higher disposable income and positive economic growth, has increased housing demand and property prices in the European housing market.

As indicated earlier, banks play a crucial role in determining the potential development of houses based on the monetary policies they pursue. However, Martín, Moral-Benito, and Schmitz's (2019) research argues that house prices can also determine the status of an economy. The high exposure to financial instruments (i.e., leverage, loans) from advanced economies contributes to higher construction rates and house prices, thus lead to a potential housing bubble. This is observed in the case of Spain between 1995 and 2007-2008. The same research also suggested that when Spain's housing bubble burst, banks handed out higher credits that increased risky mortgages. As a result, this increased the probability of a financial crisis. Thus, suggesting that the housing cycles can be correlated with spillovers in an economy (Martín, Moral-Benito, and Schmitz 2019).

Geographical Disparity in Europe

The European housing market is characterized by its differences rather than its commonalities. A report published by the European Commission in 2021 finds a correlation between European housing cycles and vast differences between each country's housing markets (Martins et al. 2021). Regarding the rate of homeownership, countries across the EU vary considerably. While rates are high in Hungary (91.3%) or Slovakia (92.2%), rates are much lower for Portugal (77.3%), France (64%), or Germany (50.4%) (Eurostat 2021). In addition, the household mortgage debt to GDP diverges strongly among EU member states. On the low end, Romania exhibits a household mortgage debt to GDP ratio of 15.4%. Portugal is slightly above average with 63.5%, and Denmark is located on the high end with 110.2%. Not only does the amount of indebtedness vary but also the characteristics of mortgage debt. For example,

fixed-rate mortgages dominate in Germany, Belgium, or France, whereas in Portugal, Spain, or Italy, adjustable-rate mortgages are prevalent (Albertazzi, Fringuellotti, and Ongena 2019). This difference explains to a certain degree why housing cycles in the EU show less synchronization than business cycles (Rünstler and Vlekke 2018). Martins et al. (2021) also found that structural differences can be attributed to each country's individual development in the past. It is suggested that, although these differences are significant, they do not tend to change much over time, implying that structural peculiarities are relatively constant.

EU Outlook

The European RE market is estimated at a total of €860.3 billion in 2021, and this is expected to increase to €921.1 billion by 2025, with a compound annual growth rate (CAGR) of 1.6% (MarketLine 2021b). In comparison, the CAGR between 2016 and 2020 was 1%, thus showing a good, compounded growth overall. Similarly, transaction volumes in the European RE market are expected to grow by 1.2% annually between 2020 and 2025. In contrast, the CAGR of the RE market volume between 2016 and 2020 was 0.9% (MarketLine 2021b; Appendix I).

Again, this shows strong growth, even after the Covid-19 pandemic. Overall, while the RE market is looking at relatively strong upcoming growth, its development can be closely linked to the net economic growth of Europe. This growth is due to the correlation of financial activities such as mortgage rates, which can be strongly affected by any macroeconomic shock (Cunha and Lobão 2021; Reichert 1990). These macroeconomic shocks can also create an imbalance in housing prices caused by the disequilibrium in supply and demand. This is evident when low mortgage rates allow for more property sales, leading to higher homeownership rates.

The European GDP was in a position of slow growth between 2008 and 2012 due to the global financial crisis and the European debt crisis, respectively. However, with a projected annual GDP growth rate of 4.2% and 4.4% for 2021 and 2022, respectively, Europe is on track

to achieve its fastest economic growth since 2017. Spain and France are expected to lead this growth (European Commission 2021). Between 2021 and 2026, the EU's GDP is expected to increase from $17.07 trillion to $22.14 trillion, indicating a long-term slowdown. By 2030, the EU's GDP growth rate is projected to be -0.36%, another slow projection (International Monetary Fund 2021).

The ECB continues to support the European economy with its low-interest monetary policy. Most importantly, the Pandemic Emergency Purchase Programme (PEPP) was initiated in March 2020, buying up securities for €1.85 billion (ECB 2021). As a result, EU27 states can keep increasing their debt at low interest rates, stabilizing financial markets in the short-term (Ghiaie 2020). Although inflation was low during the pandemic in the EU27, considerable increases in inflation were recently reported (Appendix II). According to Eurostat (2021), average European inflation arrived at 4.1% in October 2021, representing the highest level since inflation data was first collected in 1997. With regards to interest rates, the situation stays favorable for RE investors in Europe. Short-term interest rates remain low and are not expected to increase at least until 2023 (CBRE 2021).

Overall, it can be said that the European market is characterized by strong disparities and uncertainties. The Covid-19 pandemic imposed tough macroeconomic challenges, which were countered by the ECB with the PEPP. The financial policy is projected to remain ultra-accommodative due to low interest rates (CBRE 2021). In combination with rising inflation, the attractiveness of brick-and-mortar assets to investors increases in the short term. However, the medium- and long-term outlook is considered negative because of the continuously shrinking GDP.

2.2.2 Real Estate Types

In European RE, numerous distinct segments exist on the market. It encompasses traditional asset classes such as commercial or residential, but also more specialized classes like hotel, healthcare, or entertainment (CBRE 2021). This research focuses on the main commercial RE types (office, retail, and logistics) and residential RE. This section aims to provide an overview of the most important asset classes and assess each sector's investment attractiveness. Key risk factors for each sector are analyzed and a market outlook is provided. Ultimately, this section provides the foundation for determining on which RE type the focus of this research should be put on.

Office

The office market segment encompasses all types of RE space associated with professional working environments. It includes all sizes, ranging from co-working spaces to office buildings (Poleg 2020). However, it only applies to office spaces affiliated with the tertiary sector and does not include home offices (CBRE 2021). One of the key indicators within the industry is the so-called “take-up”. It describes the “cumulated floor space of all new lettings or sales to occupiers that will be used as offices” (ImmoStat 2019). Take-up for office space in Europe equaled 9 million sqm in 2020, representing a decrease of 40% when compared to an office take-up of 15 million sqm in 2019 (BNP Paribas Real Estate 2021b). The pan-European vacancy rate for office space is expected to increase from 7.2% in 2020 to 8% in 2022. However, the prime rental growth continues to grow at an average of 0.6% in 2022 with an average prime total return of 6.36%, thus maintaining its attractiveness for investors. In contrast, investment volume in office space decreased by 29% in 2021 due to the Covid-19 pandemic, arriving at €92.3 billion in 2020. The general outlook for office spaces is complicated to determine due to the unknown long-term effects of the pandemic. Nevertheless, it is assumed that a 20% surge in employees choosing home office will transfer into a 10% decrease in

occupier demand (BNP Paribas Real Estate 2020b). Therefore, the actual impact on demand is yet to be determined. Also, the long-term development of the office space segment depends on the industry's ability to adapt to the increasing demand for environmentally friendly spaces. A key risk factor is that new building developments cannot meet long-term environmental requirements, necessitating re-development in the future.

Retail

Retail REs are properties that are solely utilized for the purpose of marketing and selling consumer services and goods (Gilmour 2019). Investment volume in the retail sector decreased by 17% from 2019 to 2020, arriving at €37 billion in 2020, the lowest value since 2012 (BNP Paribas Real Estate 2020d). The majority of the investment volume, roughly 32.5%, is directed to Germany, while 2.5% flows to Portugal (BNP Paribas Real Estate 2020d). In Europe, high street prime rents are deemed a key indicator for the industry. It shows the highest rental value for a top trading location, such as the Avenida da Liberdade, in Lisbon (BNP Paribas Real Estate 2020d). Differences between countries and cities across Europe are large. Average high street prime rents range from €135 per month per sqm in Lisbon to €300 in Berlin and peak at €1,986 in London (BNP Paribas Real Estate 2020d). A central challenge of the industry is to adapt to the Covid-19 pandemic and its corresponding changes in customer behavior. It is feared that consumers' shift to online shopping could be constant, especially due to the surge of online grocery buying and e-commerce (BNP Paribas Real Estate 2021c). However, BNP Paribas Real Estate observes a strong correlation between retail sales and consumer immobility caused by, for example, national lockdowns. It becomes clear that retail sales strongly rebounded after each mobility shock, emphasizing that decline in demand is primarily attributable to external shocks rather than general changes in customer behavior (Appendix III). This is further underlined by the fact that 74% of consumers in the EU and the US prefer to buy products in local stores or collect them in-store (Uberall 2021). Another positive outlook for the industry is

the consumers' trend towards sustainability. Social and environmental costs associated with online shopping and returns are high. The growing importance of environmental friendliness for consumers could decelerate the advancement of e-commerce and yield an opportunity for traditional retailing (BNP Paribas Real Estate 2021c).

Logistics

The logistics RE market can be defined as facilities related to distribution, warehousing, industrial, and commerce-related system such as fulfillment centers (BNP Paribas Real Estate 2021b). The logistics market is a critical part of the industry, supporting most commerce activities of a country. The rise of e-commerce and the importance of supply chains have only increased the forecasting of its market size (JLL 2021). Fueled by this exponential growth, the European logistics sector saw a 30% year-over-year increase between Q1 2020 and Q2 2021, with over $53 billion injected in 2021. This makes the logistics sector the biggest after the residential market and one of the best performers during the Covid-19 pandemic (BNP Paribas Real Estate 2021a; Savills 2020).

Furthermore, BNP Paribas Real Estate (2021b) also pointed out that the logistics and industrial sector is slowly catching up with the others in market share. This is a result of strong and resilient growth, which saw investments go up by 400%, whereas the market share increased by 100% over the last decade. This market share was deducted from the office and retail segment of the RE industry, resulting in increased investment volume by 9% in 2021. As such, the average rental growth is expected to increase between 1-2% each year until 2025 (BNP Paribas Real Estate 2021a).

The Covid-19 pandemic highlighted the logistics sector’s demand for warehouses and commercial buildings’ focus shift from international distribution to regional (BNP Paribas Real Estate 2021b). As a result, higher demand not being met by the lower supply and higher domestic warehouse demand resulted in many central European countries benefiting from rising

returns on investment (JLL 2021). Over the coming years, this demand is expected to continue rising, led by the rapid technological adaptation in supply chains and distributors globally. Followed by the residential sector, BNP Paribas Real Estate's forecast (2021b) also points out the logistic sector as having an impressive potential for rental growth in the mid-long term.

While the future of the logistics market remains bright, the manufacturing and industrial sectors of the logistics market can face uncertainties and risks. These risks include the interruption caused by new restrictions and lockdowns. This disrupts the demand, leading to supply chain issues (BNP Paribas Real Estate 2021c).

Residential

The residential RE market is composed of apartments, homes (family and single), villas, and various other housing projects such as student residences. It is also the largest sector in the global RE industry, with a value of over $258 trillion, an increase of 8% from 2019. In addition, this sector accounted for about 79% of the world's value of RE in 2020 (Savills 2021). While the Covid-19 pandemic saw major lockdowns, most European countries witnessed a surge in demand for houses during the later stages of the pandemic. A factor for this growth can be since governments across the globe, in the wake of the pandemic, have reduced interest rates. This resulted in more people being able to afford to buy homes (PwC 2021). This demand, driven by urbanization, is increasing house prices in urban, suburban, and medium cities.

Along with a change in demand, a change in consumer trends was also experienced. According to Savills (2020), buyers are stressing the importance of bigger living rooms and the availability of a workstation since more people are willing to work from home (Savills 2020). Supply and demand play a major role in fixing the prices of homes. Therefore, as the demand for newly refurbished apartments is currently outpacing the supply, this is leading to a rise in housing prices in major economic hubs such as Berlin, Paris, and London (PwC 2021; Savills 2020).

Additionally, homeownership across Europe has increased over the last decade for reasons such as lower average cost of housing, and low-interest rates, giving people a higher buying power. In addition to high homeownership levels, residential rents across Europe have also been on a steady rise over the last couple of years (BNP Paribas Real Estate 2021b). Countries like Spain and Ireland have experienced rents rising by over 40% since 2015, with the low supply unable to keep up with demand. As such, it is crucial to understand that what is driving demand are not exclusively families or individuals. A vast majority of house purchases are made by institutional investors aiming to diversify or enlarge their portfolios. The reason for this consists of historically high returns and appreciation of properties. Based on BNP Paribas Real Estate's (2021b) estimation, the average return on investment in Europe, adjusted to risks, is 8.8% for half a decade. This return may foresee a further increase to 25% of Europe's combined investment numbers in the residential RE sector.

In terms of forecast, BNP Paribas Real Estate (2021a) expects higher demand in city outskirts due to increasing demand for bigger houses while being closer to their workplaces. This strong demand also increases the growth of projects that aim to Build-to-Rent or simply construct and rent out to short & long-term tenants. Secondly, rising short-term rents may simply be a temporary trend if vaccination programs reach their goal, allowing tourism back to previous levels. These rising rents and house prices in Europe are shown in Appendix IV.

Given the differences in each RE industry segment, the focus of this paper will reside on the residential sector. Various characteristics such as its high return on investments, resiliency during the Covid-19 pandemic, and increasing demand forecasted suggest a strong outlook for the future (BNP Paribas REIM 2021). Additionally, the fact that the residential market is due for technological advancements points to the sector's high growth potential for the coming years (BNP Paribas REIM 2021). Moreover, given that the residential sector is very liquid,

opportunities for companies to establish themselves as industry leaders can further lead to competition. Consequently, driving the need for innovation.

2.2.3 Competition in the European RE brokerage

The European market for RE brokerage is characterized by its fragmentation and competition. This can be primarily traced back to the low barriers of entry and its high numbers of market participants (Barwick and Wong 2019). According to Eurostat (2021), the total number of RE agencies in the EU28 was 286,841 in 2018, as compared to 233,844 agencies in 2011. In 2015, this corresponded to an average of 0.55 RE agencies per 1,000 inhabitants across the EU28 states (Eurostat 2021; Europa.eu 2021). In a report issued by the European Commission (2018), National Competent Authorities in the EU were surveyed regarding market competition in their respective country. While 17% indicated a "very competitive" market structure, the majority of interviewees (56%) indicated "quite competitive". Surprisingly, zero respondents replied “not competitive”, but 28% stated “not applicable”. An additional survey conducted within the scope of this report found that one property is usually marketed by two or more RE agencies. Consequently, the level of competition in the RE market is further promoted (European Commission 2018).

Competition in the European market is further intensified by increased internet adoption of customers. According to Inmanns (2018), the internet has become the buyer’s de facto broker. This tendency is best underlined by the fact that in 2018 89% of buyers started with an internet search before contacting a buying agent compared to 43% in 2003 (NAR 2018). This trend has severe implications on the relevance of modern RE brokers. For instance, the percentage of households that first discovered their house with a RE agent dropped from 50% in 1997 to 33% in 2015 (NAR 2015). As postulated by the National Association of Realtors (2020), the share of home buyers who used the internet to search for a home increased to an all-time high of 97

percent. Another contributing factor to RE competition is the availability of real-estate information on the internet. This data was previously held exclusively by professionals but is nowadays free accessible. Relevant data points are, for example, property values, historical sale prices, property features, or number of houses on the market. While this data is scattered across the various available platforms in Europe, it is bundled in the Multiple Listing Service (MLS) in the US.

2.3 Covid-19 impact on RE

In late 2019, the world was impacted by a global pandemic, described as a black swan event with a substantial negative impact on the economy (Yarovaya, Matkovskyy, and Jalan 2022). This event disrupted industries worldwide (Haydon and Kumar 2020). The Covid-19 outbreak forced governments to install "stay-at-home" policies, locking down billions of the world's population. Daily activities and business stopped as waves of infections appeared, causing most countries' GDP to decline (Uchehara et al. 2020). Contrarily to past crises, after which demand and preferences soon returned to normal, Covid-19 impacts are expected to be much stronger.

What is now known as "the new normal" brings up changes affecting all sectors and long-term instability affecting industries' performance (Uchehara et al. 2020). The RE industry is no exception to the rule. Covid-19 has reshaped the way business is done, and RE professionals will have to adapt their business in the face of the changes caused by the pandemic.

2.3.1 Short-term challenges

Covid-19 has altered the life of billions of people, as people's daily routines changed. Massive lockdowns were marked by empty streets and closed businesses, and few stores continued operations (Gujral et al. 2020). Other than some essential services, businesses' revenue momentarily ceased to exist, which inevitably led to extensive lay-offs and business

failures. Consequently, this brought much uncertainty to people's lives. People started being more cautious about how they spent their money (Balasubramanian 2021). The uncertainty and fright of the future due to the pandemic led citizens to start rationalizing purchases more than ever. In the short-term, this led to a decrease of more than 30% of existing home sales (Balemi, Füss, and Weigand 2021). According to D'Lima, Lopez, and Pradhan (2020), this sudden decline happened not only due to decreases in demand but also in supply. On the one hand, buyers had less purchasing power, and they were also unable to perform optimal house searches due to restrictions and safety concerns regarding physical visits. On the other hand, the decrease in transactions was also explained by suppliers' risk aversion in selling houses in the uncertain Covid-19 market (D'Lima, Lopez, and Pradhan 2020).

Along with this, RE companies had to mitigate the health risks associated with physical visits. This factor represented a challenge, as physical tours are an important and decisive factor in the purchasing journey, and buyers wanted their safety guaranteed (Gujral et al. 2020). This also constitutes a long-term challenge, as people move towards e-commerce and demand superior experiences through safe online channels.

2.3.2 Long-term challenges

Covid-19 effects on the RE industry are more than just an immediate challenge. Adding to the short-term decrease in demand, the unprecedented crisis also brought lasting changes in customer behavior. These changes will, in turn, cause the need for long-term changes in the RE business itself (Gujral et al. 2020).

One of the leading lifestyle changes due to Covid-19 was increased work from home. The urge for social distancing decreased the necessity of commutes to the office (Ramani and Bloom 2021). This experience with "smart working" made people realize the lack of space in their homes (Billio and Varotto 2020). There was also a shift in demand from city centers towards

the suburbs (Ramani and Bloom 2021). After the early pandemic impacts, people see the benefits of living away from crowded cities and prefer options such as quiet suburbs, replete of social distancing, and outside spaces (Taylor 2020). Consequently, demand is expected to increase with the search for bigger suburban houses (Billio and Varotto 2020). Although households are increasingly cautious with the way they spend their money, low interest rates, together with preferred social distancing, are increasing the desire for privately owned homes (Balemi, Füss, and Weigand 2021).

Additionally, Covid-19 accelerated technological transition and digitalization. People were already performing online purchases, but with the closure of shopping centers midst pandemic, even consumers resistant to change were forced to adopt e-commerce. While more customers shifted buying habits towards the digital world, RE brokers also started to increase digital presence (Marona and Tomal 2020). According to Marona and Tomal (2020), who conducted a survey with RE brokers in 2020, 60% of professionals confirmed to devote more time to the digital world after Covid-19. Market players felt the need to digitize and provide more distinctive experiences to their online clients (Gujral et al. 2020). This move towards online commerce also represents a solution for safety concerns. The most intelligent players will perceive this change as permanent and adapt their long-term strategy. This can be done while deepening relationships with stakeholders, increasing transparency, efficiency, and resilience for future events (Balemi, Füss, and Weigand 2021).

Given this, the economic slowdown is not expected to last long-term. However, Sulaiman et al. (2020) inform that RE is one of the industries most affected by this worldwide disease and changes caused. Real estate companies will have to adapt their service to new customer demands and with new strategies in mind. According to Billio and Varotto (2020), the change in the industry resulting from the pandemic will be characterized by the adoption of current futuristic trends and innovation.

2.4 An Overview on Innovation

The challenges created by Covid-19 increased the pressure and need for innovation in RE. Innovation in the RE sector is simultaneously driven by the need to streamline procedures, improve customer experience, and enhance relationships between stakeholders (Maarbani 2017). Researchers have defined "innovation" as the generation of a new idea or the acquisition of new knowledge and its implementation into a new product, service, or process (Kogabayev and Maziliauskas 2017; Afuah 1998). In general, it is known as developing something new to the market and should benefit both the company and its stakeholders (Wong, Tjosvold, and Liu 2009). On the one hand, the new idea must answer a market need or a change in customer demands or lifestyle (Baregheh, Rowley, and Sambrook 2009). However, according to Kogabayev and Maziliauskas (2017), innovation is also about optimizing processes, maximizing profits, increasing efficiency, and companies' economic growth. Finally, it is not a punctual phenomenon but a long-term process that develops over time and involves changes and decision-making processes (Castro et al. 2010).

To survive in the new dynamic business environment, companies must constantly innovate, adapt and respond to changes in the industry (Danneels 2002). Companies that keep developing new offerings targeted to the needs of the market and the desires of customers are more likely to grow in the market (Gault 2018; Bytyqi 2014). To understand how the global and regional RE market will evolve, it is important to look into the past and analyze RE trends and developments to get a better market overview.

2.5 Trends in Real Estate

The following literature review seeks the reasoning behind major trends in the market and their influence in terms of innovations and improvements. These trends can provide an outlook on how the current state of the market might develop and how technological and human

advancements will play out in the future. The two major influential factors in the European residential RE market were identified as demographical and technological shifts in the industry.

2.5.1 Demographic factors

A geographical migration's effects on the RE markets worldwide can be profound. It can lead to a major transformation in global demographics and changes in a country's demand and supply for housing. As such, a demographic trend in the RE market can be linked with migrations across the world. The first industrial revolution resulted in a mass geographical migration due to increasing manufacturing, services, and technological advancements in various cities. This resulted in increased job creation and a much better quality of life (Çağlar 2014). Urbanization undeniably led to an increase in prices for urban and suburban houses. Recently, this demand was pushed even further by the Covid-19 pandemic all around the world, and it is expected to increase further (Savills 2020; MarketLine 2021b). Based on a report by the United Nations (2018), Europe is expected to reach 80% of its population living in cities or urban areas by 2030, which represents an increase of 10%. In terms of potential, human migration plays and will most likely continue playing a crucial role in defining a country's supply and demand for residential housing (Parker et al. 2018).

Furthermore, a study by Parker et al. (2018), reveals that the change in demand and supply for housing can be greatly affected by the population structure of a country. As higher urbanization leads to higher urban demand, it is no surprise that with higher population comes higher demand. As a result, most countries in Europe experienced increasing house and rent prices over the last decade (Eurostat 2021). For a large share of the population moving around and working from abroad, a rental system is highly preferred over having owned houses in terms of financial ability. This happens because purchasing a home usually takes up a large proportion of one's disposable income (MarketLine 2021). This scenario can be linked with the

rising tenancy ratios in Europe. One of the biggest tenant ratios in Europe is in Germany, with almost 50% of the houses occupied by rental (BNP Paribas Real Estate 2021c). This rising tenancy has pushed rental prices even further in cities like Berlin, indicating a willingness to rent over buying, thus changing the demand further.

Along with the population structure, the development within an economy contributes greatly to demand and supply change. Research by MarketLine (2020) indicates that in developing economies, people prefer to live less in rental houses compared to the higher number in developed economies. Similarly, developing economies would face lower regulations such as rent control in the industry by their own government versus a typically high intervention for developed economies. This is due to various internal and external factors, such as the geopolitical risks involved and the demographic structure of an economy (PWC 2021). From a customer point of view, government-driven rent control rules and regulations may be beneficial for various countries. For example, the introduction of affordable housing in numerous cities has allowed more people to rent homes and at lower prices in European cities (MarketLine 2021). However, from an organizational point of view, rent control may contribute to higher rivalry between players in the market, leading to lower rental returns due to various government programs in place. As a result, rent control may contribute to lower evictions, thus less people forced to reallocate, leading to lower geographical migrations (Pastor et al. 2018).

As part of demographics, each country may attract investors from different countries due to differences within an economy. Portugal, for example, saw a massive inflow of foreign money over the last couple of years. Programs like the Golden Visa allowed foreigners to obtain Portuguese citizenship by investing a certain amount of money into the country's RE sector and holding it for approximately five years (SEF 2021). This program has led to one of the highest investments from all over Europe. Foreigners from China, Brazil, Turkey, and United States were among the most contributing investors, respectively, with over €5.8 billion invested since

2012 (SEF 2021). Additionally, the EU Next Gen Programme has allowed for further inflow and purchases into the economy. The factors above have led to a higher demand coupled with a lower supply of houses in Portugal, leading to much higher prices to rent and purchase homes. With such high prices in capitals and major cities, the demand for suburban houses has steadily increased across Europe, and the pandemic has additionally pushed this demand higher (BNP Paribas Real Estate 2021a).

All in all, over the last decades, human migration, population change, and economic attractiveness have contributed to a change in housing supply and demand. Thus, resulting in the rise of house and rental prices, foreign investments, and the introduction of various policies to control pricing dynamics.

2.5.2 Technological factors

Another major trend identified in the RE industry is the growing influence of technological advancements such as the rise of PropTech. PropTech is an acronym for Property Technologies. It can be defined as the technologically driven evolutions occurring in the RE sector to improve efficiency (ING Economics Department 2018). PropTech, in general, encompasses various emerging and potentially disruptive technologies, such as Virtual Reality, Augmented Reality, drones, Blockchain, and Internet-of-Things-enabled sensors or appliances (Siniak et al. 2020). According to Braesemann and Baum (2020), the concept of PropTech can be categorized into the following three tiers: PropTech 1.0, PropTech 2.0, and PropTech 3.0.

PropTech 1.0, or the first wave of PropTech emerged after 1970, when the first personal computer and its powerful future-oriented potential was unveiled, showcasing what data can be used for. Eventually, this wave of digitization was interrupted by the dot-com bubble burst in 2000 (Siniak et al. 2020). Although this wave mainly occurred in the US and UK, it also birthed online platforms, e-commerce, and various other services (Baum 2017; Shaw 2018).

PropTech 2.0's rise in 2007-2008 resulted in the mass availability of data online. This wave led to the rise of smartphones, cellular and mobile technologies, cloud computing and big data (Braesemann and Baum 2020). PropTech companies such as Airbnb, Zillow and OpenDoor are redefining our interaction in the RE market while showcasing the power of Artificial Intelligence (AI) and Big Data. This second wave witnessed companies like Airbnb adapting to the significant changes in technological adoption, experienced around 2008. This change happened through property management software, architectural platforms, and the increased implementation of FinTech transactions in the marketplace (Braesemann and Baum 2020). This innovative wave also saw the conceptual birth of smart houses, smart cities, and IoT-enabled devices. Additionally, while urbanization increased the demand for residential development, the implementation of PropTech 2.0 also included an increasing trend in sustainability (Baum et al. 2020). Additionally, work by Shaw (2018) has observed that PropTech 2.0 experienced a massive inflow of money worth over $12 billion in 2018 invested into this wave of innovation. This investment represented an increase of over $5 billion from 2017, showcasing higher confidence in these technologies year over year. Undeniably, this digitized growth has empowered the purchase and sale of houses at a much faster rate using online marketplaces and platforms. Throughout PropTech 2.0, a benefit to users (renter/leaser) is a more simplified, yet smarter search element (ING Economics Department 2018).

PropTech 3.0 or the third wave, quickly introduced further innovation into the industry from 2014 onwards (JLL 2018). It allowed disruptive technologies like 3D printing, Machine Learning (ML), Artificial Intelligence (AI), Augmented Reality (AR), Virtual Reality (VR), drones, smart contracts and Blockchain to come to life. This wave brings simplified transactions and improvements in customer experience while making the most of available data (Baum 2017). Since the RE industry is slow to evolve, the wide-scale applications of these emerging techs remain distant yet inevitable (Braesemann and Baum, 2020). Baum (2017) also argues

that although PropTech 3.0 is not implemented yet, AI and Blockchain may be the biggest winners of this wave, with real possibilities to disrupt the industry. Moreover, Statista's (2020) research has shown that between 2008 and 2018, PropTech companies' investments multiplied from less than $1 billion to over $18 billion. This number is expected to continue growing, with most of the funding coming from the US. While PropTech is still focused on growing economies like China, India, North America and, certain cities in Europe, its widespread capabilities may take time to develop further (Kasprzak 2015).

The rise of these technologies has already sparked an evolution in various sectors such as transportation and agriculture. This transformation led to more efficiency, which allowed for reduced costs (Ullah, Sepasgozar, and Wang 2018). Such advancements can allow better management, planning, transactions, analytics, and marketing of properties. Consequently, this introduces more efficiency, autonomy, transparency, sustainability, and innovative ideas in the global RE market (Kasprzak 2015; Baum 2017).

The application of the mentioned technologies involved in PropTech can benefit tenants and owners of properties. Owners can benefit from the implementation of PropTech by potentially having higher added value on their properties through smart buildings while having better market information through the availability of data and AI (ING Economics Department 2018). Meanwhile, users and tenants can benefit from an enhanced market understanding. This can be achieved with search optimization and higher transparency in the market enabled by IoT, Blockchain, AI, and potentially more technologies.

What remains to be evaluated is how the RE industry can leverage technology and innovation. Additionally, it is essential to understand how the approach towards RE is altered while using technologies such as MLS, Blockchains, IoT, AR, and VR to innovate while keeping risks lower and opportunities high for all parties (ING Economics Department 2018).

2.6 Upcoming Real Estate Technologies

Within this section, eight technological developments for the RE industry are analyzed. This analysis follows the "Systematic Review of Smart Real Estate Technology" published by Ullah, Sepazgosar, and Wang in 2018. However, their proposed structure of the "Big 9 technologies" was adapted and enriched by external sources and expert opinions. As this paper's literature review established the importance of blockchain for the industry, it was incorporated in this review. Due to the limited applicability of wearables to the RE brokerage industry, it was removed from the list, and Software as a Service (SaaS) was integrated with Cloud technology. The analyzed technologies can be divided into three main categories: data mining technologies, networking tools, and data collection technologies.

2.6.1 Data Mining Technologies

Data mining refers to the systematic application of statistical methods to big data sets (IBM 2021). Its main target is to create links between different sets of data and to draw industry-relevant conclusions from its analysis. This yields several benefits that primarily support marketing and business intelligence efforts (Ester and Sander 2013). With regards to RE, it has already been applied to identify risk factors prematurely or to automize business forecasts (Ullah, Sepasgozar, and Wang 2018). Although data mining applications can be found in a variety of shapes, the focus of this research is on Big Data, AI & Robotics, and Clouds.

Big Data

The term Big Data describes the increasing availability of large amounts of data. Big data is defined as a collective phrase for massive and interconnected databases that need innovative software and processes to obtain relevant information (Winson-Geideman and Krause 2016). According to Chen and Lu (2018), most existing definitions for Big Data circulate around three features: processing speed, large data volume, and data coverage. According to the "2017 Big

Data and Analytics Forecast", Big Data total revenues are expected to accumulate to $99.4 billion in 2027, representing a CAGR of 12% between 2016 and 2027 (Gilbert 2017). Concerning RE brokerage, Big Data analytics primarily helps to understand market trends and customer behavior. Also, it saves brokers time because analyses do not have to be conducted manually and thus, it enables brokers to focus on their primary responsibilities (Ullah, Sepasgozar, and Wang 2018). Some companies, such as Zillow.com, Immobilienscout24.de, or casafari.pt adopted Big Data analytics already. They supply insights to customers such as buying price averages and forecasts, area developments, crime rates, or average time on the market (Zillow 2021; Immobilienscout24.de 2021). Therefore, Big Data analytics is considered beneficial to agents and consumers.

AI & Robotics

AI can be defined as the capability of machines to imitate human skills such as logical thinking, planning, learning, and creativity (European parliament 2021). Robotics uses AI by implementing it in modern robots, thus enabling them to solve complex problems without human interaction (Kehoe et al. 2015). The global market for AI is growing rapidly and industry revenues are expected to increase by approximately 1,250% between 2018 and 2025, eventually arriving at $126 billion in 2025 (Omdia 2020). It must also be mentioned that AI is expected to be responsible for the loss of more than 75 million jobs by 2022 (World Economic Forum 2018). However, AI is also expected to create 122 million jobs during the same time period but forcing employees into higher-skilled roles (World Economic Forum 2018). The net effects for the RE industry remain unknown at the moment. The applicability of AI and robotics within the RE industry is manifold. On the agent side, AI may be used to create 3D renderings of properties, do initial screenings of customers to save time, or improve targeting of marketing strategies (Ullah, Sepasgozar, and Wang 2018). Robotics could be used to do routine inspections and maintenance as well as cleaning and mowing of remote places (Warburton

2016). On the consumer side, AI can facilitate the search process with personalized filters, improve the matching process, save time, and reduce the probability of human errors (Ullah, Sepasgozar, and Wang 2018). Concrete examples for AI applications within the RE industry include selling price forecasts which were implemented in Italy (Morano, Tajani, and Torre 2015), machine-learning based selling and building decisions (Rafiei and Adeli 2015) as well as RE business predictions (Rossini 2000).

Blockchain

Although not part of Ullah, Sepazgosar, and Wang's "Systematic Review of Smart Real Estate Technology", experts believe that Blockchain has a major role to play in terms of innovative technologies in the RE industry (Baum 2017). As defined by IBM (2021), Blockchain technology is a digitally accessible database (or Distributed Ledger Technology) capable of recording, tracking, and verifying transactions. A key component of blockchain is its ledger functionality and the fact that transactions' details on the chain are tamper-proof, hence immutable. Additionally, Blockchain has the capability to run and store digitally automated contracts known as Smart Contracts.

According to Goldman Sachs (2016a), Blockchain technology can be applied to several industries in the economy. The financial sector is already a major winner due to Blockchain-enabled transactions that have saved the industry billions of dollars annually. The RE industry benefits from the transactional use of Blockchain and transforms its title registry process. Since Blockchain minimizes transaction costs and human mistakes, it is estimated that Blockchain could save between $2 and $4 billion in the United States alone by facilitating land transactions and registrations (Goldman Sachs 2016a).

Moreover, because Blockchain is a relatively new technology, experts do believe that a full-fledged implementation may take more time and bigger adoption if implemented right (Lansiti and Lakhani 2017). However, it is essential to note that the increasing market size for

Blockchain is seen as a major plus point for adoption. A study by Statista (2018) estimates that the global market size for Blockchain stood at $1.57 billion and is forecasted to hit over $160 billion by 2027. Europe has witnessed countries such as Spain implementing Blockchain-based transaction and land registry systems to improve on efficiency and security within the industry (JLL 2018). Additionally, to further drive Blockchain development into various fields, the European Commission has launched the "European Blockchain Partnership" that aims to increase communication and information exchange between European countries (European Commission 2021).

2.6.2 Networking Tools

Networking is the process of interchanging data through a shared network in an information system (Scarpati 2018). It allows users to share information through Local Area Networks (LAN) or Wide Area Networks (WAN). Applications in RE are widespread, including Customer Relationship Management (CRM) tools or building management platforms. Clouds and IoT were identified as the most relevant technological developments for the RE sector, which is why analysis is limited to these technologies.

Clouds

Over the past years, cloud technology started replacing traditional mediums of storage. While it was necessary to run local hardware-based data centers in the past, clouds are now enabling companies to retrieve data straight from the internet (Ullah, Sepasgozar, and Wang 2018). Following the definition of the National Institute of Standards and Technology (2011), cloud computing consists of five fundamental elements: On-demand self-service, broad network access, resource pooling, rapid elasticity, and measure service. The four service models associated with the usage of cloud computing are Infrastructure as a Service, Platform as a Service, Software as a Service (SaaS), and Function as a Service. SaaS is expected to account

for about 56% of total cloud computing revenues in 2025, thus representing the technology's most valuable sector in the medium-term (Statista 2021). It is based on the principle that software and IT infrastructure is operated by external service providers but can be licensed to customers using a subscription model. It provides a decentralized system that allows users to access it through the internet without major investments into privately-owned IT infrastructure (techopedia 2021). That is why the adoption of SaaS creates extensive cost savings and efficiency improvements for companies.

The Technology Market Outlook, conducted by Statista in August 2021, forecasts that the European cloud computing market will rise at a 20.8% CAGR over ten years. The market size is predicted to arrive at €135 billion in 2025 (Statista 2021). However, worldwide cloud adoption is enormously accelerated by the outbreak of the Covid-19 pandemic. In the "2021 State of the Cloud" study from Flexera, 90% of respondents indicated that cloud usage is now higher than it was initially planned before Covid-19. Within the RE domain, cloud computing offers benefits such as cost savings, flexibility, improved CRM, or increased collaboration. It can also improve transparency and communication, thereby solving the information asymmetry between brokers and clients (Stantchev and Tamm 2012). A concrete example for cloud usage in RE is the German company FlowFact which provides a fully cloud-based CRM and marketing tool for agents (FlowFact 2021). More industry examples include Spaceflow, an innovative building management tool to improve the tenants' experience (Spaceflow 2021), or ShowingTime, a showing management tool that also provides market statistics (ShowingTime 2021).

IoT

Internet of Things (IoT) is a network that connects people and the objects around them (Vailshery 2021). It is a technology that enables innovation in most businesses by transforming ecosystems and enabling faster and stronger connectivity between people and IoT devices. This

results in instant data analysis and consequently "smart action" (Deloitte 2017). IoT has numerous applications, most of which have to do with monitoring something tangible, such as the environment, health, industrial processes, customer experience, and even project performance (Chen et al. 2014; Nord, Koohang, and Paliszkiewicz 2019). Furthermore, addition to monitoring, IoT enables the management of fleets, home care, agriculture, logistics, and energy, where it is more than just a smart device but also a service provider (Chen et al. 2014; Bouguettaya et al. 2021).

IoT is growing rapidly and gaining traction among executives who consider it more relevant than AI or robotics (Nord, Koohang, and Paliszkiewicz 2019). As of May 2020, 2,552 thousand companies in Europe have invested in IoT, and the number of IoT platforms has doubled to 620 globally from 2015 to 2019 (Vailshery 2021; Liu 2021). In 2020, total investment reached US$749 billion and is expected to increase to around US$1.1 trillion by 2023 (Vailshery 2021).

IoT can influence RE in several ways. The building of smart houses creates more connected properties, with personalized accessibility, time management, and energy savings, increasing customer convenience (Demir and Ventura 2021). Additionally, it has applications in business decisions in RE. It can be used in office spaces by gathering information about employee wellbeing, productivity, and innovation. IoT can aid businesses investment decisions and optimize operational efficiency (Napp and Ribeiro 2020). Several companies such as MAPIQ and Maps people, are working with businesses to create adaptable solutions to transform the office space into a more productive place through smart technology (MAPIQ 2021; Mapspeople 2021).

2.6.3 Data Collection Technologies

Data collection technologies are physical tools that support users in gathering and modeling data. The applicability within the RE sector is vast. It includes areas such as digital storytelling

through AR, real-time synchronization of virtual and analog data, and autonomous control (Ullah, Sepasgozar, and Wang 2018). While a multitude of technologies exists, this review discusses drones, 3D Scanning, and VR & AR.

Drones

Drones are formally described as unmanned aerial vehicles (UAVs) (Techtarget 2019). They can be operated remotely and are usually equipped with high-resolution cameras within the context of RE. Drones may be applied to take aerial pictures of properties to improve product marketing and give customers more detailed information. Consequently, clients profit from increased transparency and reduced post-purchase regrets (Ullah, Sepasgozar and Wang 2018). Firms of any size can adopt drone technology as it requires limited upfront investment (CompTIA 2019). Real Estate companies in the US are among the top three hiring industries for drone talent, underlining the relevance to the sector (CompTIA 2019). According to a study from Kuzma et al. (2017), drone adoption in RE was already at 52% in France and 48% in the UK, Germany lacking behind with only a 24% adoption rate. Prominent examples in the RE industry are Betterview, which conducts drone-based property inspections, or Pix4D S.A., which creates exact maps and models only from drone pictures (PWC 2018).

3D Scanning

3D Scanning is one of the most recent technological developments among the Big 8 technologies. By using mobile or hand-held scanners, often equipped with laser scanning technologies, multi-dimensional models can be created, and information can be stored (Sepasgozar, Forsythe, and Shirowzhan 2016). This facilitates RE management regarding maintenance and supports the RE broker in the marketing process. The corresponding improvement in the quality of RE objects' information is beneficial to all parties involved, including proprietors, clients and, RE brokers (Ullah, Sepasgozar, and Wang 2018). Arrival3D is an example of a 3D modeling agency that creates multi-dimensional models (Arrival3D

2021). Matterport, a pioneer in the industry, combines 3D scanning with VR and AR functionalities, providing brokers with a full-stack 3D data platform (Matterport 2021).

VR & AR

While VR is a technology that completely immerses users in a virtual, computer-generated world, AR adds to the real world by projecting virtual objects into real environments (Carmigniani and Furht 2011). These technologies have a unique potential regarding improvements in RE customer experience. Some applications include virtual home tours, improvements in housing advertising, and more efficient communication between brokers and buyers (Tawania and Rao 2020). The RE industry is perceived as one of the most impacted by AR and VR, with a projection to reach at least $80 billion by 2025 (Ullah, Sepasgozar, and Wang 2018). According to Goldman Sachs (2016b), luxury RE agency Sotheby's is already providing virtual home tours to its customers since 2016, allowing for increased sales efficiency.

2.7 Disintermediation and Digital Platforms

The discussed technological developments possess the potential to disrupt the RE industry. However, these technologies need to be implemented on digital platforms to add value for landlords, buyers, and brokers. Currently, several digital platform models are competing in the market. By analyzing the peculiarities of each approach, a future outlook on the position of the RE broker in a dynamic environment is provided.

This is relevant because the broker’s profession was expected to become extinct with the rise of information and communications technology (ICT) the internet marketing revolution in the mid-1990s (Saiz 2019). Even though many professions, such as travel agents, suffered immensely from disintermediation, it rarely affected the RE industry (Wigand 2020). As a matter of fact, FSBO rates are today lower than ever before, and some types of digital platforms

are cooperating with agents rather than competing with them (National Association of Realtors 2018). Every year, new PropTech start-ups enter the RE market. Only in 2019, $8.9 billion was invested in RE start-ups, funding more than 500 companies (CB Insights 2020). Hence, considerable differences exist between platforms regarding business models, commission fees, and integration of RE brokers. After conducting a market analysis and literature review, existing platforms for RE brokerage were divided into four categories: digital marketplaces, MLSs, hybrid platforms, and FSBOs. While hybrids and FSBOs aim to disintermediate brokers, digital marketplaces and MLSs focus on re-intermediating brokers (Schlotawa 2018; Barwick and Wong 2019). In most European countries, digital marketplaces are predominant, but hybrid platforms are on the rise, imposing a real threat to brokers (Handelsblatt 2019; Hunziker 2017).

It is feared by industry experts that the PropTech 3.0 wave will lead to massive job losses in RE brokerage (Saiz 2021). Thus, it is essential for brokers, investors, and PropTech companies to understand and monitor industry developments closely. According to Levy and Murnane (2013), adaptation and retraining is the only chance of survival for intermediaries in the future.

3 Individual Contributions

What remains to be evaluated is how these technologies can effectively be implemented on innovative RE platforms and the impacts caused by this implementation. Following this research, individual contributions focus on four disruptive trends and their impact in the RE industry. The first individual contribution was created by Nadine Santos, exploring "The Impact of Augmented and Virtual Reality in Real Estate Customer Experience". Maria João Primitivo produced the second research on "IoT as a Sustainable Solution". This is followed by an elaboration on "The impact of Blockchain and Smart Contracts on the Real Estate Industry",

composed by Nabil Bardai. The fourth and last individual contribution was written by Jan Schmidt, exploring "The Future of Real Estate Platform Models and the Role of the Broker".

4 Methodology

To address the research topics, primary data was collected through two distinct Microsoft Forms online surveys. The first survey assessed the RE brokers' perspective and was directed towards European RE agents and brokers. This survey was distributed mainly through email, but social networks such as LinkedIn were also used. The second survey approached the end-customer perspective, and it was targeted at European residential RE buyers and potential customers. The objective consisted in understanding users' perceptions of the three technologies being studied – VR/AR, IoT, and Blockchain – when applied to RE. Distribution channels included social networks such as Facebook, WhatsApp, and LinkedIn. The software Microsoft Excel was used as the statistical analysis tool for the data collected.

Concerning the methods used to evaluate each question, several scales were applied. The first one to mention is the Customer Satisfaction Index (CSI). CSI consists of assessing how satisfied customers are with a company or product, and the rating goes from "Extremely dissatisfied" to "Extremely satisfied" (Eskelinen 2020). In addition, a Likert rating scale was used. This scale resides in evaluating the level of agreement respondents have with specific statements, in a rating from 1 to 5, ranging from "Strongly disagree" to "Strongly agree" (Albaum 1997). Additionally, some questions were evaluated through the Net Promoter Score (NPS), which measures the willingness of a customer to promote a specific product, technology, or company to others. It is evaluated on a scale from 0-10, and respondents are classified as detractors (0-6), passives (7-8), or promoters (9-10) (Reichheld 2003).

Apart from quantitative research methods, qualitative methods were applied too. Expert interviews were conducted with both industry professionals and academic experts. Experts were

contacted via email, LinkedIn, and the authors' network. The interviews complement the findings from the literature review and the study by indicating the future development of RE platforms in Europe.

5 Results

Regarding the *"End-Customer Perspective"* survey, there were 161 responses collected. Of these 161, only 159 were considered valid because they accepted the terms and conditions. The survey was distributed to people of different ages, nationalities, and countries of residence. Around 66.7% of the respondents are between 18 and 26 years old, while the remaining 34% are distributed in the age groups over 26 (27-35, 13.8%; 36-44, 9.4%; 45-53, 5.7%; 55-62, 3.8%; over 62, 0.6%). Approximately 77.4% of the respondents are Portuguese, 11.3% are German, 3.1% are Italian, and the remaining 8.2% are evenly distributed among Arab, Belgian, Belarusian, Brazilian, Canadian, Chinese, English, French, Ghanaian, Mozambican, Polish, Venezuelan and Tuvaluan nationalities. Except for one respondent living in Tuvalu, all others live in European territory, with 79.9% living in Portugal.

There were 58 valid responses to the *"Real Estate Broker Perspective"* survey. The survey was distributed to individuals of multiple age groups, countries of residence, and roles in the RE industry. Around 36.2% of the respondents are between 45 and 53 years old, 24.1% are between 36 and 44 years old, 20.7% are between 54 and 62 years old, 10.3% are between 27 and 35 years old, 5.2% are between 18 and 26 years old and 3.4% are over 62 years old. In terms of country of current residence, approximately 82.8% live in Portugal, and the remaining 17.2% live in Germany. The majority of respondents are RE brokers (77.6%). About 12.1% are company owners, and both respondents from HR and managing directors make up 3.4% of each of the samples in this survey. The other 3.4% are equally divided into sales managers and marketing managers.

Further results from these surveys are presented in each members' individual contribution according to their relevance for the technology being analyzed.

6 The Future of Real Estate Platform Models and The Role of The Broker

by Jan Schmidt

Introduction

Since the emergence of the internet, residential real estate (RRE) brokers have been widely predicted to become entirely extinct. Digital marketplaces were supposed to disintermediate expensive brokers due to the enablement of online For-Sale-By-Owners (FSBO). However, these fears did not materialize, FSBO rates are at an all-time low. Brokers managed to adapt to digital marketplaces and got successfully reintermediated. As a result, new platform oligopolies surfaced in Europe. They exploit their market power and impede market entry for alternative platform models. Nevertheless, with the PropTech 3.0 wave, new technological opportunities have arisen that threaten the existence of brokers once again. Therefore, this paper explains the drivers of disintermediation and tries to identify the most relevant platform model trends within the RRE industry. Understanding these trends is relevant for European brokers willing to adapt to modern market environments.

Literature Review

Process of Mediation, Disintermediation, and Reintermediation

To understand the role of modern RRE agents, it is fundamental to explain previous and current market dynamics. The theoretical framework underlying the broker's profession can be referred to as mediation. Mediation and transaction cost theory was first elaborated in Coase's work "The nature of the firm." in 1937. Before the rise of Information Technology in the 1980s, transactions between suppliers and customers were usually mediated by brokers (Giaglis et al.1999). The positive effects of intermediation on costs were first scrutinized by Baligh and Richartz (1967). It was found that contacts between buyers and sellers can drastically be reduced through intermediaries, thereby reducing

coordination costs and generating added value. Mediation effects apply to various features within economies and were named Baligh-Richartz effect. In addition, Wigand (2020) argues that intermediaries create additional value by reducing transaction costs. These transaction costs can be divided into four distinct categories: search, contracting, monitoring, and adaptation costs. Coase (1937) argued that companies opt for transactions that minimize transaction costs. But with progressing Information and Communication Technologies (ICT) and the emergence of the internet, a massive transaction cost reduction occurred. As a result, the unit cost of coordination transactions is heading towards null, thereby decreasing the added value of mediators (Benjamin and Wigand 1995).

Additionally, the rise of ICT created priorly unimaginable approaches to business transactions (Rockart and Scott-Morton 1991). Most importantly, electronic markets emerged, which inhabited the potential to create direct communication between suppliers and customers. First research in the field of intermediation suggested that intermediaries will be entirely removed from the value chain due to the rise of ICT (Malone et al. 1987). According to Benjamin and Wigand (1995), major economic incentives exist for suppliers and customers to eliminate middle persons in the value system. Removal of the intermediary was expected to affect the suppliers' gross margin positively and simultaneously decrease the end price for customers (Giaglis et al.1999). The process of leapfrogging these middle professions was coined “disintermediation” (Benjamin and Wigand 1995). It was believed to drive traditional match-making models such as travel agencies, brokerage firms, or RRE agents to extinction (Wigand 2020).

Although it was widely believed within academic literature that electronic commerce would eliminate middle professions, these fears did not yet come into effect (Wigand 2020). It became evident that producers could not operate the emerging electronic markets efficiently. Simultaneously, intermediaries explored new opportunities within the transformed value systems (Chircu and Kauffman 1999). Wigand (2020) argues that electronic markets enabled intermediaries to explore new responsibilities and labeled this process "reintermediation”.

However, according to Acemoglu and Restrepo (2018), intermediaries and low-skilled workers are subject to a constant race against disruptive technologies. Innovations such as automation or electronic

markets are expected to decrease the demand for labor. Nevertheless, it is argued that innovative technologies create new products and functions which expand the demand for human resources. Finally, Acemoglu and Restrepo (2018) conclude that the decrease in labor is currently outpacing the creation of new jobs, which results in a human-replacement effect. However, Levy and Murnane (2013) argue that a human-replacement effect may be successfully countered by retraining low-skilled workers and intermediaries. Adaptation to arising challenges is considered substantial for the workforce to remain competitive (Saiz 2019).

Incentives for Disintermediation - Commission Fees

Landlords and consumers have an economic incentive to drive out intermediaries to reduce costs for both parties involved (Benjamin and Wigand 1995). It is fundamental to analyze current commission structures and sizes to understand the actual monetary impact of disintermediation within the European real estate (RE) industry.

The average commission fee for buying agents in 11 of European Union (EU) member states has decreased from 3.6% in 2002 to roughly 3% in 2015 (The Wall Street Journal 2016). Meanwhile, commission fees in 2015 were at an average of 6% in Japan, 5.5% in the United States (US), 5% in Brazil and, 4% in Israel. On the one side, Levit and Syverson (2008) argue that decreases in commission fees result from internet-related disruptive technologies. On the other, Barwick and Wong (2019) state that a decline in commission fees is a result of increased competition within a market. Although average commission rates decreased, this does not imply that total industry revenues are decreasing. Due to the increase in property prices and transaction volumes, relative commissions might be decreasing, but absolute values are increasing (Voigtländer 2018).

Within the EU28 states, the average commission paid to brokers by buyers and sellers was €5.576 in 2018 (European Commission 2018). However, huge differences exist between members states (

Individual **Part Appendix**

Appendix I). While commission fees in Romania have a median value of €870, Luxembourg exhibits a median commission fee of €20,800 (European Commission 2018). Regarding rentals, the European average commission fee was 900€, and 59% had to be paid by landlords and 41% by tenants on average (Appendix II). Again, Romania exhibits the lowest average commission fees (€239), whereas Denmark shows the highest, namely €3,677 (European Commission 2018). It is essential to mention that commissions are usually split between parties. The exact commission split is country-dependent, but on average, 57% were paid by sellers and 43% by buyers (Appendix III). However, in some countries, such as Portugal or Denmark, the owner usually pays the commission, whereas fees are borne by purchasers in the Netherlands and Poland (European Commission 2018). Therefore, the economic incentive to cut out RRE brokers applies to different stakeholders depending on the country of residence.

Digital Platforms - Defined

Digital platforms function as the central link between multiple players in the market, enabling efficient interaction between stakeholders (Engelhardt, Wangler, and Wischmann 2017). The concept first emerged with the PropTech 1.0 wave and became predominant in the European market (Voigtländer 2018). This success can be attributed to factors such as their vast economies of scale, winner-takes-all effects, and network effects (Batura, von Gorp, and Larouche 2015).

On the one side, RRE agents profit from an infrastructure that they do not have to develop or maintain and can focus on their core responsibilities (Moring, Maiwald and Kewitz 2018). On the other hand, agents are subject to fierce price and innovation pressure, often deliberately enforced by platform operators (Keese 2014). Moreover, the platform owns the data of both parties, increasing their dependency on the platform. Eventually, the platform can set prices and conditions freely, and the controlling relationship is almost total (BMWi 2016)

Clement and Schreiber (2016) argue that digital platforms exhibit network effects and, therefore, impede new market entry and competition. It is postulated that market participants favor those platforms on which most customers are interacting already (Clement 2016). Thus, once a platform is established as the market leader, market players experience strong difficulties abstaining from it, and entry barriers are created (Kraft and Jung 2016). This is further underlined by the findings of Professor Albert Saiz (2019), who argues that oligopolies emerge in the RE arena due to the centralization of market data.

According to Engelhardt, Wangler, and Wischmann (2017), digital platforms can be split into two categories: transaction-centered and data-centered. Transaction-centered platforms function primarily as intermediaries, connecting supply and demand to realize transactions. It can be compared to traditional marketplaces, although they act in the digital space. Data-centered platforms focus on the connection of data-based information. Here, a comprehensive data-based system is created by linking complementary products to a single comprehensive digital ecosystem (Moring, Maiwald, and Kewitz 2018). This paper focuses on four transaction-centered platforms: Multiple-Listing-Service (MLS), digital marketplaces, hybrid brokerages, and FSBO.

MLS

An MLS is a digital platform on which a group of RRE brokers shares information about properties (CFI 2021). This system allows brokers to upload property data in the MLS and share it with all brokers and buyers within the network (Chen 2020). In an MLS system, the fastest agent to find a potential buyer wins the lead, thus creating fierce competition between the individual brokers. Commission fees are shared at a pre-determined rate between the broker who uploaded the property and the broker who found the buyer (McKinnon 2021). Although this implies that brokers have to share commission fees, agents receive access to a much bigger pool of properties and increase their number of deals (Dietz 2014).

When the system first emerged in the early 2000s in the US, more than 700 local MLSs came into existence (Barwick and Wong 2019). Under the leadership of the National Association of Realtors (NAR), all members were effectively forced into adopting the MLS system (Hahn 2018). Therefore,

MLSs dominate the US market today, with more than 80% of homes being sold through the approximately 800 local MLSs (Reso 2021). According to the interview conducted with Prof. Albert Saiz (2021), information is shared between most MLSs, leading to an accumulation of data into a single MLS database. Barwick and Wong (2019) consider it the most valuable asset in the US RE industry.

In Europe, some minor MLSs were founded on a national level, but few survived. Prominent examples of failed MLSs in Europe include sixpercent, myIRENS, Implius, or Tuttocasa. According to Bernhard Schmidt, founder of the MLS start-up Re-Share, there has been an approach to create a European MLS in 2012 with German, Italian and Turkish cooperation. However, the project was stopped due to the lack of European standards with regard to RE software (Dietz 2014). Concrete examples for MLSs in Europe are RE-SHARE for closed groups of realtors or Flowfact MLS, a realtor CRM system enabling cooperation between users (RE-Share 2021; Flowfact 2021).

Digital Marketplaces

Digital marketplaces are online platforms that connect sellers and buyers, while cooperation between agents is not enabled (Voigtländer 2018). According to Rochet and Tirole (2003), digital marketplaces are two-sided markets that generally incorporate three essential characteristics. First, the two user groups on the platform interact independently but are complementary. In the case of RRE brokerage, the agent interacts with the tenant. Second, the utility of one group increases if the other group's number of members increases. Regarding RRE brokerage, this means that an increase in the number of listed properties is beneficial for customers (Voigtländer 2018). Third, an intermediary is needed to operates the marketplaces.

By leveraging the power of bundling, digital platforms all over the world expand their market powers away from their core business to complementary products (Barwick and Wong 2019). Large parts of their revenues are derived from complementary services sold at high rates to customers. Additionally, there are also concerns that digital platforms raise the prices as soon as they achieve a

critical market share (Batura, van Gorp, and Larouche 2015). Further, the large amount of customer data helps digital platforms exploit customer biases over time (Barwick and Wong 2017).

In Europe, digital marketplaces are dominating the RRE brokerage market. This is underlined by an Alexa Rank, a tool to assess website popularity (Alexa Internet 2021). It shows that Germany's top four marketplaces have a combined score of 27.17, while the following four marketplaces have an accumulated score of (Immobilien-Jobs 2020). Prominent examples for digital marketplaces in Europe are idealista (Spain, Portugal, and Italy), immobilienscout24 (Germany), or seloger (France).

Hybrid Brokerage Platforms

Hybrid platforms in Europe vary significantly with regards to their characteristics. However, they primarily aim to minimize the involvement of RRE brokers and reduce costs for consumers (Schmidt 2021). Hybrid brokers perceive themselves as software companies rather than brokerage firms (Hunziker 2017). Due to the high degree of automatization and the limited involvement of RRE brokers, hybrid brokerages are highly scalable (Kricheldorf 2020). Third-party brokers cannot access hybrid platforms, and all properties are sold by in-house agents.

In Germany, the market leader within the hybrid segment is McMakler (AssCompact 2019). The company was founded in 2015, achieved a transaction volume of €400 million in 2018, and hired the 400th RE broker in 2021 (McMakler 2021). This was achieved by combining traditional in-person brokerage with online tools such as Big Data, on-demand property valuations, or online booking options for house viewings. Hybrid companies are often backed by extensive funding from outside creditors such as venture capital firms (Hunziker 2017). Therefore, hybrid brokerage firms often have large marketing budgets compared to SMEs, which provides them a substantial competitive advantage (Schlotawa 2018). McMakler, raised €50 million in a Series C round in 2019, thereby setting a venture capital record for European PropTechs (Loritz 2019).

FSBO Platforms

FSBO describes the process of selling a property without employing a RRE broker (Chen 2021). The main advantage of an FSBO is the cost-saving regarding the commission fee of the RRE broker (Araj 2021). An FSBO can be conducted through a multitude of mediums. The emergence of FSBO goes along with the PropTech 1.0 wave, starting in the 1990s. Although it was industry-wide believed that RRE brokers would be disintermediated in the medium-turn, FSBO did not live up to the expectations (Saiz 2019). This is underlined because the share of FSBOs in the US shrank to 7% in 2018, thus arriving at an all-time low (NAR 2018). Similarly, the portion of customers who purchased directly from sellers in 2018 was 6%, relative to 15% in 2001 (NAR 2018).

Nowadays, most digital marketplaces offer features that allow individuals to post properties online by themselves (Immobilienscout24.de 2021; idealista.pt 2021). Here, owners usually pay very low to no fees for this service, implying intense price discrimination against professional RRE brokers (Voigtländer 2018). In addition to FSBOs on digital marketplaces, several companies exist in the market, focusing specifically on FSBOs. Prominent examples are forsalebyowner.com, fsbohomes.com, or fsbo.com. However, a multitude of industry-unrelated platforms started indirectly enabling FSBOs recently (Harris 2017). Examples are eBay, Facebook, and Instagram.

Start-ups are Rethinking RE

Investment in RE start-ups has increased internationally. According to CB Insights (2020), global funding in RE start-ups increased by about 400% between 2015 and 2019. In total, $8.9 billion in equity funding was invested, spread across 510 deals in 2019 (CB Insights 2020). Thus, the number of funded start-ups increased at a CAGR of 12.67% between 2015 and 2019. Accordingly, the RE sector observes a variety of new PropTechs emerging every year.

OpenDoor Labs is considered one of the most promising PropTechs. It raised $350 million and achieved unicorn status, a valuation of $1 billion, within just three years (Crunchbase 2021). OpenDoor Labs automizes the selling process of properties, enabling complete house sales within a matter of days

(Ullah, Sepasgozar, and Wang 2018). They benefit from the spread on the house price and save on realtor commission fees. Meanwhile, sellers save on commission fees and benefit from a fast and transparent sale process (Poleg, Rethinking real estate: A roadmap to technology's impact on the world's largest asset class 2020).

Methodology

To achieve valuable findings, a survey was conducted with RE professionals, and three personal interviews were performed. The survey aimed at understanding the current usage of digital platforms and identifying common pain points associated with them. Survey questions can be divided into three sections. In the first section, respondents were asked to indicate demographic data. In section two, brokers' usage and satisfaction with current platforms is analyzed, and pain points are identified. Finally, awareness of MLSs is assessed and the willingness to participate in such a system.

The literature review showed that a variety of research exists regarding RE technology, PropTech, and platform models. However, only a few papers discuss the future development of platform models in RE and the role of brokers within them. Thus, it was deemed necessary to obtain expertise from industry experts to resolve key research questions. The interviewed experts provide insights from differing perspectives to provide a comprehensive overview. Professor Albert Saiz provides an academic view. Today, Prof. Saiz holds the professorship of urban economics and real estate at the Massachusetts Institute of Technology after teaching at Harvard and Wharton. Prof. Saiz published many academic papers on the future of RE which were frequently cited within the scope of this work. Mr. Marc Snehotta is a Director and Head of Business Development at CBRE in Frankfurt and has worked for over 15 years in the industry. Mr. Faruk Karasin, Senior Sales and Operations Manager at Vimmo and formerly Manager at McMakler, provides market insights from two German hybrid-brokerages.

Results and Discussion

Within this section, the results from the survey and the interviews are scrutinized and discussed. The two methods deliver important findings for answering the research questions. It will be discussed which platform model will profit from the PropTech 3.0 emergence and what implications this has for RRE brokers.

Dissatisfaction with Digital Marketplaces

To assess general satisfaction with the respondents' current primary digital platform, a Net Promoter Score (NPS) as developed by Reichheld (2003) was applied. Surprisingly, only 31.03% were categorized as "promoters", 39.66% as "passives" and 29.31% as "detractors". Overall, this results in a slightly positive NPS value of 2. However, it can be argued that at least 29.31% of respondents are unsatisfied with their current digital platform. Even though it was asked for "primary digital platform" it may be inferred that most respondents were referring to digital marketplaces. This can be postulated because 82.76% of respondents indicated in a previous question that their primary digital platform is a digital marketplace.

While this survey finding underlines the market power of digital marketplaces in Europe, it was confirmed by Mr. Karasin (2021) and Mr. Snehotta (2021) in a personal interview. Also, it aligns with Prof. Saiz's prediction that oligopolies will be formed and market concentration increases (Saiz 2021). Nevertheless, 82.76% declared that they use three or more digital platforms for marketing their properties (Appendix IV). Here, the study findings contrast the interviews and the literature review. This divergence could be attributed to the large share of Portuguese survey respondents, indicating that the Portuguese RRE market might be more balanced.

Additionally, it was found that the main problem of digital marketplaces for RE brokers is the pricing. One-third of respondents stated that they have to pay between 15-45% of their revenues to digital platforms (Appendix V). Considering the median brokerage commission fee of €5,576, this implies that fees for marketplace usage per transaction range between €836-€2509 (European Commission 2018). However, 60.34% of respondents declared that they spend only 1 – 15% of their

revenues on fees for digital platforms, suggesting a considerable price range. Mr. Snehotta (2021) substantiates the study's findings regarding high prices of digital marketplaces. Additionally, it is stated that large brokerage firms, such as JLL or CBRE, develop in-house digital marketplaces as a response to rising prices. The objective is to reduce fees and dependency on marketplaces (Snehotta 2021). However, according to the interview conducted with Prof. Saiz (2021), this strategy is only applicable for large companies due to high development costs. Further, it is considered unlikely to replace the need for third-party marketplaces entirely.

MLS Adoption in Europe is Difficult

The study shows that most RE brokers (72.41%) are familiar with the concept of MLS (Appendix VI). When asked whether they would participate in an MLS if it existed in one's country of residence, 67.24% indicated "yes" while only 13.79% replied "no" and 18.96% "not sure" (Appendix VII). In addition, respondents were asked to state whether they would prefer an MLS or a digital marketplace, assuming that both platforms exhibit equal cost and network size. Astonishingly, 53% of interviewees opted for an MLS system and 47% for digital marketplaces (Appendix VIII). According to Mr. Karasin (2021), this finding is congruent with the situation in Germany. Brokers face the problem that demand is very high in urban areas, but supply is low. Therefore, brokers are desperately searching for new ways to attain mandates and are willing to share commissions. This process could be facilitated through MLSs.

Even though interest in MLSs might be high in Europe, Prof. Saiz (2021) considers the creation of a European MLS very unlikely. This is caused by the variety of country-specific legislation and peculiarities. Nevertheless, even on a national level, the foundation of an MLS is expected to be unsuccessful in Europe. According to Björn Dahler (2014), CEO of a German RE brokerage firm, there is only one viable option to implement a large-scale MLS in Europe. Members of realtor associations have to be forced into an MLS, just like in the US (Dietz 2014).

Hybrid Brokerage on the Rise

According to Prof. Saiz (2021), hybrid brokerage platforms represent a real threat for RRE agents operating within the low- to medium-value residential RRE segment. Due to the high degree of standardization of properties, this sector is expected to be among the first that are automatized. This result is complemented by Mr. Snehotta (2021) as it is postulated that industrial and logistic properties are relatively secure from automatization due to their great extent of specialization. Even though it was believed in literature that hybrids will primarily penetrate the rental sector (Hunziker 2017), Mr. Karasin (2021) emphasized the economic relevance of property sales. This finding is further underlined by an article from Putschögl (2019) stating that McMakler recently started to focus entirely on property sales instead of rentals. However, both Mr. Karasin (2021) and Mr. Snehotta (2021) are convinced that the personal involvement of an experienced broker is irreplaceable for specialized, high-value deals. Lastly, hybrid brokerages are expected to put high pressure on industry commissions due to their fixed fees and improved cost structures (Karasin 2021; Fabricius 2021).

Social Media FSBO is Trending

Similar to hybrid brokerage, it is believed by industry experts that FSBO is primarily applicable to low- to medium-value segments (Saiz 2021; Karasin 2021). It is expected that the younger generations increasingly use social media such as Facebook or Instagram for marketing properties (Karasin 2021). However, this was primarily observed for rentals and sub-rental agreements, segments that are economically less attractive to brokers (Putschögl 2019). Moreover, the study found that some brokers show antipathy towards platforms that enable FSBOs. When brokers were asked about their biggest problems with existing platforms, 6.5% indicated the availability of FSBOs. Although this is only a small share of respondents, it must be highlighted that an open question was asked with no reference to FSBOs.

Implications for RRE Brokers

59% of respondents stated in the survey that they receive at least 25% of their properties through offline channels (Appendix IX). This underlines the importance of local office spaces and customer relationship management. This finding aligns with the results of the European Commission's (2018) study, which states that the reputation and location of a RRE agent are the most critical aspects when choosing between brokers.

Nevertheless, according to Prof. Saiz (2021), the RRE brokerage landscape will experience increasing market concentration in the medium turn. Large market incumbents such as CBRE or JLL are expected to grow, while SMEs will gradually perish. These findings coincide with recent academic research. Clement and Schreiber (2016) stated that network effects favor digital marketplaces, and impede competition, and promote winner-takes-all effects. Additionally, hybrid brokerage firms are expected to slowly push SMEs out of the market due to their price advantage (Karasin 2021). Therefore, experts predict the disappearance of traditional brokerage firms in the long-term (Saiz 2021; Karasin 2021). However, it also constitutes an opportunity for brokers willing to retrain and join hybrid brokerages (Snehotta 2021).

Conclusion

This paper attempted to outline essential characteristics of current platform models in the European RRE brokerage market. By providing an outlook on future platform models, brokers are provided suggestions for future business positioning.

The study has shown that disparities exist between current market incumbents, i.e., marketplaces, and brokers' desire for cooperation in the form of MLSs. However, the adoption of an independent MLS is considered unlikely by interviewed industry professionals and in literature. Additionally, respondents showed resentment towards digital marketplaces because of their exploitation of market power. Agent's antipathy is mainly attributable to high membership fees and FSBO enablement. The emergence of PropTech 3.0 created vast innovation opportunities for the industry. However, these technologies are primarily leveraged by uprising hybrid brokerages. Hybrids were found to exhibit substantial cost

advantages due to their scalability, allowing them to undercut commissions. The emergence of hybrids is expected to toughen competition and represent a threat to SMEs. FSBOs are expected to gain new traction due to the rise of social media. Nevertheless, FSBO is considered to gain relevance mainly in low-value segments, thus imposing a minor economic threat to RRE brokers.

All in all, disintermediation will primarily affect brokers unwilling to adapt to the changing market. Reintermediation is realistic for cooperative, and technology-savvy RE brokers that focus on specialized market segments. An MLS is desired by brokers and recommended by academics, but its likelihood of implementation on a European level is low.

Limitations and Future Research

So far, only a limited number of academic publications about the European RE industry are available. RE brokerage papers are often country-specific and thus, exhibit language barriers. Thus, German and English papers were primarily used even though the entire EU market is analyzed. Similarly, the study's sample size of 58 is relatively small, and respondents were mainly from Portugal and Germany. Also, only three expert interviews were conducted. Accordingly, survey and interview results may be biased. In addition, a multitude of platform models emerge every year on the market, but only four categories were discussed in detail. Due to the experts' location in the US and Germany, their expertise on the EU market is limited.

Future research could elaborate on other European markets in more detail and provide an improved pan-European overview. Moreover, a precise categorization of current platform models is lacking in academic literature. While the subject of historic disintermediation is well researched, few outlooks are provided regarding future reintermediation.

7 Final Conclusion

This paper aims to identify important PropTech 3.0 technologies that can help residential real estate brokers stay competitive. While technological adoption in RE still lags behind, exciting technologies recently emerged on the market.

The RE industry is influenced by external factors such as economics, digitization, and emerging technological advancements. Similarly, Covid-19 acted as a catalyst in digitalization, creating new business model opportunities and adding innovative pressure. While the retail and office segments became less attractive as people started buying online and working from home, the residential segment and logistics flourished.

The two surveys highlight crucial areas for improvement on current RE platforms, such as low satisfaction, poor purchasing experience, and low industry transparency. That is why individual contributions explore specific technologies, namely VR & AR, IoT, Blockchain & Smart Contracts, to analyze their potential for RE experience enhancement. Further, digital platforms were analyzed to provide an outlook on the future relevance of RE agents. AR and VR represent valuable adoptions in the RE industry when considering improvements in customer experience. Incorporating these technologies leads to better decision-making, faster purchasing processes, and more satisfied customers, solidifying firms' market position and creating value. IoT has a wide range of possible applications in RE that create a more comfortable and safe living space. Although IoT has been found to contribute to sustainability, such as energy optimization, its large-scale adoption is dependent on people's willingness to implement these solutions. Integrating Blockchain and smart contracts can lead to higher transparency, lower costs and fees, and more autonomous processes. However, governments and institutions need to address low adoption levels and country regulations for successful Blockchain implementation. Finally, it was found that brokers are unsatisfied with current platform models due to their exploitation of power. While a preference for MLS was identified

in the study, interviewed experts underlined the unlikelihood of implementing an MLS in Europe.

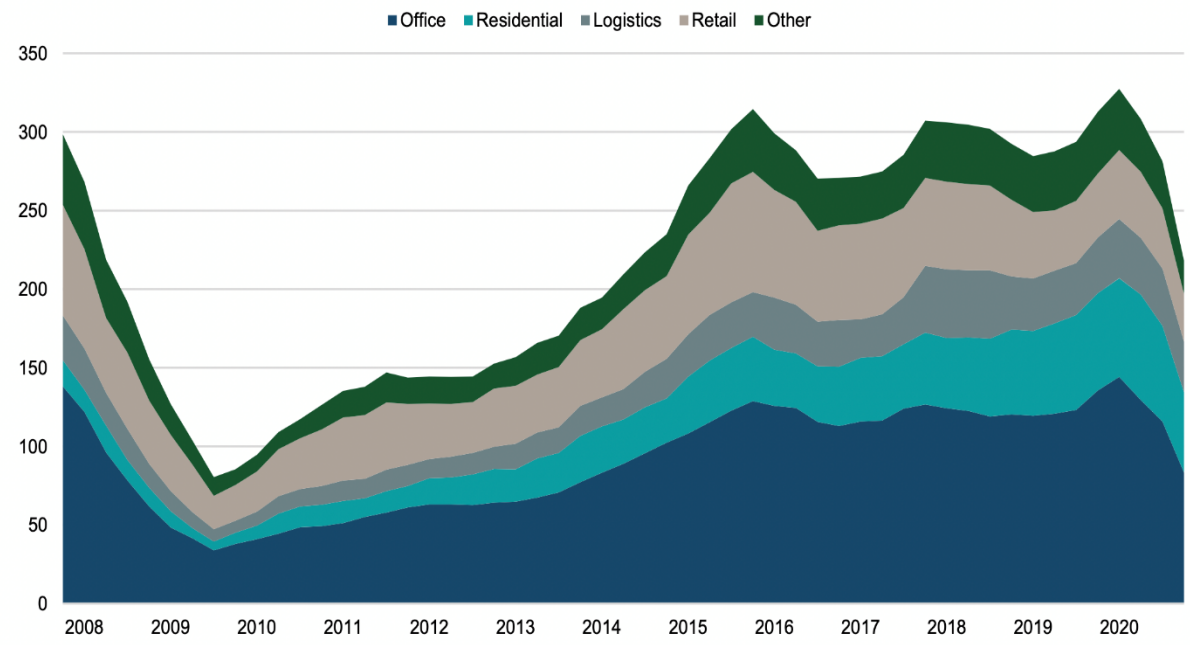
Ultimately, this paper concludes that recent developments in technology have pressured the RE industry. An MLS with VR & AR functionality, on-platform IoT cross-selling option, and blockchain-based transactions could disrupt the RE market. By adopting these technologies, brokers can remain competitive, and customers can benefit from improved experience and market efficiencies.

7.1 Limitations and Future Research

This thesis analyzes future platform models and the importance of technology adoption in residential real estate. The study is limited by focusing on three particular technologies: VR/AR, IoT, and Blockchain & Smart Contracts. Additionally, the potential of the three technologies is addressed through two surveys targeting European real estate brokers and potential buyers. Another limitation is the number and demographics of the "End-Customer Perspective" survey respondents, which might not represent European customers. Moreover, both surveys were distributed in English, limiting the research to those who comprehend the language.

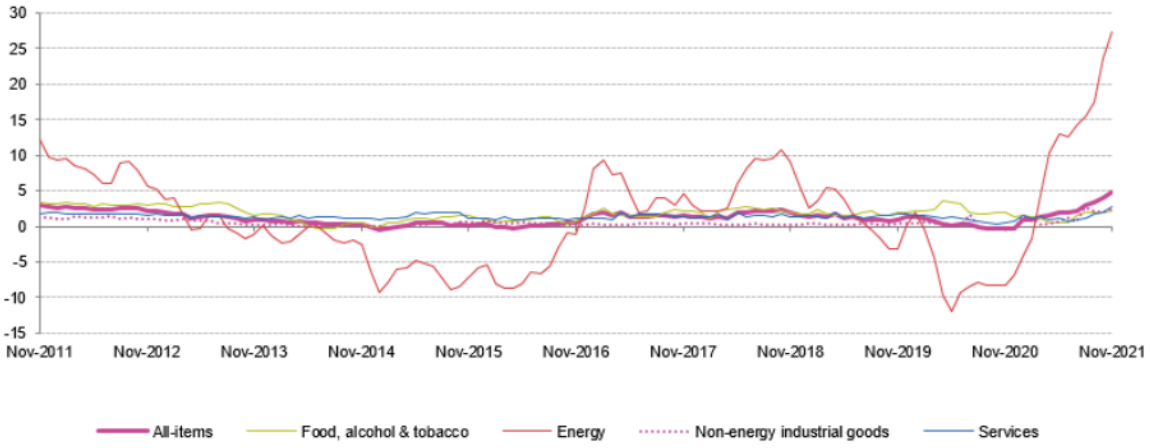
Future research should build on technology application to RE, exploring the remaining technologies mentioned. VR/AR, IoT, and Blockchain adoption have multiple benefits in the RE industry, but further research should focus on other technologies and their impact. Additionally, future studies could focus on specific countries or more restricted areas. These aspects can contribute to higher accuracy when identifying which technologies each company would take a higher benefit from and, therefore, make an investment in.

Appendix



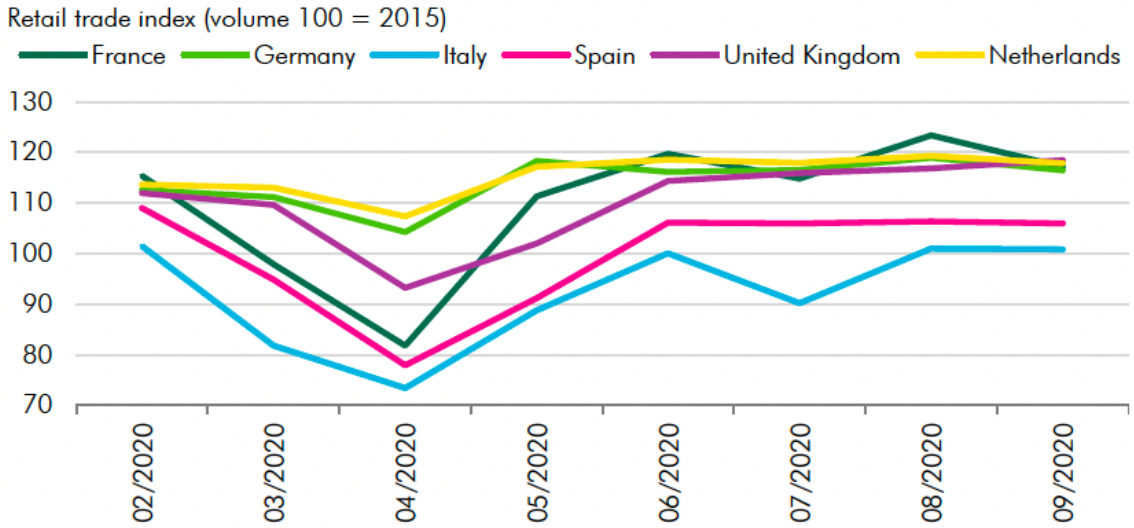
Appendix I: European RE transaction volumes by sector (in billions of €).

Source: Real Capital Analytics, January 2021 (Figure from DWS 2021).



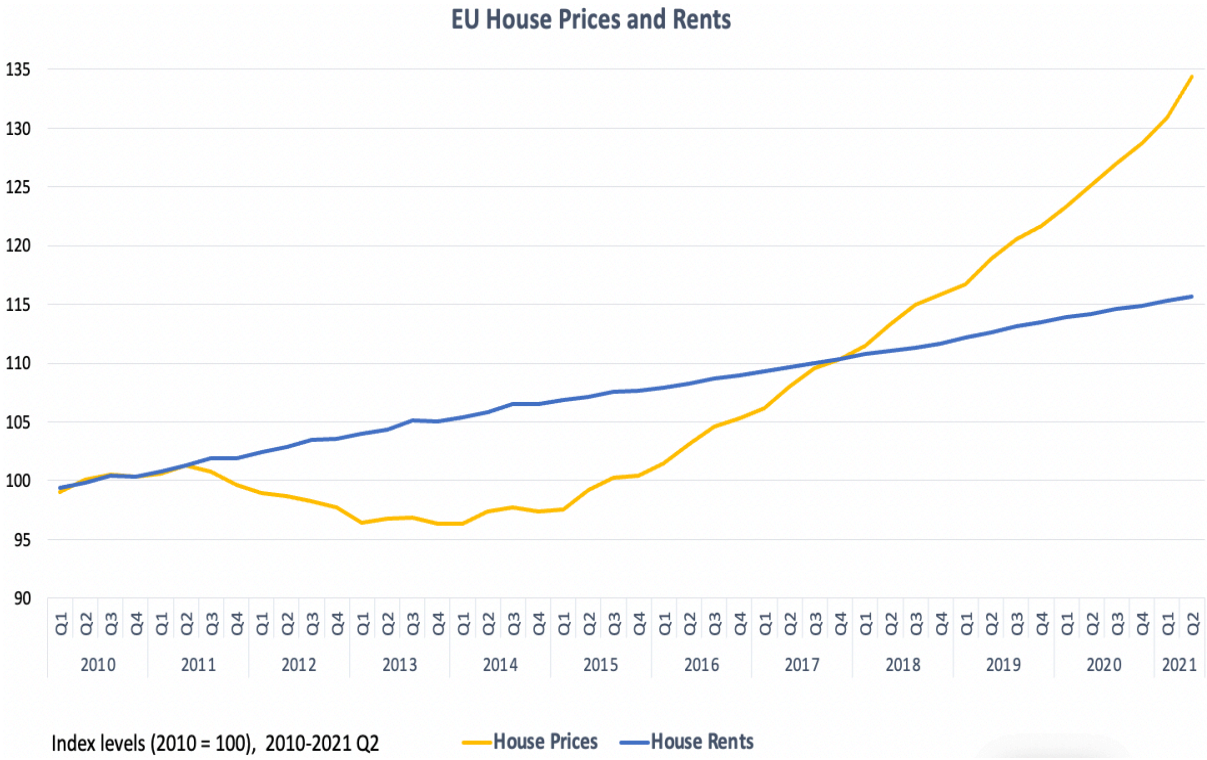
Appendix II: Euro area annual inflation & its primary drivers, November 2011 – November 2021 (estimates).

Source: Eurostat (online data code: prc_hicp_manr).



Appendix III: Retail Revenue Recovery in 6 European Markets.

Source: (CBRE 2021).



Appendix IV: Rising house and rent prices.

Source: Eurostat 2021 (own figure).

Individual Part Appendix

Appendix I: Commission fees paid to the RE broker by buyers and sellers

	Buyer	Seller
AT	€ 5,000	€ 3,600
BE	€ 5,000	€ 5,800
BG	€ 771	€ 514
CY	€ 2,750	€ 5,250
CZ	€ 1,153	€ 1,738
DE	€ 5,000	€ 2,700
DK	€ 2,217	€ 6,449
EE	€ 1,000	€ 1,000
EL	€ 1,500	€ 1,700
ES	€ 2,000	€ 3,600
FI	€ 1,900	€ 3,465
FR	€ 8,000	€ 7,280
HR	€ 1,215	€ 904
HU	€ 654	€ 980
IE	€ 2,000	€ 3,000
IT	€ 4,000	€ 2,375
LT	€ 500	€ 500
LU	€ 10,000	€ 10,800
LV	€ 300	€ 618
MT	€ 3,000	€ 5,500
NL	€ 2,000	€ 2,700
PL	€ 702	€ 889
PT	€ 1,500	€ 5,000
RO	€ 435	€ 435
SE	€ 1,107	€ 4,216
SI	€ 1,860	€ 1,200
SK	€ 1,400	€ 1,500
UK	€ 2,184	€ 2,271
IS	€ 563	€ 4,020
NO	€ 2,163	€ 5,408
EU average	€ 2,396	€ 3,180

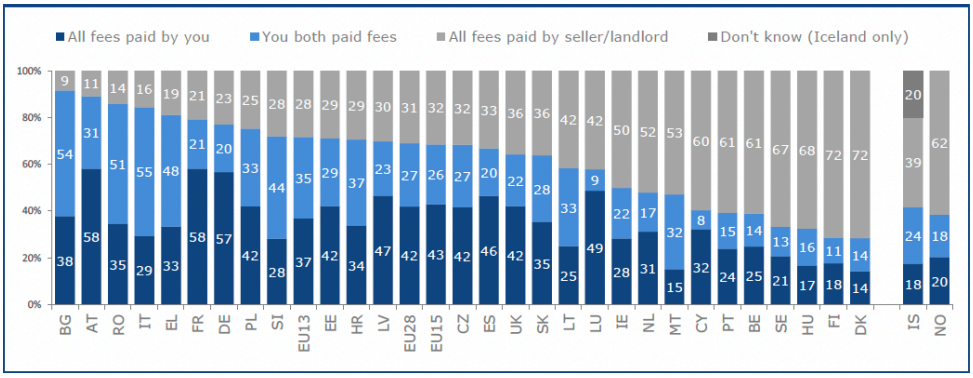
Source: European Commission 2018

Appendix II: Commission fees paid to the RE broker by tenants and owners

	Tenant	Landlord
AT	€1,150	€750
BE	€250	€755
BG	€114	€154
CY	€350	€450
CZ	€307	€277
DE	€900	€600
DK	€1,023	€2,654
EE	€250	€575
EL	€200	€300
ES	€500	€350
FI	€250	€690
FR	€600	€450
HR	€270	€241
HU	€82	€235
IE	€250	€750
IT	€550	€450
LT	€150	€250
LU	€1,250	€1,080
LV	€100	€150
MT	€300	€500
NL	€323	€680
PL	€158	€178
PT	€300	€400
RO	€109	€130
SE	€211	€543
SI	€360	€300
SK	€275	€320
UK	€273	€655
IS	€121	€804
NO	€108	€273
EU average	€369	€531

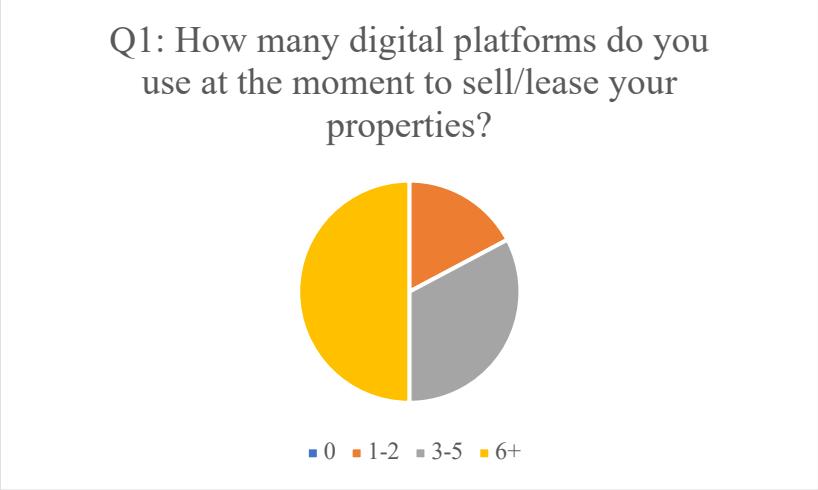
Source: European Commission 2018

Appendix III: Side responsible for paying the commission fee to the RE broker



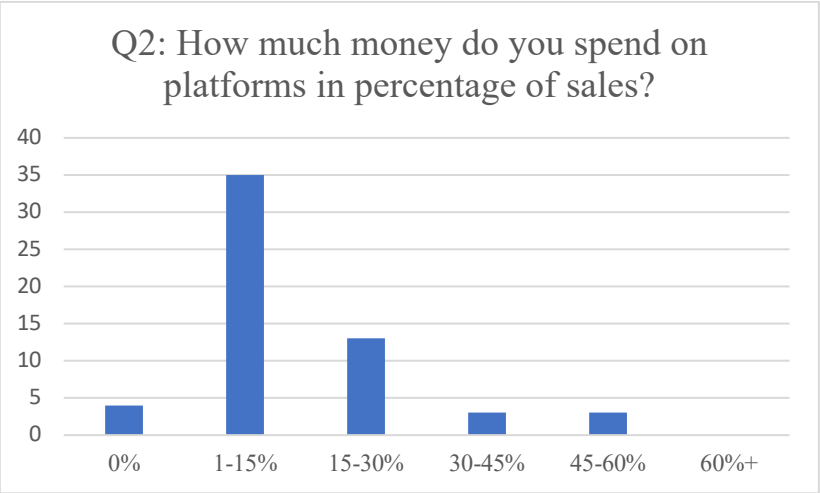
Source: European Commission 2018

Appendix IV:



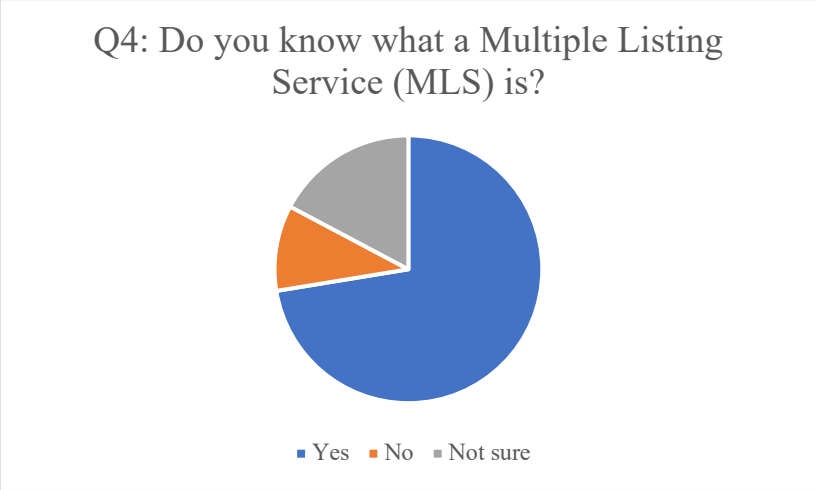
Source: Real Estate Broker Survey (2021)

Appendix V:



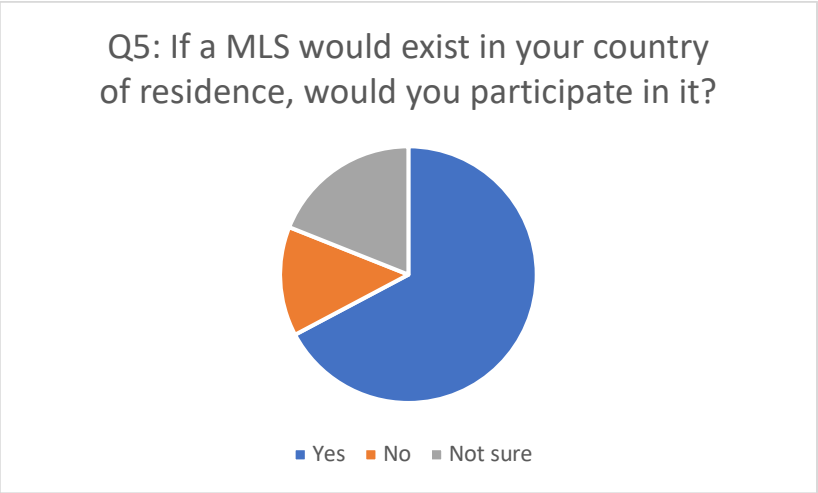
Source: Real Estate Broker Survey (2021)

Appendix VI:



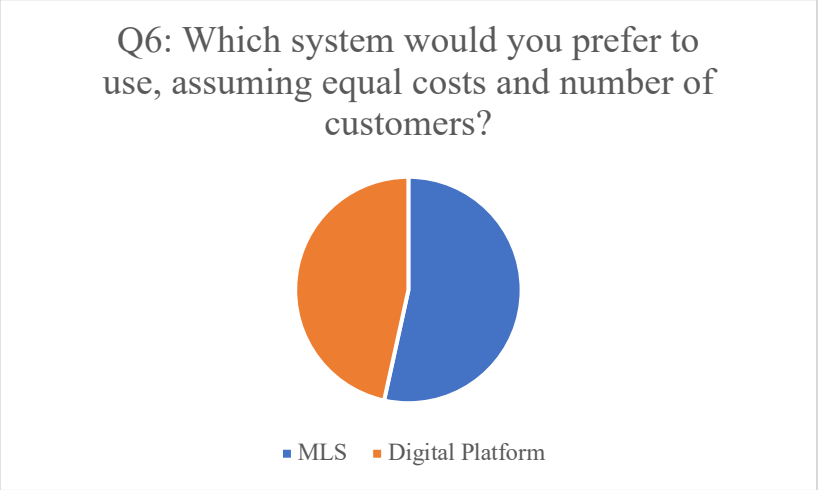
Source: Real Estate Broker Survey (2021)

Appendix VII:



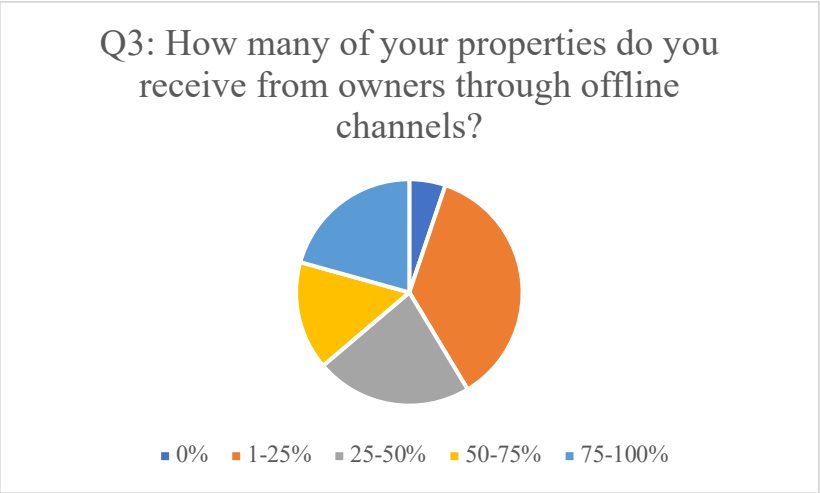
Source: Real Estate Broker Survey (2021)

Appendix VIII:



Source: Real Estate Broker Survey (2021)

Appendix IX:



Source: Real Estate Broker Survey (2021)

List of Abbreviations

AI	**A**rtificial **I**ntelligence
AR	**A**ugmented **R**eality
CAGR	**C**ompound **A**nnual **G**rowth **R**ate
CE	**C**ustomer **E**xperience
CRM	**C**ustomer **R**elationship **M**anagement
CSI	**C**ustomer **S**atisfaction **I**ndex
ECB	**E**uropean **C**entral **B**ank
EU	**E**uropean **U**nion
GDP	**G**ross **D**omestic **P**roduct
ICT	**I**nformation and **C**ommunications **T**echnology
IoT	**I**nternet-**o**f-**T**hings

ML	**M**achine **L**earning
MLS	**M**ultiple **L**isting **S**ervices
NPS	**N**et **P**romoter **S**core
PEPP	**P**andemic **E**mergency **P**urchase **P**rogramme
RE	**R**eal **E**state
SaaS	**S**oftware **a**s **a** **S**ervice
SQM	**Sq**uare **M**eter
UK	**U**nited **K**ingdom
UN	**U**nited **N**ations
US	**U**nited **S**tates
VR	**V**irtual **R**eality

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