



Instituto de Geografia  
e Ordenamento do Território  
UNIVERSIDADE DE LISBOA



Universidade de Lisboa

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Escola Superior de Hotelaria e Turismo do Estoril

## **Technology Adoption in the Short-Term Rental Property Management Industry**

**Susana Gong**

Dissertação de Mestrado orientada  
pelo Prof. Doutor Agustín Cocola-Gant

Mestrado em Turismo e Comunicação

2023



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## Abstract

This dissertation explores the technologies adopted by professional property management companies in the short-term rental (STR) industry. The term "professional management companies" refers to companies that manage multiple short-term rentals on behalf of homeowners, encompassing a range of responsibilities from distribution and reservation to cleaning operations. Given that there is a lack of literature on technologies used in the STR industry, particularly in a professional context, this research delves into the array of technologies adopted by property managers. The objective is to understand what technologies short-term rental property managers use, and for what purposes.

This dissertation uses an exploratory qualitative approach and begins with secondary desk research analyzing industry reports, blogs, and online materials. Then in-depth interviews were conducted with STR property management companies and STR technology service providers.

Findings indicate that the rapid expansion of STR technology is driven by industry growth and low entry barriers for tech entrepreneurs. Property managers display a notable embrace of fundamental technologies like Property Management Systems (PMS), channel managers, keyless entry systems, dynamic pricing tools, and task management tools. PMS stands out as the most important software for property managers. Interviews highlight property managers' preference for integrated options like all-in-one PMSs, streamlining tasks such as reservations, channel management, task management, pricing, guest communication, and regulatory reporting. The study also found that digital guest experience technology is booming, spotlighting advancements like smart locks, 3D tours, chatbots, home automation, noise control devices, and voice concierge services. These innovations enhance guest interactions and experiences, a pivotal focus for growing companies. Industry consolidation is also a trend, as major STR firms' acquisitions reshape the market. Despite this, the fragmented STR technology landscape poses a challenge, driving the need for more interconnected solutions to enhance guest satisfaction and operational efficiency.

**Key words:** Short-Term Rentals, Property managers, Digital platforms, Software studies, Digital technology

## Resumo

O interesse e importância atribuídos ao tópico do Alojamento Local (AL) têm aumentado progressivamente. Isso é notável devido ao contínuo aumento de propriedades de acomodação temporária e de curta duração sendo disponibilizadas para fins turísticos. Desde o lançamento da empresa Airbnb, Inc. em 2008, o tamanho da indústria de alugueres de curta duração multiplicou-se desde então. Além disso, em 2014, a indústria viu o surgimento de empresas de gestão profissional (Cocola-Gant et al., 2021). Estas empresas geram as propriedades com licença de alojamento local, desde distribuição e reserva até à limpeza. Eles oferecem mais serviços do que anfitriões individuais e utilizam a tecnologia para otimizar as suas operações. No entanto, ainda não foi realizada nenhuma exploração aprofundada das tecnologias usadas nesta indústria. A tecnologia digital no mercado de AL, bem como em indústrias relacionadas, refere-se principalmente à utilização de plataformas online para a distribuição de anúncios de propriedades e soluções de software para gestão de propriedades e negócios (Baum, 2017). Esta dissertação explora as tecnologias adotadas pelas empresas profissionais de gestão de estabelecimentos de alojamento local.

Este estudo tem como principal objetivo listar os principais *softwares*, plataformas e aplicações utilizados por empresas de gestão de AL e explicar os seus propósitos. A lista inclui não apenas tecnologias utilizadas para melhorar a experiência do hóspede e a interação do proprietário, mas também tecnologias usadas para gerir operações internas e comunicações. O primeiro objetivo deste estudo é aprofundar-se no atual panorama tecnológico dentro da indústria de aluguer de curta duração. O segundo objetivo deste estudo envolve explorar como e por que os gerentes de propriedades utilizam efetivamente essas tecnologias.

Para estabelecer um sólido quadro teórico, esta dissertação começa por realizar uma extensa revisão bibliográfica. Dada a disponibilidade limitada de literatura que se concentra especificamente na adoção de tecnologia na gestão de AL, esta revisão bibliográfica abrange também as tecnologias adotadas nos domínios vizinhos: setor imobiliário e hoteleira. Ao fazer isso, busca examinar se as tecnologias na indústria de AL derivam do setor de hospitalidade, do setor imobiliário ou de uma combinação de ambos. Esta revisão bibliográfica serve como a base para compreender o corpo de conhecimento existente sobre a adoção de tecnologia na indústria de aluguer de curta duração.

A próxima secção é a metodologia deste estudo. Tomou-se em consideração, o facto deste tópico não ser ainda amplamente estudado, e por essa razão procurou-se adotar uma abordagem exploratória. Este estudo qualitativo começa com uma pesquisa secundária, analisando relatórios, *blogs* e materiais *online* publicados pelos atores da indústria. Os dados secundários fornecem uma visão geral das

informações disponíveis e do conhecimento existente sobre o uso de tecnologia por empresas de gestão de AL. De seguido fiz entrevistas em profundidade com empresas de gestão de AL e empresas de tecnologias para AL. Esta segunda etapa do estudo foi construída com base numa série de 13 entrevistas. As entrevistas ofereceram valiosos dados primários e perspectivas e informações de primeira mão.

As pesquisas secundárias responderam maioritariamente ao primeiro objetivo, onde investiguei as tendências predominantes do setor. O rápido crescimento do cenário tecnológico no setor dos ALs é impulsionado pelo surgimento de grandes operadores, que exigem um *software* robusto para manter padrões profissionais, e baixas barreiras de entrada que facilitaram empresas tecnológicas entrarem no mercado (Wheelhouse, 2023b). A minha pesquisa indica que muitas tecnologias no setor de gestão de ALs, como *Property Management System (PMS)* e *Channel Manager*, originaram-se da indústria hoteleira, o que deu à indústria de AL uma base sólida para começar. Por outro lado, as ferramentas de análises e coleta de dados do mercado de aluguer de curto prazo são adotadas do *PropTech* do setor imobiliário (Göppinger e Luque, 2022).

Durante a pesquisa secundária, um total de 23 tecnologias de *software* e 13 *gadgets* foram identificados. Estas são tecnologias mencionadas frequentemente nos materiais publicados pelos atores da indústria. Os dados secundários dos relatórios do mercado, revelou que um substancial 75% dos gerentes de propriedades usam as cinco tecnologias "fundamentais", que são *Property Management Systems (PMS)*, *Channel Managers*, *keyless entry systems*, *dynamic pricing tools*, and *data providers* (Transparent Intelligence, 2023b). Sublinhando a robusta integração tecnológica do setor.

Particularmente notável é o ressurgimento do PMS, assegurando a sua posição como a tecnologia mais amplamente empregada entre os gerentes de AL (Rentals United, 2020). *PMSs* ou Sistemas de Gestão Hoteleira são plataformas de *software* projetadas para auxiliar na administração e operação de propriedades de aluguer de curto prazo. Essas ferramentas abrangem várias tarefas, incluindo gestão de reservas, calendários de ocupação, comunicação com hóspedes, automação de processos e relatórios financeiros (Cocola-Gant *et al.*, 2021). *Channel Managers* são ferramentas que permitem aos gestores de AL listar as suas unidades em vários *sites* de reserva, como *OTAs (Online Travel Agencies)*, *sites* de aluguer de curta duração e plataformas de reserva (Cocola-Gant *et al.*, 2021). *Keyless entry systems* fornecem aos hóspedes e gerentes de AL a capacidade de entrar num AL usando códigos digitais, aplicações móveis ou dispositivos de acesso. Esses sistemas, integrados de maneira perfeita com *PMSs*, simplificam o processo por meio da geração automatizada de códigos (Law *et al.*, 2020). *Dynamic pricing tools* são *softwares* que ajustam automaticamente os preços das propriedades

com base em fatores como demanda sazonal, eventos locais, taxas de ocupação e concorrência (Magyar, 2021). *Data provider tools são softwares* que oferecem informações e *insights* sobre o mercado de aluguer de curto prazo (Friedman, 2022; Hostfully, 2022).

Os estudos também mostram que a tecnologia de experiência digital para os hóspedes está a florescer na indústria, à medida que as empresas de AL começam a se concentrar em oferecer melhores experiências aos hóspedes (AJL Atelier, 2022). Diversas tecnologias inovadoras, como *smart locks*, *tours* da casa em 3D, *chatbots*, soluções de automação residencial, dispositivos de controlo de ruído e serviços de *concierge* por voz, estão a ser adotadas para aprimorar a experiência do hóspede. Sistemas de entrada sem chave se destacam como a tecnologia mais utilizada para a melhorar experiências dos hóspedes (Transparent Intelligence, 2023b).

A consolidação na indústria emergiu como outra tendência significativa, grandes empresas como Sykes Holiday Cottages e Feriepartner.dk (Rentals United, 2019b, 2019c) estão a adquirir pequenas empresas para expandir os seus negócios. Enquanto alguns veem a consolidação como benéfica para os hóspedes devido a serviços padronizados e profissionalizados, outros, como o CEO da City Relay (Rentals United, 2019a), enfatizam a importância do conhecimento local e do serviço personalizado que os pequenos gerentes de AL podem oferecer. A fragmentação das tecnologias para gestão de ALS também foi discutida como um desafio enfrentado pelos gerentes de AL (Barak, 2023). A presença de várias soluções de *software* com funcionalidades específicas cria complexidade, e há uma crescente necessidade de soluções tecnológicas integradas para otimizar processos e melhorar a satisfação dos hóspedes. Portanto, a integração e a conexão entre sistemas tornaram-se a principal prioridade de muitos gerentes de propriedades, um tópico extensivamente explorado durante as entrevistas.

Na segunda fase do estudo, as entrevistas forneceram uma visão esclarecedor na parte operacional de gestão de AL, vários gerentes generosamente compartilharam o seu ecrã e *interfaces* de painel dos seus *PMSs*. Foram identificadas 14 categorias de tecnologias durante as entrevistas, sendo estas as tecnologias que os gestores de AL mencionaram que utilizam e forneceram detalhes adicionais sobre o motivo pelo qual as utilizam. Essa experiência prática revelou outra tendência do mercado, pois os gerentes de AL expressaram claramente uma forte inclinação de preferir *all-in-one PMSs*, já que todos eles usam uma. As plataformas "*all-in-one*" integram perfeitamente funcionalidades-chave como reservas, *Channel Manager*, *dynamic pricing*, mensagens para hóspedes, ferramenta de gestão de tarefas e relatórios governamentais.

O mercado de AL é diversificado e apresenta dinâmicas distintas para a adoção de tecnologia. Empresas menores buscam soluções integradas no pool de fornecedores de serviços externos,

enquanto empresas maiores optam por sistemas criadas internamente com uma equipa de informática, garantindo o controlo dos dados e independência dos terceiros. Uma das ferramentas da *all-in-one PMS* que os gerentes de propriedades consideraram mais importante para suas operações é o instrumento de gestão de tarefas de limpeza e manutenção. Isto é porque os gerentes de AL precisam de soluções tecnológicas para automatizar o agendamento das tarefas e comunicar com as equipas operacionais. As entrevistas também revelaram que as empresas que gerem uma quantidade maior de ALs utilizam sistemas de *smart locks* para facilitar o auto check-in e melhorar a eficiência operacional. No entanto, como muitos participantes afirmam, é difícil implementar em grande escala devido às diferentes características das propriedades e à disposição do proprietário para instalar.

Esta dissertação permitiu abordar as diferentes tecnologias que as empresas de gestão de AL usam durante as suas operações no dia a dia. Revela a existência de preferências variadas na adoção de tecnologia dentro do setor, que dependem das diferentes empresas. O mercado atual oferece uma variedade de tecnologias, permitindo que os gerentes de propriedades tenham flexibilidade para experimentar até identificar o "conjunto de tecnologias" mais adequado às suas necessidades comerciais específicas. Este estudo mostrou a importância dessas tecnologias para alcançar sucesso e sustentabilidade a longo prazo no setor de gestão de Alojamento local.

**Palavras-chave:** Alojamento Local, Gestores de Propriedades, Plataformas Digitais, Estudos de Software, Tecnologia Digital.

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# 1 Introduction

Since the creation of Airbnb in 2008, short-term rentals (STRs) have grown significantly. They now form a consolidated product in the lodging industry. After 2014, the industry saw a rise in professional management companies, called by some authors as Corporate Hosts (Cocola-Gant et al., 2021). These companies manage several STRs on behalf of property owners, from distribution and reservation to cleaning operations. The STR industry has since then grown to a bigger scale. These companies maximize profit for property owners and try to provide the best experience for guests. They provide more services than individual hosts and, importantly, use digital technology to optimize their operations, allowing STRs to capture a higher market share in the lodging industry (Dogru et al., 2020). Digital technology in the STR market, as well as in related industries, primarily refers to the utilization of online platforms for the distribution of property listings and software solutions for property and business management (Baum, 2017). However, an in-depth exploration of the technologies used in the industry has not been undertaken before.

The dynamic nature of the short-term rental market demands property managers to employ efficient and innovative technologies. There is compelling evidence to support the notion that technology plays a pivotal role in the short-term rental market. Studies reveal that professional management companies increasingly rely on software to streamline their operations. This digital infrastructure has evolved into a vital and specialized asset for these companies (Cocola-Gant et al., 2021; Bosma, 2022). Industry player research on property managers has shown that 74% of respondents were already utilizing or considering implementing the fundamental technologies which are property management systems, channel managers, dynamic pricing tools, keyless entry systems, and data providers (Transparent Intelligence and Rentals United, 2022). For example, a property management system (PMS) is what property managers would use to manage the bookings of all their listings. Other than these technologies property managers have a wide array of technology options at their disposal.

However, despite the growing evidence of technology in the STR sector, and numerous innovative software solutions that have been developed for STR management (AJL Atelier, 2023), there remains a lack of comprehensive research that examines the specific technologies utilized by property managers and their underlying purposes. Most papers regarding professional property management of short-term rentals are still at an early exploration stage and offer limited insights into the utilization of technology. These studies explore the rise of professionalization (Dogru *et al.*, 2020; Cocola-Gant *et al.*, 2021; Gil and Sequera, 2022) and the performance of professionally managed homes (Xie, Heo and Mao, 2021; Bosma, 2022).

Other existing literature primarily focuses on specific technological advancements, such as channel management strategies (Giannoni *et al.*, 2021), revenue management tools (Kiczmachowska, 2022) and in 2022, Göppinger and Luque studied market data collection and analysis tools. These studies explain the characteristics of specific digital products and assess their performance, thereby leaving a notable gap in comprehending the multifaceted technological landscape within the industry. My dissertation aims to provide a comprehensive overview of the various technologies employed and describe their purposes, and in this way fill this gap.

Moreover, the short-term rental industry represents a convergence of the hotel and real estate sectors, as it combines hotel-like services within the context of real estate rentals (Cocola-Gant *et al.*, 2021). These industries have been extensively studied and recognized for their significant technological advancements. The hotel industry has embraced various management technologies to streamline operations and enhance guest experiences (Shin, Perdue and Kang, 2019; Dyshkantiuk *et al.*, 2020). Similarly, the real estate industry has witnessed significant advancements in technology, commonly known as PropTech (Baum, 2017; Siniak *et al.*, 2020). It has been noted that the professional STR management sector has learned greatly from these two industries, leading to rapid digital advancements (Cocola-Gant *et al.*, 2021). To develop a framework for my dissertation, I will analyze digital technologies used in the hotel and real estate industries, exploring to what extent the STR sector has learned from them.

My interest in the topic comes from my practical experience within the STR management domain. Two years ago, as a Reservation and Distribution Intern in a London-based STR management company, I handled client booking inquiries and property listings using a channel manager. Currently, I manage three STR properties in Lisbon, overseeing bookings, check-ins, check-outs, and cleaning tasks. These experiences have deepened my understanding of professional STR management, including the necessary tools and operations. Therefore, apart from having an academic interest, I intend to transfer my findings to the industry. I am keenly aware of the ubiquitous presence of technology and its transformative impact on the industry. This awareness, coupled with my passion for the field, has catalyzed my choice of this dissertation topic.

## 1.1 Aim and Objectives

Airbnb, as an online distribution platform, offers various integrated technologies for hosts to manage their properties, including a smart pricing tool, task management tool, and guest ID and biometric

verification tool (Airbnb, 2023a). However, professional property managers seem to refrain from using these tools as they seek out suitable digital solutions through third-party software providers or develop their own technology (AJL Atelier, 2023). In my view, two reasons explain this phenomenon. Firstly, Airbnb's integrated tools are limited to the platform itself and cannot be applied to reservations received from other platforms like booking.com. This limitation hinders the ability of professional property managers to effectively manage their properties across multiple channels and platforms. Secondly, the features provided by Airbnb's integrated tools are considered basic and insufficient for the advanced needs of professional property managers. These tools are more suitable for individual hosts with only a few properties, while property managers require more sophisticated and robust functionalities to efficiently manage larger portfolios.

This dissertation will specifically explore the technologies adopted by professional property management companies, excluding individual hosts. Hence, the aim of this study is:

- **To understand what technologies short-term rental property managers use, and for what purposes.**

This dissertation is an exploratory study that aims to discover the technologies used by STR property managers. This research mainly aims to describe the main software, platforms, and applications used by STR companies and explain their purposes. The description includes not only technologies used to manage internal operations and communications but also technologies used to improve the guest experience and owner interaction.

This broad topic is narrowed into two specific objectives. The first being:

- a) To explore the landscape of existing technologies in the short-term rental industry

Although the applications of digital technologies in the STR sector have been elaborated on in various theoretical and empirical studies (Giannoni *et al.*, 2021; Göppinger and Luque, 2022; Kiczmachowska, 2022), there is a lack of studies that offer a comprehensive overview of the applications of digital technologies in the STR industry. This study aims to address this gap by doing secondary research and systematically reviewing industry materials on STR technologies. These sources encompass various mediums, including blogs, reports, webinars, and podcasts. They are made available by various organizations and companies involved in the STR industry. By reviewing secondary material, I intended to describe the technologies and identify the emerging trends in technology adoption among property managers. Additionally, it is to uncover the most popular and widely used technology in the industry, showcasing the advancement and competitiveness of various digital tools. By comprehending the

development of technology adoption, this research contributes to a deeper understanding of the present-day technological landscape in the short-term rental industry.

The second objective I mean to study is:

- b) To explore how and why property managers use these technologies.

This dissertation aims to understand the utilization of technologies by property managers by conducting semi-structured interviews with professional STR property managers. The primary goal is to gain insights into how and why these technologies are leveraged to optimize and streamline STR management processes. Additionally, this research objective includes developing a profound understanding of the distinctive features and functionalities of these technologies. To achieve this, interviews were held with both property managers and software developers, enabling a comprehensive perspective on the topic.

The dissertation will show how tech-intensive this industry is and the benefits property managers get from using these technologies. Ultimately, this research aims to advance knowledge in the field and provide a foundation for further exploration of technology adoption within the professional short-term rental management sector.

## 1.2 Structure of the dissertation

The structure of this dissertation is organized into four main sections, each contributing to a comprehensive exploration of the research topic. To establish a solid theoretical framework, an extensive literature review was conducted. The first section of this dissertation entails a thorough and critical examination of the literature. Given the limited availability of literature specifically focusing on technology adoption in short-term rental property management, this literature review also encompasses the realms of real estate and hotel technology adoption. By doing so, it aims to examine whether the technologies in the short-term rental industry are derived from the hospitality sector, the real estate industry, or a combination of both. This literature review serves as the bedrock for comprehending the existing body of knowledge concerning technology adoption in the short-term rental industry.

The next section is the methodology, which outlines the research approach and design adopted for this study. It presents a comprehensive explanation of the two main research methods utilized: secondary desk research and primary research through interviews with property managers. The

rationale behind selecting these research methods will be discussed, highlighting the strengths and limitations of each approach. Each section concludes with a description of the data analysis, emphasizing the thematic analysis and systematic coding of the materials found.

The third section presents the findings from both the secondary desk research and primary interviews. The initial part will present the key findings from the secondary research, highlighting the prevailing trends, challenges, and technologies adopted in the short-term rental industry. The succeeding part will present the findings from the primary research, showcasing the perspectives and experiences of property managers in adopting technology solutions. To provide a comprehensive analysis, the two sets of findings will be compared and contrasted in the interview findings part, allowing for a deeper understanding of the convergence and discrepancies between industry-wide trends and individual experiences.

The final section of this dissertation will consolidate the research findings and draw meaningful conclusions from the analysis of both secondary and primary data. The conclusions will address the research objectives and contribute to bridging any identified research gaps. Moreover, the limitations of the study will also be acknowledged, along with recommendations for future research in this domain.

## 2 Literature review

Currently, the world is in a digital era, and many sectors of the economy have gone through a digital transformation in order to use technology as a tool to become more efficient. Several sectors including tourism and hospitality have been increasingly innovative in using technological and digital assets (Shin et al., 2019). According to Vial (2019), digital transformation is “a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies”. Companies have seen the advantages of using digital tools and how they have been optimizing operations and facilitating management (Pelet et al., 2019; Shin et al., 2019; Vial, 2019). The short-term rental industry is closely related to technology as the growth of this sector has been accelerated by many digital platforms such as Airbnb (Guttentag, 2015). Moreover, according to several authors, professional STR management companies use technology to facilitate and optimize their management (Dogru *et al.*, 2020; Cocola-Gant *et al.*, 2021), and these technologies go far beyond the tools provided by Airbnb.

In this literature review, I aim to explore what technologies short-term rental property managers use and why. I will look at how research has progressed over time and how the topic of technology has been discussed. Research about STR is quite recent and there is not much literature regarding technology adoption in STR property management. Therefore, it will be necessary to review other industries related to the short-term rental sector to grab onto similar characteristics. Research states that the short-term rental industry is the convergence of the hotel and real estate industries (Cocola-Gant *et al.*, 2021), and this is why I will learn from both literatures.

For context, I will explain how the STR sector is related to the hotel and real estate industries. First, short-term rentals' primary goals are to host and provide lodging and hospitality services to their guests, like at a hotel. These rentals make guests feel home away from home and aim at offering them an authentic experience during their travel journey. Cocola-Gant et al. (2021) show with their study that professional STR property managers have learned and imitated many practices from the hotel industry when it comes to hospitality services. The STR sector has now become a hybrid product where hotel-like services are provided in these rental experiences. Professionally managed rentals have standardized operations to ensure that the guests have an exceptional experience during this day and have 24/7 support, just like the hotel front desk (Dogru *et al.*, 2020; Cocola-Gant *et al.*, 2021). Research has also shown that the short-term rental industry competes with traditional hotels for customers and can impact the demand for hotel rooms (Guttentag & Smith, 2017). The hospitality sector literature

will contribute to finding the technologies that are used to improve the guest experience and management.

Second, the STR sector has to do with the real estate sector since STR companies manage portfolios of real estate properties. Investors and property management companies now find that the short-term rental market allows them to maximize rental income and bring in more profits than long-term rental markets (Cocola-Gant and Gago, 2021; Shin, Shin and Gim, 2022). For that reason, many real estate investors have turned their target onto short-term rentals. Moreover, the short-term rental industry also affects the real estate market, as it allows individuals to rent out their properties for short-term stays, which can affect the demand for long-term rentals (Yrigoy, 2019).

In addition, these industries are crucially mediated by digital platforms. *Platformization* is a significant concept shared among the hotel, real estate, and short-term rental industries. Hence, understanding this concept is also crucial for the literature review. According to Cocola-Gant and Malet Calvo (2023), *Platformization* is a business model that connects users in a two-sided market, where the platforms enable and facilitate transactions between players. Today, numerous STR and hospitality digital platforms function as distribution channels, commonly referred to as Online Travel Agencies (OTAs) such as Airbnb and Booking.com. Furthermore, in the real estate industry, the platforms are property marketplaces or listing websites such as Zoopla (Shaw, 2020). The article "*Platformization*" by Poell et al. (2019) explores the emergence of platforms as the dominant form of digital organization in the 21st century. The authors argue that platforms are fundamentally different from traditional businesses, as they create and capture value through network effects and data-driven algorithms. Platforms also facilitate the interaction and exchange of goods, services, and information between different actors, such as consumers, producers, and intermediaries.

It is important to distinguish between platforms and software, as well as analyzing how both are connected. Software is a program or set of programs designed to perform specific tasks on a computer or other digital device (Helmond, 2015). These software applications are standalone products that can be installed and run on computers or other digital devices to perform specific functions within a hotel or hospitality organization, for example, a Property Management System (PMS). API is an important instrument that allows platforms to interact and connect with software applications. An API, or Application Programming Interface, is a set of protocols and tools that allow different software applications to interact with each other and exchange data (Helmond, 2015). For instance, in the hospitality and STR industry, APIs connect an OTA platform to a PMS.

Hence, software represents specific applications with designated functions, while platforms provide the underlying technology and infrastructure supporting the development and deployment of these applications. As stated by Ullah et al. (2018, p. 15) in reference to property markets, “Real estate technology is the combination of online platforms and software tools that are used by industry stakeholders, including investors, brokers, real estate-focused lenders, and property owners, mortgage providers, and managers, as well as consumers”. Ullah et al.’s statement can be applied to both hotel and STR sector technologies.

In this regard, in the next section, I will examine the platform and software technologies in these three interconnected sectors. This literature review will be divided into three different sections. The first section will explain hotel technology adoption followed by real estate industry technology adoption. Lastly, this literature will analyze the few academic articles that mention STR technology innovation and adoption. I will identify what technologies have the academics explored and if the technologies in STR are adapted from the hospitality industry, the real estate industry, or even a combination of both of them.

## 2.1 Technology in hotel management

The digital revolution has drastically altered hotel operations and administration, and digital technologies have been identified as the key sources of efficiency and competitive advantage in the hotel industry (Shin et al., 2019). This section will review the literature on hotel technologies such as their development and main technologies for hotel management purposes.

Digital software and online platforms play a crucial role in the hotel industry, enabling hotels to manage their operations, reach new customers, and compete effectively in the marketplace (Sirirak, Islam and Khang, 2011). After conducting a systematic review of articles on the applications of digital technologies in the hotel industry, I have identified the most common software and platforms utilized by hotels. (Table 1).

Online Travel Agencies (OTAs) <b>Platform</b>	Online distribution channel/platform that allows consumers to book and purchase travel-related products and services directly through the internet. Examples include Booking.com, Expedia, and Orbitz. (Gilbert et al., 2008)
Global Distribution Systems (GDSs) <b>Platform</b>	Computerized reservation systems used by travel agents, tour operators, and other intermediaries to access and book travel-related products and services from multiple suppliers. Examples include Amadeus, Galileo, and Sabre. (Buhalis & Law, 2008)

<b>Metasearch Platforms Platform</b>	Online platforms allow consumers to compare prices and availability from multiple travel providers, including airlines, hotels, rental car companies, and more. Examples include Google Hotels, Trivago, and Kayak. (Cantallops, Cardona and Matarredona, 2013)
<b>Property Management System (PMS) Software</b>	Software that helps a hotel or collection of hotels manage front-office functions such as reservation booking, guest check-in/check-out, room assignment, managing room prices, and billing. (Moyeenudin et al., 2018)
<b>Channel Management Software</b>	Automation of online sales. This software will help in synchronizing sales between different channels/platforms and updating the calendars so that there is no overbooking. (Dyshkantiuk et al., 2020)
<b>Revenue management Software</b>	A software solution that helps hotels optimize pricing and inventory strategies to maximize revenue and profitability. It involves analyzing market demand, competitor pricing, and historical data to make informed pricing decisions and implement dynamic pricing strategies. (Kimes, 2017)
<b>Customer relationship management (CRM) Software</b>	A CRM system is a firm tool that is technology-based for developing and leveraging consumer knowledge to nurture, maintain, and strengthen profitable relationships with consumers. (Foss, Stone and Ekinci, 2008)
<b>IoT-connected gadgets Software</b>	A network of connected devices with sensors, actuators, and processors, is used to control a process, collect data, or exchange information with another device. (Pelet, Lick and Taieb, 2019)
<b>Artificial intelligence Chatbots Software</b>	This software is an AI that lets people communicate with machines as if they were communicating with people. Using voice input, it processes information and responds with relevant actions. (Pelet, Lick and Taieb, 2019)
<b>Contactless check-in technologies Software</b>	Digital, mobile self-check-in service or contactless arrival kiosks. (Shih and Chiu, 2022)

*Table 1 - Functions of hotel management technologies*

Source: Own elaboration based on: Moyeenudin et al. (2018); Gilbert et al. (2008); Buhalis & Law (2008); Serra Cantallops et al. (2013); Dyshkantiuk et al. (2020); Pelet et al. (2019); Shih & Chiu (2022)

In regard to software tools, the article “Modern hotel business management tools” by Dyshkantiuk et al. (2020), identified the most common automation and digitalization tools used by hotel managers, these tools are Property management systems (PMS), channel managers, website, chatbots, and revenue management tools. In addition to the findings of Dyshkantiuk et al. (2020), this literature review also uncovered other commonly used technologies in the hotel sector, including Customer relationship management software (CRM), artificial intelligence, Internet of Things (IoT) and contactless technology (Foss, Stone and Ekinci, 2008; Law, Sun and Chan, 2019; Pelet, Lick and Taieb, 2021; Shih and Chiu, 2022). Consider these hotel management software tools in more detail below.

The digitalization of the hotel industry initially prioritized operational efficiency through the implementation of Property management systems (PMS) in the 1990s. During this period, many hotels

transitioned to computerized PMS for improved management and administration (Buhalis, 1998). A hotel PMS is a software that helps a hotel or collection of hotels manage front-office functions such as reservation booking, guest check-in/check-out, room assignment, managing room prices, and billing (Moyeenudin et al., 2018). Many studies and hotel management education books do acknowledge PMS as one of the most important software applications in the hotel industry (Kokaz, Hilary and Murphy, 2011; Walker, 2017; Dyshkantiuk *et al.*, 2020). A study conducted in Langkawi, Malaysia, revealed that nearly all hotels in the area utilize PMS, except for smaller hotels that have less than 15 rooms (Ahmad and Scott, 2019). In recent times, hotel PMSs have undergone significant advancements, integrating various other tools. These enhanced PMSs now encompass features such as controlling in-room entertainment, energy management, and managing guests' preferences. (Kokaz, Hilary and Murphy, 2011; Moyeenudin *et al.*, 2018).

According to Buhalis & Law (2008) two of the most productive authors on the topic of hotel technology adoption (Shin et al., 2022), since the year 2000, technology such as hotel websites, Global Distribution Systems (GDS), and online booking platforms started to grow exponentially. This marked the beginning of hotels' commercialization and distribution era, enabling them to promote their services and reach new customers. GDS is a computerized reservation platform used by travel industry professionals to access and book hotel rooms from hotel companies (Buhalis and Law, 2008). GDSs provide these intermediaries with a centralized database of travel-related information and a unified booking process (Gilbert, Beveridge and Lee-Kelley, 2008). Examples of GDSs include Amadeus, Galileo, and Sabre.

GDS is an internal system, whereas OTA (Online Travel Agency), as an evolution of GDS, is accessible to everyone through the internet. OTAs are digital platforms that allow consumers to book and purchase various products and services, such as hotel rooms directly through the internet (Law et al., 2019). OTAs typically offer a wide range of options and provide users with an easy-to-use interface for searching, comparing, and booking different products and services. Examples of OTAs include Booking.com, Expedia, and Orbitz (Gilbert, Beveridge and Lee-Kelley, 2008).

An additional significant online platform within the hotel industry is Metasearch. Metasearch platforms enable consumers to compare prices and availability from multiple travel providers, including Online Travel Agencies (OTAs), hotel websites, and Global Distribution Systems (GDSs). By aggregating information from multiple sources in one place, metasearch platforms make it easier for consumers to find the best deals on hotels and make informed booking decisions (Serra Cantallops *et al.*, 2013).

Channel manager is a tool that aids in the automation of online room sales, it is also an important tool to optimize hotel revenue (Dyshkantiuk *et al.*, 2020). Literature shows that in the 2000s *switch companies*, also known as channel management software, were developed to perform as an intermediary between the GDS and the hotel central reservation system (Gilbert, Beveridge and Lee-Kelley, 2008). Channel management software nowadays uses API to connect to online booking platforms (Panina, Simbuletova and Kakhuzheva, 2022). Hotels use channel management software to distribute their availability and other information including prices to different platforms and channels. This software will help in synchronizing bookings between different channels and updating the calendars so that there is no overbooking (Gilbert, Beveridge and Lee-Kelley, 2008). The main benefit of having a channel manager is that it will increase sales as the hotels are distributed and are visible on many different platforms (Beritelli and Schegg, 2016).

Frequently, revenue management software is integrated alongside channel managers, as it allows for easier updating of prices on different platforms by the channel manager (Honerkamp, 2020). Revenue management (RM) practices are well-established in the hotel industry. It has been an electronic property management tool since the 1990s which helps hotels to maximize revenue and facilitate making decisions (Kimes, 2017). Hotel revenue managers use lead time, occupancy, prices, and other variables to allocate the right type of capacity to the right kind of customer at the right price. Today RM practices are much more data-driven and can include more variables which help with a more strategic approach (Kimes, 2017). These technologies also help managers generate reports and analytics to improve decision-making.

As consumer demand continues to grow and the industry started to develop technologies to improve service quality and gain competitive advantage, hotels developed various consumer-focused technologies, which mainly revolve around guest management and guests' digital experience (Buhalis & Law, 2008; Shin & Jeong, 2020). A large number of academic articles are dedicated to studying hotel strategies aimed at enhancing customer satisfaction and loyalty, as well as attracting potential customers. (Lin and Su, 2003; O'Connor and Murphy, 2004). In 2003, Piccoli and colleagues examined the advantages of customer relationship management (CRM) and concluded that hotels need to keep track of their customer relationships because, in the hospitality industry, businesses need to match the expectations of the clients to improve and gain a competitive advantage. According to Foss, Stone and Ekinici (2008), "A CRM system is a firm tool that is technology-based for developing and leveraging consumer knowledge to nurture, maintain, and strengthen profitable relationships with consumers." These systems analyze big data in order to help hotels with a more targeted marketing and organization of guest profile information for example managing guest preferences. Talón-Ballesteró

and colleagues (2018) studied CRM using big data which showed that simple data available from the organization's CRM system, may provide a good understanding of guest preferences.

According to Pelet, Lick and Taieb (2019), technologies that improved hotel guests' digital experience the most are the Internet of Things (IoT) and Artificial intelligence (AI). IoT is a network of connected devices with sensors, actuators, and processors, it is used to control a process, collect data, or exchange information with another device. Car et al. (2019) highlight that digital solutions leveraging the Internet of Things (IoT) have been present in the technological realm for nearly 20 years. However, their implementation in the hospitality industry, particularly regarding the utilization of IoT technologies for data collection, analysis, and improvement, is a more recent development. Examples of IoT technologies are smart locks, temperature controllers, and light sensors (Nadkarni *et al.*, 2020; Pelet, Lick and Taieb, 2021). These locks utilize IoT technology to enable remote access, control, and monitoring of door locks through a network connection, typically via Wi-Fi or Bluetooth (Bantau and Rayburn, 2016). Most major hotel brands have invested heavily in digital keys so that guests can skip the front desk and use their phones as room keys. It is a mobile application that allows guests to have a keyless door entry solution (Torres, 2018). In this app, hoteliers can add many other features to improve the stay experience.

With IoT technology, guests will enjoy their stay with more convenience and comfort, while hotel owners and operators benefit from higher efficiency, cost savings, and guest satisfaction (Pelet, Lick and Taieb, 2019). IoT may also help reduce hotel operational costs, as hoteliers can use smart energy management systems to regulate and even optimize their energy consumption. IoT sensor data is used in predictive maintenance to assist hoteliers in detecting potential risks and recognizing harmful tendencies before they occur (Infante-Moro, Infante-Moro and Gallardo-Pérez, 2021).

Artificial intelligence as a branch of IoT (Pelet, Lick and Taieb, 2019) has also been greatly integrated into hotel operations. The most common uses of AI in hotels are chatbots, voice assistants, and analyzing customer data to create personalized experiences such as pushing special deals and activities (Nam *et al.*, 2021). According to Buhalis and Moldavska (2021), the first examples of In-room voice assistant technologies were installed in 2016. This software is an AI that lets people communicate with machines as if they were communicating with people. Using voice input, it processes information and responds with relevant actions. Google Nest Hub and Alexa for Hospitality are adaptations of home artificial intelligence voice assistants specifically designed for the hotel industry. These solutions allow hoteliers to implement them in guest rooms, providing a range of convenient features and services (Buhalis and Moldavska, 2021).

Nowadays, the industry is still experiencing a major paradigm shift due to the rapid development of technology (Tai, Wang and Luo, 2021). Furthermore, the COVID-19 pandemic has accelerated the adoption of digital technologies and cloud applications in terms of delivery of businesses, for example, contactless technologies, digital money, and cashless payment systems have become prevalent (George, Lakhani and Puranam, 2020; Amankwah-Amoah *et al.*, 2021). The term “untact” service (Lee and Lee, 2020) was introduced in South Korea in the year 2018 to describe the new service delivery style adopted from consumer behavior. According to Lee and Lee (2020, p.3), “untact service refers to a service that is provided without face-to-face encounters between employees and customers through the use of digital technologies”. During COVID-19, as governments applied social distancing measures, contactless communication helps hotels stay compliant with health guidelines while fulfilling their guests' needs. COVID-19 has accelerated the adoption of contactless technologies (George, Lakhani and Puranam, 2020). These technologies are here to stay, all major hotel brands have implemented some sort of digital self-check-in service or contactless arrival kiosks (Rahimizhian & Irani, 2020; Shin & Kang, 2020). Soon, robot receptionists, facial scan check-ins, voice guest control, robot deliveries, robot concierge assistance, and other contactless services are expected to replace human-to-human contact services (Jiang and Wen, 2020).

Technology in the hospitality sector is found to be a crucial aspect in order for the industry to evolve and it is also proven that it can improve hotels' productivity and efficiency (Sirirak, Islam and Khang, 2011). This part of the literature review helps in identifying the development of hospitality technologies. Through this literature review, we can understand that the use of technology in the hospitality sector has a long history and that hotels have been very responsive to digitalization. Hotel technology started with property management, where technology has enabled hotels to streamline operations, improve efficiency, and increase revenue. Then hotels started changing the way they distribute and market their rooms which gave rise to online booking platforms and channel managers. Finally, after reaching operation efficiency and solid distributions, hotels used technology to enhance the guest experience by providing guests with more convenient and personalized communication and services. The market continues to grow to embrace many different types of innovative technologies. This literature review can help identify technologies that could be similar to the short-term rental industry, and also identify what technologies have the short-term rental industry adopted from the hotel industry.

## 2.2 PropTech

In this section I review the literature on real estate technologies, starting by discussing technological developments in the industry and then expanding to relevant real estate platforms and technologies for the management of properties.

PropTech also known as property technology, is the application of information technology (IT) to the management and purchase of real estate by both individuals and businesses (Baum, 2017). This is a field now explored by several authors in the real estate technology discussion (Fields, 2022; Sadowski, 2020; Shaw, 2020; Siniak et al., 2020; Starr et al., 2021). Compared to the hotel industry, the real estate industry has been slow to adopt new digital technologies. As stated by Ullah et al. (2021), There are three categories of barriers to digitalization: technological, organizational, and environmental. Technological barriers encompass challenges such as the high costs associated with software and hardware acquisition, as well as limitations in information gathering, integration, maintenance, and data management capabilities. Organizational barriers relate to issues like the hesitancy of management and lenders to trust in innovative and new technology adoption, along with difficulties in achieving stakeholder coordination and cooperation. The environmental category primarily pertains to the highly regulated nature of the industry and the absence of government incentives to facilitate digitalization efforts. In addition, the real estate industry is reliant on personal relationships and face-to-face interactions instead of doing everything online (Shaw, 2020).

The 1990s was an important period as digital and information technologies emerged, however, there is no paper discussing real estate technology around that time. It is possible to find in Baum's (2017) article that in the 1980s the real estate industry started to develop software technologies on computerized databases and predictive models. In 2003, Sawyer et al. analyzed the Information and communications technology (ICT) usage of real estate agents such as cell phones, and communication software. In the article, he concluded that these technologies were used more to build social capital. It aided real estate agents to create social networks to get to know more clients and help in selling/buying real estate and meeting other experts in the industry. Nowadays many new technologies have the potential to revolutionize the real estate industry, such as the Internet of things (IoT), cloud computing, and artificial intelligence (AI) (Starr, Saginor and Worzala, 2021). Field (2022) explored the influence of technologies automating essential property management functions on the accumulation of financial capital for landlords and real estate companies. The study reveals that these innovative tools can effectively increase the income of stakeholders. Nevertheless, it is important to

note that such technologies also possess the potential to exacerbate income inequality and worsen housing insecurity for renters.

Starr et al. (2021) examined in the commercial real estate sector the impact of digital technologies and the emergence of PropTech. The authors concluded that it has been rapid technological advancements and that the real estate sector needs to upgrade to a people and technology-driven business. Because technological advancements will help to build an environment that is more efficient, valuable, and safer. PropTech leverages digital innovation to meet the needs of the real estate industry, just as FinTech focuses on the use of technology in banking (Baum, 2017; Starr, Saginor and Worzala, 2021). Baum (2017) from the University of Oxford has produced a report presenting the definition of PropTech and its various categories (Table 2).

Online Marketplaces <b>Platform</b>	Online platforms for property buyers, sellers, and renters to find, list, and search for real estate properties, often offering additional tools and resources. For example Zillow (for Residential Real Estate Search) and Airbnb (for Short-term Rental search).
Data, Valuation, and Analytics <b>Software</b>	Providers of commercial real estate data and analytics for brokers, investors, and property managers, including property information and market trends.
Property Management <b>Software</b>	Software for property managers/landlords to manage properties, tenants, leases, and maintenance, often offering online portals for tenants and owners.
Virtual Tours <b>Software</b>	Virtual tour software that allows real estate agents and property managers to create immersive 3D and VR tours of properties to help buyers and renters visualize spaces.
Construction Tech <b>Software</b>	Software for construction project management, including project planning, communication, document management, and workflow automation.
Payment Processing <b>Software</b>	Apps and software that enable secure and easy payment processing for real estate transactions, including rental payments, application fees, and property purchases. For example, Stripe.
Smart Buildings/IoT <b>Software</b>	Technologies that enable smart, connected buildings and IoT devices, including energy management, lighting, HVAC, security, and other building operations.

*Table 2 - PropTech list*  
Source: Baum (2017)

I have identified that PropTech serves two primary purposes: Firstly, it involves platforms used for the distribution of property listings, and secondly, it encompasses software designed for property management. This closely resembles the type of digital tools adopted in the hotel sector.

Platforms play a pivotal role in the real estate industry as it facilitates effective communication and collaboration among various stakeholders while streamlining different processes (Ullah, Sepasgozar and Wang, 2018; Shaw, 2020). Shaw (2020) identifies a platform as it is something connecting users

and pulling things together into new aggregations and somehow relating to value. These platforms are changing the way real estate transactions are conducted. One of the main ways platform technologies are used in the real estate industry is through online marketplaces and portals, which allow buyers and sellers to connect and share information (Poell, Nieborg and van Dijck, 2019). Furthermore, online home rental platforms (e.g. Zillow and Redfin), have revolutionized the way buyers search for homes compared to the traditional method of using local rental magazines (Shaw, 2020). This platformization of real estate technology has provided buyers with a more efficient way to search for homes, and they also provide sellers with a way to market their homes to a wider audience (Baum, 2017; Siniak et al., 2020; Fields, 2022). Platform technologies also facilitate communication and collaboration between real estate professionals, such as agents and brokers, by providing tools for managing leads, tracking progress, and sharing information (Shaw, 2020).

On the other hand, many PropTech technologies are for property management purposes, they are utilized to efficiently manage the properties held by real estate companies or landlords (Baum, 2017; Sadowski, 2020; Fields, 2022). Firstly, the article by Fields (2022) discusses how digital technologies are being used by landlords and real estate companies to automate various aspects of the rental process, such as marketing, screening tenants, and collecting rent. Fields explains that these platforms can automate tasks such as rent collection and maintenance requests, and they can also provide landlords with valuable data about their properties. These platforms have given rise to “automated landlords” where the management of the properties has become online and automated rather than in-person local landlords.

Secondly, more automation technology has been examined by Ullah, Sepasgozar and Wang (2018). They identified the Big9 current real estate technologies which are drones, the internet of things (IoT), clouds, software as a service (SaaS), big data, 3D scanning, wearable technologies, virtual and augmented realities (VR and AR), and artificial intelligence (AI) and robotics. According to the authors, the adoption of technology has been beneficial to the industry by increasing efficiency and decreasing operational costs in terms of property management. This is because technology has allowed for the automation of numerous processes, from the construction of buildings to the management of property. In particular, the use of 3D printing has revolutionized the construction process, allowing for the production of buildings at a faster rate and with greater precision than ever before (Ullah, Sepasgozar and Wang, 2018). Moreover, the use of virtual reality has allowed potential buyers to view properties without having to physically visit them, thus saving time and money. Although not all real estate websites are using virtual reality technologies to show their platforms, they're slowly catching up with these types of technologies to attract more potential customers in the online markets (Ullah,

Sepasgozar Samad and Siddiqui, 2017). By embracing these technological solutions, the real estate industry has been able to modernize and increase its efficiency, and this trend is likely to continue in the future (Ullah, Sepasgozar and Wang, 2018).

Finally, the incorporation of data analytics and artificial intelligence assumes a pivotal role in shaping strategies and guiding decision-making processes for investors, professionals, and tenants during property management and search (Ullah and Sepasgozar, 2019; Fields, 2022). Data analytics software assists real estate agents with finding potential customers, property information, and market trends by utilizing data-mining search algorithms to gather data. It also aids them in enhancing marketing strategies and effectively reaching potential clients through social media and email, thus optimizing their workflows (Ullah, Sepasgozar and Wang, 2018). These software solutions use advanced algorithms and techniques to derive valuable insights and patterns from the data, helping real estate professionals make informed decisions and optimize their strategies. Furthermore, on the consumer side, these immersive AI-driven systems can assist home renters in refining their property search by analyzing vast datasets through predictive analysis, thereby finding relevant properties more efficiently (Ullah, Sepasgozar and Wang, 2018; Fields, 2022).

Other than distribution platforms and property management technologies, PropTech is also making significant developments in the realm of transaction management, where it intersects with FinTech, the technology powering online finance platforms (Baum, 2017; Saiz, 2020; Starr, Saginor and Worzala, 2021). Notably, this includes the emergence of payment processing apps, digital lenders, and alternative financing solutions apps aimed at facilitating real estate investments. These applications effectively streamline the transaction process for both buyers and sellers, enhancing efficiency, and lowering the costs associated with real estate transactions (Starr, Saginor and Worzala, 2021).

Overall, the real estate industry has gone through a significant shift with the adoption of technology over the past decade, leading to an increasing amount of efficiency. It started with the emergence of platforms that allowed a more connected real estate world, then followed the advancement of new technologies such as tenant management software, virtual reality, data analysis software, and AI to embrace automation within property management. Technologies have also allowed for seamless communication between agents and clients. How the real estate industry has been able to embrace and readily adopt these new technologies has proven to be a benefit for all involved (Ullah and Sepasgozar, 2019). In turn, through this section of the literature review, we are able to identify the importance of the platforms and property management technology in the real estate sector which are two important technologies in the STR industry.

### 2.3 Short-term rental technology adoption

In this section, I examine articles regarding short-term rental technologies, and how the literature has evolved. Research about technology in this industry is still in its early stages, with only some recent studies focused on certain types of technologies. Upon delving into the available literature on STR property management technology, it becomes evident that many of these technological advancements draw inspiration from both the hospitality and real estate sectors (Cocola-Gant *et al.*, 2021; Göppinger and Luque, 2022). As a result, this section will include some relevant comparisons from these industries to provide a comprehensive understanding of the technological adaptations in the context of STR property management.

The short-term rental or vacation rental industry has a history of technology adoption dating back to the early days of the internet. Although the exact origins of STR technology were not identified in the academic papers, a reputable hospitality news source, Skift (Trivett and Staff, 2013), sheds light on its early development. According to their report, in the 1990s, pioneering online vacation rental platforms such as VRBO (Vacation Rentals by Owner) and HomeAway emerged as some of the first digital platforms to enable property owners to advertise and rent out their homes directly to travelers. In the short-term rental industry, the early platforms are where hosts and guests can meet and finalize their transactions on a shareable asset, in this case, a home. However, the booking and payment processes were offline, the parties could not conduct transactions through the platform.

In contrast to the hotel sector, which primarily commenced its technological development with property management technologies, and the real estate sector, which embraced database software, the remarkable expansion of the short-term rental industry can be predominantly attributed to the explosion of online platforms during the 2000s (Dagkouli-Kyriakoglou *et al.*, 2022; Guttentag, 2015). These online platforms played a pivotal role in fueling the growth of the STR industry and revolutionizing the way travelers could find and book vacation rentals. These platforms rely on network effects to grow, the more listings there are on these sharing platforms the more users will be using these platforms (Akbar and Tracogna, 2018).

It is commonly confirmed that Airbnb was a disruptive innovation that has profoundly disrupted traditional accommodation (Guttentag, 2015; Gallagher, 2017). In 2008, Airbnb was founded, which brought a new dimension to the industry by allowing homeowners to share their homes as well as their personal space, and that made it a more immersive, authentic experience (Guttentag, 2015). The main difference introduced by Airbnb's platform was online booking and transactions, while VRBO

was just for advertising short-term rental listings. With this model, Airbnb's success grew exponentially, and it quickly became one of the most popular vacation rental platforms in the world (Gallagher, 2017). Guttentag is an important author who contributes to the understanding of the technology disruption of STRs. In his article from 2015, "Airbnb: disruptive innovation and the rise of an informal tourism accommodation sector", we can examine the technologies that the platform utilizes to facilitate and manage the booking process and enhance the user experience, including:

- A user-friendly website and mobile app that allows hosts and guests to search for and book accommodations, as well as communicate with one another.
- A secure payment system that enables guests to pay for their stay through the platform, with the money being held in escrow until the end of the stay.
- A rating and review system that allows guests to rate their stays and leave feedback for hosts and other guests to see, which helps to build trust and accountability within the community.
- Advanced analytics and machine learning algorithms help to optimize the search results and pricing for guests and hosts.

More recently, it has been spotted that a new phenomenon in the STR market is the growth of professionalized STR property management companies. They share one common goal: to provide efficient and comprehensive property management services for property owners in the short-term rental market. These services include property listing optimization, guest communication and support, cleaning and maintenance coordination, pricing strategy optimization, occupancy rate management, and financial reporting, among others. Many studies started to explore the rise of professionalization (Dogru *et al.*, 2020; Cocola-Gant *et al.*, 2021; Bosma and van Doorn, 2022) and the performance of professionally managed homes (Xie, Heo and Mao, 2021; Bosma, 2022). These studies all mentioned in common that the STR property manager uses an extensive range of software and applications. See Table 3 for some of the STR software and platforms from the examined literature.

STR management software <b>Software</b>	As the hotel's PMS, it is to manage reservations, bookings, guest communication, and property listings. (Cocola-Gant <i>et al.</i> , 2021)
Channel management software <b>Software</b>	Imitated from the hotel sector, it is software to connect and synchronize listings across multiple platforms. (Cocola-Gant <i>et al.</i> , 2021)
Online travel agency <b>Platform</b>	Online vacation rental platforms for property owners to advertise their homes and perform booking transactions with travelers (e.g. Airbnb, Booking.com, VRBO). (Giannoni <i>et al.</i> , 2021)

Market analysis software (Revenue management software) <b>Software</b>	The software tracks market and competitor performance and generates pricing strategies, consumer behavior, and other market trends. This is mainly used to undertake price management strategies and consumer behavior analyses. (Cocola-Gant et al., 2021)
Smart home technology <b>Software</b>	In-room gadgets, for guests to control various aspects of their rental, such as lighting, temperature, and security, using a mobile device or voice commands. (Dey et al., 2020)

*Table 3 - STR technology*

*Source: Own elaboration based on: Cocola-Gant et al. (2021); Giannoni et al. (2021); Dey et al. (2020)*

In recent years, technology has continued to play a major role in the industry, with the development of new tools and platforms to help property owners and managers automate various aspects of the management process. Cocola-Gant et al. (2021) have indicated that STR management software, channel manager, and market analysis software are the three fundamental digital tools for the functioning of a professionalized STR property management company. These technologies were derived from the hotel industry. The interviews from this study showed that STR companies hired hospitality professionals from the hotel industry in order to improve and professionalize their operations.

STR management software is an adaption of the property management software (PMS) from the hotel industry. In short-term rentals, this technology integrates and centralizes many more different tasks of the operations such as cleaning, check-ins, maintenance guest communication, marketing, and financial operations (Cocola-Gant et al., 2021). A short-term rental PMS has features such as task management, multi-calendar views, and owner portals which are functions superficially catered to multi-listing hosts and it is one of the most important tools for a professional property management company (Bosma and van Doorn, 2022). Similar to the property management platforms used in the real estate industry it allows short-term rental property management companies to efficiently manage there are large portfolios of listings.

STR management businesses use channel management software for distribution and marketing purposes (Giannoni et al., 2021). This is another software technology imitated from the hotel sector, where managers can manage multiple channels in one place. Cocola-Gant et al. (2021) find that STR property managers list their properties on more than twenty platforms, but the main platforms are Airbnb, Booking.com, and VRBO. Giannoni et al. (2021), explored how STR hosts use different platforms to distribute and market their listings onto different. The author also found that professional hosts that have more properties are more inclined to diversify their distribution channels hence using a channel manager. The reason for this vast strategy of distribution is to improve the performance

and visibility of their listings and hence enhance their economic performance. The integration of other platforms like Booking.com, and Expedia, enables hosts to reach a wider audience and increase their bookings (Bosma and van Doorn, 2022).

The use of data and analytics to optimize pricing, occupancy, and yield management has also become increasingly common in the industry. According to Bosma & van Doorn (2022), same as hotels using revenue management software, STR companies use third-party algorithmic pricing/ tools to optimize listing prices across platforms. Cocola-Gant et al. (2021) stated in their studies that STR property managers use market analysis software to create an algorithm that automates daily price calculations. Wang et al. (2021) have shown in their study that revenue management in STR is much more complicated than in the hotel industry. The reason for the complexity of dynamic pricing calculations is due to the different factors of a rental unit such as property sizes and features, availability, lead time, market selling prices, and others. These types of algorithms and software need to integrate much more complex data in order to make pricing recommendations that optimize short-term rental companies' revenues (Kiczmachowska, 2022).

In 2022, Göppinger and Luque conducted a study focusing on the technologies employed by short-term rental property managers to gather market information. The research revealed that the STR market extensively utilizes various PropTech solutions, with a significant emphasis on data collection and analysis tools. Furthermore, Cocola-Gant et al. (2021) stated that some professional STR companies have IT departments, that work fully on market analysis software by monitoring the market and extracting useful data from the STR platforms. According to the authors, property managers who leverage these technologies gain a substantial competitive advantage and exhibit a higher likelihood of survival in the market.

Additionally, there has been an increased use of smart home technology in all real estate-related sectors including hotels and short-term rentals. For example, smart locks, security cameras, and smart thermostats can enhance the guest experience and make the rental process more convenient for property managers (Dey *et al.*, 2020). Contrary to the hotel industry, not many pieces of literature in STR have explored automated in-home gadgets to improve the guest experience. An exception is the work of Law et al. (2020), who studied the application of smart keys in short-term rentals and described the complex technology behind digital keys using QR codes or Apps instead of physical keys in STR homes. They have developed a prototype with the technology of IoT which then is connected to a property management system (PMS) for the administrators to generate digital keys. They concluded that the incorporation of smart locks into this system would improve ease of use and give

STR guests a new stay experience. This allows more efficient property management and a more hassle-free experience for the guests.

In conclusion, the utilization of software and platforms for STR property management plays a critical role in professionalizing the short-term rental industry and optimizing the management of professionally handled properties. This literature review has been able to identify that the industry has grown from the explosion of platforms to self-developing various innovative technologies. The short-term rental sector has adopted many technologies from the hotel industry in terms of hospitality management and from the real estate industry such as the data analysis PropTechs. However, it is worth noting that the literature on technology adoption in the short-term rental property management industry remains limited in both quantity and scope. No study has provided a comprehensive description of technologies used or analyzed STR technology landscapes. As a result, further research is necessary to address these gaps and comprehensively investigate the extent and impact of technology adoption in this sector. My research aims to bridge these gaps and contribute valuable insights to the field of technology adoption in short-term rental property management.

### 3 Methodology

Recognizing that this topic has yet to be thoroughly examined in academia, this study uses an exploratory approach. *Exploratory research* is a methodological approach that investigates research questions that have not previously been studied in depth (Veal, 2017). It is useful for exploring new or challenging issues, looking for patterns or anomalies, and forming the basis of more conclusive research. This approach enables me to explore nuances, uncover new insights, and capture the complexities of technology adoption and purposes among property managers. Exploratory research is characterized by its flexible and adaptable nature (Stebbins, 1997). This flexibility is valuable in a dynamic field like technology, where new tools, trends, and practices constantly emerge. By adopting an exploratory approach, I could stay open to novel findings and adapt my research as needed.

Exploratory research can be used in an inductive framework to suggest hypotheses about the data and the underlying processes, in contrast to the more commonly used deductive-based confirmatory analysis (Veal, 2017). Since my research question seeks to understand the technologies used by short-term rental property managers and their purposes, an inductive approach allows me to explore and discover patterns, themes, and emerging concepts within the data. Exploratory research is a broader term encompassing various techniques, including qualitative and quantitative methods (Xin, Tribe and Chambers, 2013). In this particular topic, conducting quantitative research poses a challenge due to the absence of statistical data about the theme of my research (Flowerdew and Martin, 2005). A qualitative approach is well-suited here for generating insights and thoroughly exploring and understanding short-term rental property managers' experiences, perspectives, and motivations (Xin, Tribe and Chambers, 2013).

To accomplish this exploratory research, I collected data from secondary and primary sources. The first stage was to conduct desk research and collect information from secondary sources. Secondary research, also known as desk research, involves gathering and analyzing existing data and information from sources already published or collected by others (Durberry, 2017). It is a research method that relies on existing data rather than collecting new data directly from primary sources.

I chose this data collection technique because, like any other sector, essential players usually share their results and thoughts online, whether through reports, blogs, presentations, or podcasts (AJL Atelier, 2023; Magyar, 2022; Short Term Rentalz, n.d.). To my advantage, there is free access to abundant online resources. Through desk research, I was able to tap into a wealth of information about technology adoption by STR property managers worldwide. Desk-based research provides an

overview of the available information and existing knowledge about the use of technology by STR management companies. According to Flowerdew and Martin (2005), the desktop stage is essential to help the primary research stage in identifying gaps in the literature and refining my research.

The second stage involved collecting primary data by interviewing STR property managers and STR software companies, which offered valuable firsthand insights and perspectives. I opted to interview STR management companies in the second research phase because this can provide more detailed and specific information about their technology usage and the purposes for which they use it. Primary sources enable me to gather specific and detailed information directly from individuals involved in the field (Bryman, 2016). Interviews allow me to investigate the "why" behind their technology choices, uncover emerging or innovative practices, and capture real-world examples. I conducted semi-structured interviews with STR property management companies and software providers to gather detailed insights into their technology usage and purposes. Each interview with an STR management company offers unique and complex perspectives, allowing for a comprehensive understanding of their experiences and practices related to technology usage. These interviews provide an opportunity to delve into each company's specific experiences, perspectives, and practices regarding technology usage and purposes. According to Flowerdew and Martin (2005), using an interview format that is interactive and conversational enables the interviewee to direct the discussion based on their particular areas of knowledge and expertise. Also, this approach allows for the potential for interviewees to raise topics or concerns that the interviewer may not have considered otherwise (Dwyer, Gill and Seetaram, 2012).

Interviewing STR software providers for this research was also important as this allowed me to get an alternative perspective on the technologies used in short-term rental property management. I may get more information on the technologies' origin, usage, and technical details of the software. This can be useful in comparing and contrasting the different software options available. Their information will complement the data obtained from property managers and provide a more comprehensive understanding of the technological landscape in the industry.

By combining desk-based research with interviews, I can improve my findings and increase the validity and reliability of the research (Flowerdew and Martin, 2005). The secondary sources provide a broader context and theoretical background. In contrast, the primary sources offer a more nuanced and in-depth understanding from the viewpoints of STR property managers and software companies. This data collection technique allows me to cross-check information and ensure that my findings are accurate and representative of the industry as a whole.

It's important to note that my research does not revolve around a specific case study, instead, it examines the overall evolution of the STR industry on a global scale. This approach is chosen because, based on the reports from my secondary research, it's evident that the combination of platforms and software operates consistently irrespective of geographical location. Additionally, although some interviews were conducted in Lisbon, it's crucial to emphasize that the technologies mentioned by property managers are employed uniformly and consist of the same components regardless of their location.

This methodology chapter presents a comprehensive overview of the data collection and analysis techniques employed in the study. It begins by outlining the secondary data collection technique, involving extensive desk research to gather relevant information from specific sources. The chapter describes the data analysis of the secondary sources, employing thematic analysis to identify patterns, common themes, and emerging concepts within the data. Then, the chapter delves into the methods used for collecting primary data through interviews. It explains the process of selecting interviewees and provides a brief introduction for each participant. The chapter also outlines the interview questions developed for STR property managers and STR software companies, designed to explore their technology usage and underlying purposes. Similar to the section on secondary sources, this section concludes with a description of the data analysis, emphasizing the systematic coding of the interviews.

Overall, this methodology chapter offers a clear and coherent explanation of the employed secondary and primary data collection techniques, the selection and formulation of interview questions, and the robust data analysis process employed to extract meaningful insights from the collected data.

### **3.1 Secondary sources**

The first step of empirical data collection has been collecting information from secondary sources by doing desk research using the Internet. In this research, secondary sources refer to public material produced by the STR industry itself.

According to Bryman (2016), Internet search engines help find secondary sources such as online materials and websites. However, they are not evaluated. Therefore, I had to look critically at the published websites and content. The secondary sources I have identified using Google search engines primarily consist of public information published by companies related to the STR industry, I searched

company names and looked for resources on their website. These sources encompass various mediums, including blogs, reports, webinars, and podcasts. They are made available by various organizations involved in the STR industry, such as STR property management companies, STR software companies, and consulting agencies. See below a table of my sources (Table 4).

	Company name	Category of business	Year	Source type	Title of source
<b>The current state of STR technologies</b>	Rentals United	Channel Management software	2020	Report	The Global Short-Term Rental Tech Report 2020
	Transparent + Rentals United	Data intelligence tool	2022	Report	Global Vacation rental report 2022
	Transparent	Data intelligence tool	2023	Report	Global Property manager Survey 2023
	Mike Ortegon (person)	Vacation Rental Advisor	2021	Webinar	Why leaning into technology will help you delight owners and guests
	AJL Atelier	Consulting	2022	Blog	The 2023 Short-Term Rental Technology Survey: State of the Nation
	Rentals United	Channel Management software	2019	Podcast	Rentals United - The Secret Sauce of City Relay - Interview
	Rentals United	Channel Management software	2019	Podcast	Rentals United - The Secret Sauce of Sykes Holiday Cottages - Interview
	Rentals United	Channel Management software	2019	Podcast	Rentals United - The Secret Sauce of Feriepartner. dk - Interview
	Rentals United	Channel Management software	2021	Podcast	Secret Sauce of Property Management Company Evolve Vacation Rental - Interview of the CEO
	- Consolidation and Fragmentation	Hostaway	All-in-one PMS	2021	Blog
Enso Connect		Home automation software	2023	Webinar	Solving the fragmentation in hospitality technology
AJL Atelier		Consulting	2020	Keynote	Food Chain to Value Chain - The future consolidation of the tech ecosystem
- STR Technology Landscape	AJL Atelier	Consulting	2023	Report	Short-Term Rental Technology Landscape by AJL Atelier & PeakSpan
	Vrtech	Channel Management software	2021	Report	The Who's Who of the Vacation Rental World 2021
	Wheelhouse	Revenue Management software	2023	Blog	Software Market Map for Short-Term Rentals & Vacation Rentals
<b>STR technology stack</b>	Rentals United	Channel Management software	2021	Blog	<i>Vacation Rental Technology Guide: 8 Essential Tools for Property Managers.</i>
	Operto	Home automation software	n.d.	Blog	<i>Vacation Rental Technology: Building Your Perfect Tech Stack.</i>
	Hostaway	All-in-one PMS	n.d.	Blog	<i>Choosing your Vacation Rental Tech Stack.</i>
	Rented	All-in-one PMS	2021	Blog	<i>Vacation Rental Tech Stack 101.</i>
	Hostfully	All-in-one PMS	2022	Blog	<i>Top 11 Tech Tools for Vacation Rental Owners 2022.</i>
	Wheelhouse	Revenue Management software	2023	Blog	<i>Industry Map for Short-term Rentals &amp; Vacation Rentals: The Software You Need to Know to Win 2023</i>
	Air Concierge	Property management company	2019	Blog	The top 11 gadgets that every Airbnb host should know about
	iBooked.Online	Book Direct software	2022	Podcast	Tech Stack Revealed - Short-Term Rental/Airbnb Technology you MUST have

Table 4 - List of secondary sources used for the research and data categorization  
Source: own elaboration.

Twenty-three public sources have been carefully analyzed and studied in this research. The selection of these 23 materials was based on their citation in other reputable sources such as STR media and the renowned news organization ShortTermRentalz (Short Term Rentalz, no date). ShortTermRentalz is dedicated to fostering the growth of the global short-term rental (STR) business by providing industry news and intelligence. Their credibility is further reinforced by their organization of The Shortyz Awards (Short Term Rentalz, 2023), a highly regarded industry event. Therefore, the publications shared by ShortTermRentalz are considered reliable and valuable sources of information. In addition to the sources associated with ShortTermRentalz, other sources were included in the analysis because they were authored or produced by well-established STR companies. These sources are recognized within the industry and are trusted for their expertise and knowledge in the field of STR management. Including these sources enhances the reliability and validity of the findings, ensuring that the research is based on credible and respected publications.

As mentioned before, STR software companies, advisor/consulting agencies, and STR property management companies are the sources of these publications. STR software companies are the organization that provides most of the materials analyzed. They are companies that develop software and digital solutions for property managers, such as all-in-one PMS, channel management software, data intelligence tools, home automation software, and revenue management software. They post their publication on their blogs, and the general content includes a range of topics relevant to vacation rental property management, including marketing, distribution, guest experience, technology, and others. The software and strategies that these companies share can be used by all property managers despite of the location. In the next few paragraphs, I will describe their company and the sources that I used from them.

Rentals United is one of the largest channel management software in the industry, and they work with many property managers to collect information and share insightful resources (Rentals United, 2023). They are the company I identified that produces most of the resources for the industry. In 2020, they produced a complete analysis of the current state of the vacation rental tech space. "The Global Short-Term Rental Tech Report 2020" includes insights about stats, trends, and investments (Rentals United, 2020). Rentals United also posted a blog titled "Vacation Rental Technology Guide: 8 Essential Tools for Property Managers" (Magyar, 2021b). This blog is included in the research because it contributes to the technologies STR property managers use.

Rentals United also has a podcast series where they interview many STR industry players, and there is one podcast called "The secret sauce of Large Property Managers" (Rentals United, 2021b). Each episode is with one CEO or founder of a property management company and discusses various trends

that are happening in the industry. I watched the interviews with the CEO of City Relay, Sykes Holiday Cottages, Evolve Vacation Rental, and Feriepartner.dk (Rentals United, 2019a, 2019c, 2019b, 2021a). The four CEOs talk about the current state of the industry, how they manage their operations, and how they think about technology in the industry and the future lookouts. I chose these four interviews because they are well-known companies, and they talk about technology and interesting recent events. City Relay is a short-term rental management company based in London, United Kingdom. They operate over 1,500 properties in London (City Relay, 2023). Sykes Holiday Cottages is a vacation rental agency focused on rural rentals based in the United Kingdom. With over 25 years of experience, they are a holiday cottage rental agency representing over 20,000 cottages across the UK, Ireland, and New Zealand (Sykes Cottages, 2023). Evolve Vacation Rental is a property management company headquartered in Denver, Colorado, USA. They specialize in managing vacation rental properties across North America, currently operating over 14,000 properties (Evolve, 2023). Feriepartner.dk is a vacation rental agency focused on rural rentals based in Denmark. They have a strong presence in Denmark and manage 7,000 holiday homes and cottages throughout the country (Feriepartner, 2023).

Vrtech, a community of STR leaders and game changers, was established in 2015 by Vanessa de Souza Lage, who is the co-founder and CMO of Rentals United. This organization produced the report "The Who's Who of the Vacation Rental World 2021" (Vrtech, 2021). This report comprehensively lists over 220 innovative solutions providers in the STR industry and categorizes them into 35 categories. This report also has categories that are not technology-based, such as consulting and training. For this dissertation, I will only focus on the technology categories. Technology categories include PMS, channel managers, smart home technologies, revenue management systems, data analysis, IOT, Operations, guest experience, direct marketing, digital guidebooks, payments and accounting, guest screening, check-in software, and home automation. These reports are helpful for this research in identifying all the technologies that exist in the STR industry.

Wheelhouse is a pricing optimization and revenue management software for vacation rentals (Wheelhouse, 2023a). The "Software Market Map for Short-Term Rentals & Vacation Rentals" from Wheelhouse (2023b), is a report that provides an overview of the technologies powering the short-term rental space and categorizes 170 companies into 19 categories. Once again examining the variety of software categories is vital for the research. Additionally, Wheelhouse has a blog post presenting the essential technologies for property managers in 2023 (Friedman, 2022).

Transparent Intelligence is a company that provides data intelligence for the short-term rental industry. They build and maintain data analytics products for companies seeking a better understanding of the short-term rental industry (Transparent Intelligence, 2023a). In 2022, together

with Rentals United, they produced the report "Global Vacation rental report 2022" (Transparent Intelligence and Rentals United, 2022). The report is based on a survey completed by 164 global property managers representing more than 62,000 properties in total and hail from Europe, North America, Latin America, Asia, and Oceania. The report examines various topics, from operations to distribution, technology adoption, pricing strategies, and data usage. More recently, in January of 2023, Transparent produced the report "Global Property Manager Survey 2023" (Transparent Intelligence, 2023b), This report provides more recent data than the previous one, making it a valuable resource for conducting a year-to-year comparison.

Hostaway, Rented, and Hostfully are all-in-one vacation rental software solutions for property managers (Hostaway, 2023; Hostfully, 2023; Rented, 2023) and Operto is a smart home automation platform for vacation rentals (Operto, 2023). They are some of the top PMS providers and smart home solutions in the industry. Their four blog posts all show their "tech stack" recommendations to STR property managers. These contents were specifically selected for their valuable insights into the digital tools essential for property managers in the STR industry.

Enso Connect is a digital solution company in the short-term rental industry that leverages smart home devices and AI communication. Enso's technology connects to the PMS and assists in personalizing and monetizing interactions from inquiry to check-out and beyond (Enso Connect, 2023). Their webinar "Solving the fragmentation in hospitality technology" (Barak, 2023) is included in this research because it explores recent changes and emerging trends in the hospitality industry. The other participants in the webinar are Terry Whyte, CEO of a property management company, who has been in the short-term rental business for nearly three decades, and John An who founded Ohana Stay, a property management company in Honolulu. The webinar discusses how companies deal with the fragmentation and complexity of all the different technologies. It also shares tips on how hospitality professionals can leverage technology to deliver a seamless experience for guests, employees, and partners while improving overall efficiency. The session touches on the long-term outlook for the hospitality tech sector and ways to prepare for the future.

In 2022, iBooked.Online, a direct booking and marketing company (iBooked, 2023), uploaded a video to the YouTube channel "The Accommodation Show by iBooked.Online". This video is an interview with a New Zealand property manager, The Urban Butler (The Urban Butler, 2023), and they discussed tools property managers must have in their STR management companies (The Accommodation Show by iBooked.Online, 2022). This video is particularly interesting because, in addition to the insights

shared by the prominent property manager interviewed by Rentals United, it also features the perspective of an established small property manager.

All above-described sources are from STR software organizations, they publish these materials with multiple purposes in mind. Firstly, they aim to advertise and promote their services to the STR community. By sharing valuable insights, case studies, and success stories related to their offerings, these companies hope to attract potential clients and showcase their expertise in the field. For example, in the blog from Operto, when they present smart locks as a digital tool, they present their business solutions in more detail (Operto, 2022). Secondly, these STR technology companies seek to assist other property managers in improving their operations. The published information often contains practical tips, strategies, and best practices to help property managers enhance their efficiency, guest experience, revenue generation, and overall success in the STR market. It serves as a knowledge-sharing platform, allowing property managers to learn from industry experts and gain valuable insights into the effective use of technologies (Rentals United, 2021a; Transparent Intelligence, 2023b).

Despite that in the “The secret sauce of Large Property Managers” podcasts (Rentals United, 2021b), some property managers shared information about the technologies they use. However, it's worth noting that these property managers only disclosed this information verbally during the interviews and did not publish or share the details on their blogs or public platforms. My sole blog source which is from a property management company is from Air Concierge, they shared a blog post titled "The top 11 gadgets that every Airbnb host should know about" (Air Concierge, 2019). This blog post differs from others as it is from a property manager, and it targets individual hosts or property owners rather than professional management companies. Despite this distinction, the post was included in the research due to its relevance in providing insights into intriguing in-home gadgets. Property managers can recommend these gadgets to their host clients, contributing to enhanced operational services within their rental properties. There are no other posts from Property managers because not many professional property management companies share in writing their technology stacks as it is their business strategy (this information was obtained during the Interview phase of the research).

I also identified that short-term rental consultancy firm provides many insights into technological developments. AJL Atelier is a consultancy firm focused on the short-term rental industry (AJL Atelier, no date). They provide various services to help professionals in the short-term rental industry improve their operations and increase profitability. As vacation rental experts, they aim to help these professionals optimize their operations, increase profitability, and stay competitive. These services include general consulting, profitability, finance, education, and recruitment. In addition, by providing

educational resources and training programs, AJL Atelier is helping to raise the overall level of professionalism and knowledge in the industry. Some examples of their resources include presenting short-term rental company technology landscape, PMS recommendations, and other guest experience solutions. Hence it was helpful for me to review their contents and find what technology exists in the short-term rental industry. The blog post titled "The 2023 Short-Term Rental Technology Survey: State of the Nation" (AJL Atelier, 2022) primarily highlights the most recent advancements in the vacation rental industry, with a particular emphasis on digital guest experience technologies, which are experiencing rapid growth according to AJL Atelier. In this post, they provided a list of guest experience solutions and PMSs.

One significant source from AJL Atelier is the online keynote session by Simon Lehmann, founder of AJL Consulting, talking about the consolidation in the industry and presenting a technology ecosystem/hierarchy where STR companies connect guests and owners (Lehmann, 2020). Lehmann graphically introduces his findings and what he considers the most critical technologies that STR companies use nowadays. This secondary source can help map out all existing technologies and their relationships.

As STR technologies are experiencing rapid developments, players within the sector have begun categorizing the various technologies to better understand and navigate the dynamic landscape. I found three industry reports categorizing STR digital solutions, two already presented earlier (Vrtech, 2021; Wheelhouse, 2023). These provide a clear and comprehensive view of the top technologies by need and function. The number of software and platforms has grown massively, and it can be challenging to keep up and know which solutions are the right fit for each STR business. The "Short-Term Rental Technology Landscape by AJL Atelier & PeakSpan" (AJL Atelier, 2023) is one of the most extensive sources that provides a comprehensive overview of the current technology landscape in the short-term rental industry and puts over 400 technology companies into 4 groups and then into 22 sub-categories.

The 4 groups are management technologies, distribution platforms, guest experience technologies, and operations technology. Management technologies primarily aid in property management and include PMS, channel management solutions, revenue management technology, data analysis tools, website builders, and digital marketing tools; Distribution platforms encompass OTAs, metasearch, and listing sites, which are vital for the efficiency of property managers; Guest experience technologies have become a booming field as STR players aim to enhance professionalism and showcase STR as a viable lodging option to hotel guests. Guest communication software and property automation solutions are among the tools used to improve the guest experience; Operations technology focuses

on solutions for managing housekeeping, maintenance, and inspections, optimizing service efficiency and administrative operations. AJL's report emphasizes the increasing importance of integrations and partnerships among technology providers to create a seamless and efficient short-term rental ecosystem. Hence this report is helpful for further analysis of technology adoption in the STR industry.

Lastly, I included an individual industry advisor as a source for this research because he provided important insights into the STR industry. Mike Ortegon has been a vacation rental advisor for over ten years and has held executive leadership roles in VRBO ('Mike Ortegon', 2023). He was one of the speakers at the digital conference Short Stay Week 2021. Short Stay Week is a conference with over 150 speakers providing their expertise in training conferences producing actionable, informative content to help property managers optimize and grow their STR business (Short Stay Week, 2023). With his expertise, he spoke on the topic of technology implementation in an STR business and provided his advice on what should be the technology stack of a property manager. I had access to the conference videos on Vimeo through a passcode (Host B2B, 2021). Unfortunately, the videos were taken offline by the time of writing this dissertation. The below figure is a screen shot of Ortegon's presentation.

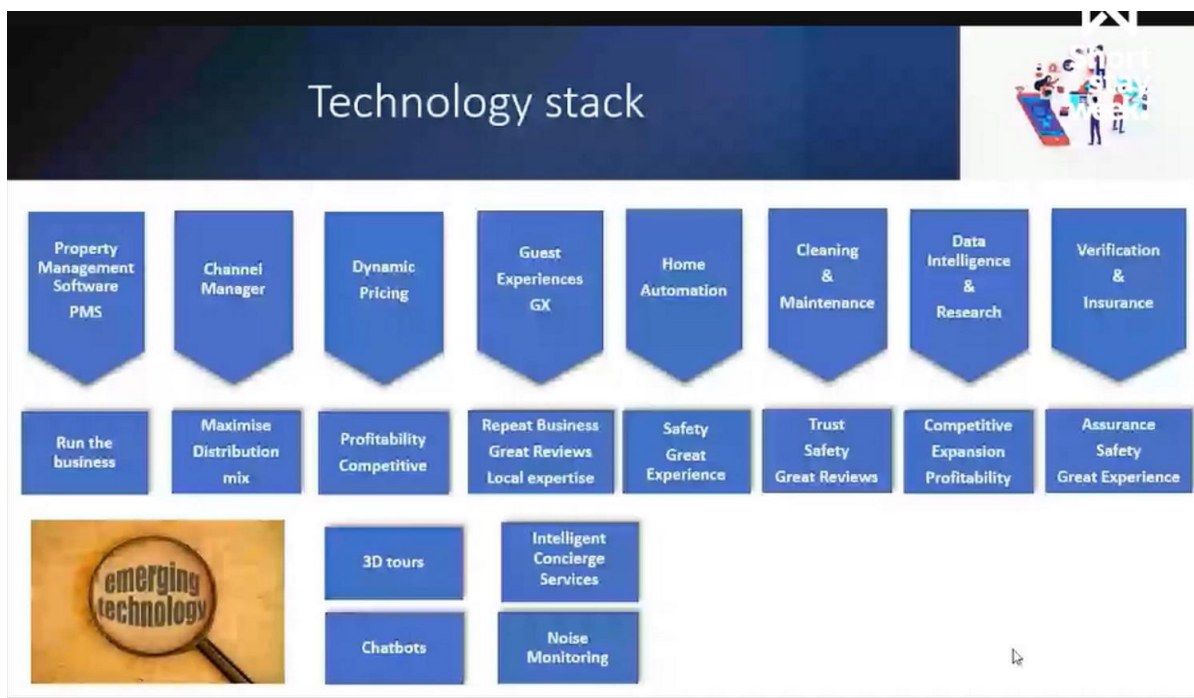


Figure 1 - Mike Ortegon STR technology Stack

Source: Short Stay Week "Why leaning into technology will help you delight owners and guests"

### 3.1.1 Secondary Sources Data Analysis

Analyzing secondary qualitative data, such as blogs, webinars, reports, and podcasts, involves a systematic approach to derive meaningful insights and themes (Veal, 2017). I followed a manual method of data analysis of the found secondary qualitative data as I had carefully read through all of them and took notes. I put them on a spreadsheet and looked at the sources to find common themes. (Flowerdew and Martin, 2005).

The data analysis resulted in categorizing the sources into two main themes, which are reflected in the left column of the table (Table 4). The first theme pertains to the current state of the short-term rental (STR) industry. While many of these sources do not specifically focus on technology, they all provide insights into the industry's current state. These insights encompass aspects such as the consolidation and fragmentation of various STR businesses and the STR technology landscape. They represent essential research conducted by key players in the industry, showcasing their perspectives on the technological landscape. These sources shed light on STR technology adoption, prevailing trends, and growth transpiring within the industry.

The second theme revolves around the STR technology stack. Establishing a technology stack is considered one of the initial steps for vacation rental property managers when starting their business. Recognizing the importance of this, prominent players in the industry have produced articles and resources related to creating and optimizing a technology stack. These materials aim to assist newcomers in the industry and help existing businesses improve their technological infrastructure. This theme holds considerable significance for the research because it is the main topic of research. In these sources, there is also information that describes what is the role of each technology inside a STR company.

The data analysis process facilitated a systematic and well-organized examination of the information, enabling a comprehensive exploration of the current state of the industry. From the identified themes of this secondary research, I will be able to answer the dissertation's first objective: To explore the landscape of existing technologies in the short-term rental industry. Following this desk research, it becomes imperative to delve deeper into the understanding of these technologies by conducting interviews with STR management companies.

### 3.2 Primary sources - Interviews

Semi-structured interviews were conducted with STR property management companies and software providers. The participants were selected during the desk research phase. Most of the property management companies were identified using Rentals United's Top 50 2022 world's largest short-term rental property managers report (Magyar, 2021a), and most of the software providers were identified using AJL Atelier's Short-Term rental technology landscape report (AJL Atelier, 2023). Emails requesting an interview were sent during March and April of 2023 to the company's general support mailbox. In this email, I explained that I am a short-term rental landlord and, simultaneously, a master's degree student doing my master's thesis on STR technology adoption. With this introduction, I could reach mostly the sales and market department and, in some cases, the CEO or founder.

During the interview process, I encountered several challenges, both in recruiting participants and in discussing the topic of technology. Four companies declined the interview request, citing that this particular subject concerns their sensitive business strategy. Moreover, many CEOs and higher-level staff members expressed limited interest in engaging with academia, as their primary focus lies in the business aspects of their operations. Additionally, while conversing with certain sales or business development teams, it became apparent that they possessed minimal knowledge about technology. Some individuals were unsure about the technical workings behind the technologies being used, and they recommended reaching out to their IT departments for more detailed insights.

Despite sending multiple emails to short-term rental companies and technology service providers, most did not respond, or communication stopped after a few email exchanges. At this stage, I had 9 participants whom I interviewed online. Intending to recruit further participants, I visited the offices of some STR management agencies in Lisbon.

As a result of time constraints and the unavailability of the intended study subjects, I managed to conduct 13 interviews. A total of 9 property management companies and 4 software providers were interviewed. I was mainly able to interview Lisbon-based STR companies and a few other transnational companies that operate in different countries. In terms of software companies, all of them are international. 6 interviews were conducted in English and 7 in Portuguese. The reason for the Portuguese interviews was that they were Portuguese-speaking participants, and they preferred to perform the interviews in their native language for better communication. The majority of the quotes utilized throughout the text are of my own translation, I did not include the original Portuguese version, so as not to fragment the flow of the text.

The study complied with ethical principles, and participants were informed of the research aims and their right to withdraw from the study at any time. I ensured that I would not identify any individual and that all information would be treated confidentially. Also, I had verbal consent from participants for the audio recording before the interviews.

The table below contains the names of the companies that consented to participate in my study (Table 5).

	Company	Participant	Portfolio	Additional information on the company
<b>STR Management Company</b>	Casas D'almedina	Founder	- 80 properties in Lisbon	Founded in Lisbon in 2014.
	Home Me – Be Oporto	Co-Founder	- 40 properties in Porto	Founded in Porto in 2015. Home Me is part of the property investment group Be Oporto.
	+351Lisbon	Co-founder	- 20 properties in Lisbon	Founded in Lisbon in 2016. A family business that saw an opportunity to manage the properties of friends and families. Currently scaling the business.
	The Lisbon Concierge	Co-founder & CEO	- 100 properties in Lisbon	Founded in Lisbon in 2014. It is part of the Portuguese group City Concierge, via franchising, they manage properties in Albufeira.
	Guest Ready	Lisbon district Sales Team	- 1200 properties in Portugal - 7000 properties globally	Founded in London in 2016, it is a rapidly growing company and is currently active in seven countries in Europe and the Middle East
	Homing	CEO	- 500 properties in Portugal	Founded in Lisbon in 2016. Manages properties in Lisbon, Porto, Algarve, and Madeira. They are currently moving into the Spanish market.
	Lovely Stays	Lisbon district Sales Team	- 850 properties in Portugal	Founded in Lisbon in 2015. in 2022 according to data from Turismo de Portugal and the TravelBI Platform, LovelyStay has a higher average profitability than competing properties.
	Feels like home	CEO	- 550 properties in Portugal	Founded in 2012 in Lisbon. Manage properties in Lisbon, Porto, Ericeira, Madeira, and the Algarve. It is a group that offers a series of consultancy and asset management services: feels like home holiday rentals, feels like home facility services, feels like home sellers and home solutions, feels like home prime suites
	Italianway	CEO	- 4000 properties in Italy	Founded in 2014 in Milan. Italianway has a franchise network of property managers, they are in 340+ destinations throughout Italy. They developed their own PMS and are now providing these technologies to other property managers. 700 listings managed directly, 300 franchisee listings, and 3000 listings with property managers that use Italianway PMS.
<b>Software Providers</b>	Enso Connect - Home Automation Software	Founder	- Boarding pass technology - Custom automation/integration - Digital guidebooks	Founded in Toronto in 2020. It is a dynamic guest experience platform for vacation rentals and boutique hotels. They can help property managers integrate with PMS, Guest verification software, and smart locks.
	Operto - Home Automation Software	Head of Marketing - EMEA	- Digital Check-in - Guest Apps - Smart locks - Noise Monitoring - Smart thermostat	Founded in Vancouver in 2016. It specializes in keyless access and IoT operating systems for vacation rentals. It can allow property managers to manage the guest app and all its connected solutions in a single platform.
	Hostify - All-in-one PMS	Sales/Account manager	- Listings/reservations management - Channel connections - Guest messaging - Payment processing - Website builder	Founded in Dover, Delaware in 2017. All-In-One Airbnb & Vacation Rental Management Software. They streamline the vacation rental business and gather all interactions in a single dashboard.
	Rentals United - Channel manager	Sales Team	- Channel management - Direct booking website integration - Guest messaging - Multi-calendar - Small-scale PMS for individual owners	Founded in Barcelona in 2015. One of the largest channel management software, they can connect to 60+ listing sites and currently every month they add 1 to 2 new platforms. They have a cloud-based technology.

Table 5 - STR management and software companies interviewed for the research  
Source: own elaboration (portfolio data as of June 2023).

A semi-structured interview guide was developed to ensure consistency across the interviews. The online interviews were conducted via Google Meet. Each participant was interviewed for approximately 35 minutes, and I started to record the audio after receiving their agreement.

The goal of interviewing STR property managers is to ask them what technologies they use to manage their properties and ask them to explain how they use them. After the first interview, I realized the participant did not voluntarily speak about some specific technologies. Hence, I had to change my interview topics to direct them to tell me if they used any other technologies in their operations. Interviewees focused on the company's origin, digital technology adoption, and online distribution platforms.

Topic	Questions
Origin of the company	- How did the company start? - Could you describe your company and its short-term rental management services?
Digital Technologies	- What technologies do you currently use to manage your properties? - What do you use them for? a) Software type <ul style="list-style-type: none"> <li>• PMS</li> <li>• Channel manager</li> <li>• Revenue management</li> <li>• Task management</li> <li>• Website</li> </ul> b) Access management c) Guest communication and internal communication d) Any other integrations
Online distribution platforms	- In your opinion, what is the importance of STR online platforms in this industry?

*Table 6 - Interview script and list of topics used with short-term rental management companies  
Source: own elaboration*

Regarding software companies, the interviews are mainly about understanding how the technology works and their integration system into other related short-term rental technologies. The topics were the origin of the company, the origin of the technology, and the integration of their technologies with other software.

Topic	Questions
Origin of the company	- How did the company start? - Could you describe your property automation service and the technologies you offer?

Origin of the technologies	- What was the origin of these types of technologies in STR? - How did these operations work before the creation of the software?
Integration	- How do you integrate your technologies with other property management systems, such as STR PMS platforms and channel managers? What other integration partnerships do you have?

*Table 7 - Interview script and list of topics used with short-term rental software companies  
Source: own elaboration*

### 3.2.1 Primary Sources Data Analysis

After each interview, I directly transcribed the audio tape. According to Flowerdew and Martin (2005), it is essential to transcribe the recording tapes in any qualitative project. With this qualitative data, I used a manual method of analysis. First, I read the transcriptions, listened to the audio tapes, and then gave codes to the topics we discussed. This process is called "open coding" (Flowerdew and Martin, 2005). For each code, I have a different color highlighting the text so that it is easier for me to find during the writing of my results.

As Veal (2017, p.462) stated, "The themes may arise from the conceptual framework and research questions and therefore be consciously searched for in a deductive way, or they may emerge unprompted in a more inductive way." The codes in my notes are mainly the names of different technologies the STR property managers used. The principal codes I have with STR management companies are "PMS," "Channel manager," "Revenue management," "Smart Locks," and other technologies. Each code includes their explanation of how and why they used them. The principal codes I have with STR software companies are "Integration," "Smart lock," "Automation," and "API".

The process of analyzing these interviews provided valuable insights into the technologies utilized by short-term rental property managers and shed light on the specific features and functionalities they prioritized for their day-to-day operations. The interviews answered the second objective: To explore how property managers use these technologies.

## 4 Presentation of results

This section is structured into two main parts, each dedicated to presenting distinct sets of findings. The first part focuses on presenting the results obtained from the secondary research conducted, which involved a comprehensive analysis of blogs, reports, and other relevant sources. The second part is dedicated to presenting the findings from the interviews conducted with property managers and software companies, delivering valuable insights into their firsthand experiences and perspectives on the utilization of technologies. This division allows for a clear and organized presentation of the research outcomes, providing a comprehensive understanding of the technology landscape in the STR sector from both a theoretical and practical standpoint.

### 4.1 Secondary research

This section will explore the findings derived from secondary sources, focusing on three main topics. Firstly, I will present the definitions of all the technologies discovered through secondary research. This will serve the purpose of compiling the list of technologies employed by property managers and establishing a fundamental comprehension of the functionalities associated with each of them. Secondly, I will examine the current state of technology adoption in the short-term rental sector. Lastly, I will explore the list of digital solutions recommended by industry players. The two latter topics were identified as the primary areas of interest based on secondary source information data analysis.

#### 4.1.1 List of short-term rental technologies

Below is the table comprising all the STR software categories identified during the secondary research, each accompanied by its respective definition. In total 23 software technologies are presented. Further elaboration and in-depth insights regarding some of these software solutions will be presented in the upcoming sections, particularly in the interview section, where property managers will share their firsthand opinions and experiences.

Software	Purposes
Property management software	To manage reservations, bookings, guest communication, and property listings
Channel management	To connect and synchronize listings across multiple platforms (e.g., Airbnb, Booking.com, VRBO)
Revenue management / Dynamic pricing tool	To optimize pricing and maximize revenue by analyzing demand patterns, market trends, and other factors that influence the pricing of short-term rentals. This can help property owners and managers to set competitive prices and increase their profitability.
Payment processing	To handle financial transactions, such as accepting payments and processing refunds
Task Management (Cleaning and maintenance)	To schedule and manage cleaning and maintenance tasks for properties
Guest communication	To facilitate communication between guests and hosts, providing channels for inquiries, requests, and assistance. These tools can include messaging platforms, chatbots, and automated messaging systems.
Guest screening	To protect the company and property by verifying guest identity and background checks and providing insurance coverage for guests and properties.
Customer relationship management	To enhance the guest experience by providing personalized recommendations, local guides, and other services that cater to their interests and preferences.
Data provider	To gather insights about the short-term rental market, such as pricing trends, guest demographics, and local regulations, to inform business strategies and decision-making.
Marketing and advertising	To create and manage marketing campaigns and listings, including email marketing, social media advertising, and website builder tools
Home automation technology	To allow guests to control various aspects of their rental, such as entrance, lighting, temperature, and security, using a mobile device or voice commands.
Keyless entry solutions (Access Control)	To provide guests with secure and convenient access to the property using technologies such as keypad locks, smart locks, or mobile apps. This eliminates the need for physical keys and simplifies the check-in process for guests.
Website Builder	to help streamline the booking process by providing a user-friendly and visually appealing platform.
Digital Guidebooks	To Help guests both navigate the property and nearby area, can reduce customer service needs & and guest complaints, increase revenue, and drive repeat bookings
Direct booking and marketing	To promote rental properties directly to potential guests, increase direct bookings, and enhance the overall visibility
Acquisition & Investment	To help expand the property manager's portfolio. Provides data and underwriting software for potential acquisitions; Helps to connect property owners to a property management company; Provides capital for acquisitions.
Conversion rate optimization tools	To enhance user experience and increase the conversion of website visitors into paying customers.
Ancillary guest service	To offer additional services and amenities to enhance the guest experience and provide added value during their stay (luggage storage app, scanner app).
3D tour software	To create immersive and interactive virtual tours of their rental properties.
Chatbot	To offer automated and instant customer support to guests, answering frequently asked questions and assisting.
Email collection software	To collect and manage email addresses of guests and potential customers for marketing purposes. This tool will request email addresses for specific amenities or access to guest services
Reputation management tools	To monitor and manage the online reputation of the short-term rental company, including tracking and responding to guest reviews, managing online ratings, and maintaining a positive brand image. These tools help in maintaining and improving the company's reputation in the market.
Human resources software	To manage employee information, track attendance and time-off, handle payroll, facilitate recruitment and onboarding processes, and streamline HR-related tasks within the short-term rental management company. This software helps in effectively managing the company's workforce and HR operations.

*Table 8 - All software technology categories identified during the secondary research*

*Source: Own elaboration based on: AJL Atelier, 2023; Friedman, 2022; Hostaway, n.d.; Hostfully, 2022; Magyar, 2021; Operto, 2022; Rentals United, 2019c; Rented., 2021; Vrtech, 2021; Wheelhouse, 2023*

Below is the table presenting the in-room gadgets that property managers include in their listings. These gadgets serve as both attractive amenities for guests and practical tools that aid property management companies in their day-to-day operations. It's important to note that most of these gadgets have a hardware component. In total, 13 in-room gadgets have been identified and some will be further discussed in subsequent sections, shedding light on their functionalities and the advantages they offer to both guests and property managers.

Gadget	Purpose
Smart TV	To provide guests with access to streaming services such as Netflix, Hulu, and Amazon Prime Video
Smart thermostat	To allow guests to control the temperature of the room from their mobile devices
Smart lock	To allow guests to access the property with a code (automatically generated for each check-in) or keyless entry (mobile app) and eliminates the need for physical keys or check-in/check-out process
Smart lighting	To allow guests to control the lighting of the room from their mobile devices
Voice-controlled assistant	To provide guests with information about the property, local amenities, and other information, as well as control other smart devices in the room using voice commands
Smart plugs and power strips	To allow guests to control and schedule the power usage of various devices, such as a lamp, fan, or coffee maker
Motion sensors	To detect motion and trigger automated actions, such as turning on lights or adjusting temperature, to enhance security and energy efficiency
Doorbell surveillance systems	To provide security and monitoring of the property entrance, allowing guests and hosts to see and communicate with visitors remotely
Bluetooth speakers	To provide guests with high-quality audio playback for music or entertainment purposes
Security cameras	To monitor and enhance the security of the property, both internally and externally
Noise control	To minimize noise disturbances for guests and ensure a peaceful environment
Safety detectors	To detect hazards such as smoke, fire, or carbon monoxide and alert guests and hosts to ensure their safety
Wi-Fi solutions	To provide reliable and high-speed internet connectivity for guests to stay connected and access online services

*Table 9 - All gadget categories identified during the secondary research*

*Source: Own elaboration based on: AJL Atelier, 2023; Air Concierge, 2019; Operto, 2022; Rented., 2021; Vrtech, 2021; Wheelhouse, 2023*

This section effectively addresses the main objective of the dissertation: To understand what technologies short-term rental property managers use, and for what purposes. The tables presented provide valuable insights into the various technologies utilized in the industry and their applications in property management.

However, it is important to acknowledge that these tables alone may not fully encompass the entire technological landscape within the STR industry. While they offer a foundational understanding of the technologies in use, a more comprehensive view will be achieved through the forthcoming sections.

### 4.1.2 The current state of short-term rental technology

The Transparent report (Transparent Intelligence, 2023b) states that technology has significantly impacted the short-term rental industry. Various technological advancements, ranging from online booking platforms and property management software to smart home technology and virtual reality, have facilitated the operations and marketing of rental properties for owners and managers.

From the secondary sources, many resources presented the current state of STR technology, where the industry players assembled statistical data and shared interesting remarks. Four key areas stood out as subtopics. Firstly, it was important to understand why the market was evolving so quickly. Secondly, statistical data with the support of property managers' testimonies were studied to understand the extent of technology adoption among STR property managers. This involved examining the usage rates and trends associated with various technological solutions. Thirdly, a focus was placed on exploring innovative guest experience technologies that are currently emerging in the STR industry. Lastly, the research delved into the consolidation occurring within the industry, examining mergers and acquisitions and their implications on technology adoption and overall market dynamics. A comprehensive understanding of the current state of STR technology adoption was obtained by addressing these four distinct subtopics.

#### 4.1.2.1 *Rapid growth*

It is confirmed by property managers, software providers, and advisors that the STR technological landscape is growing very rapidly (Rentals United, 2019a; AJL Atelier, 2022; Wheelhouse, 2023b).

Several major factors drive the rapidly evolving STR industry technology landscape. Firstly, according to Lehmann, CEO of a STR consulting company, there has been a significant increase in the scale of the industry in recent years, with more capital flowing into the sector to support the growth of operators and to fund software and hardware teams (AJL Atelier, 2023). The emergence of larger operators in the industry has created a demand for more robust software solutions. These operators share that they require advanced software tools to effectively manage their operations and meet the growing needs of their businesses (Rentals United, 2019c, 2021a).

A blog from Wheelhouse, a revenue management software company, and property managers, such as the CEO of Sykes Holiday Cottages, also mention there is a need for specialized solutions (Rentals

United, 2019c; Wheelhouse, 2023b). Since a diverse range of activities is involved in running such businesses, including pricing, cleaning, and marketing, it requires specialized solutions tailored to each vertical. Whether a single software provider can deliver best-in-class software across multiple verticals in the industry remains to be proven.

Furthermore, as the short-term rental industry continues to professionalize (Cocola-Gant et al., 2021), property managers face the imperative of adopting more professional standards and practices to remain competitive in the increasingly mature market. To distinguish themselves, property managers may need to invest in quality amenities and services, implement effective branding and marketing strategies, and, most importantly, embrace technology, as emphasized by Industry advisor, Ortegon, during his speech at Short Stay Week (Host B2B, 2021). The professionalization of the sector has driven a surge in demand for software that caters to the unique requirements of running a hospitality business (Lehmann, 2020).

Additionally, as Wheelhouse mentions in their blog (2023), the low barriers to entry in the STR industry have made it easier for technological entrepreneurs to enter the market. With a large number of fast-moving, single-decision maker businesses in the industry, software companies can quickly find paying customers for their digital solutions. The nature of the industry, where individual listings can serve as test beds for technology, further facilitates property managers' adoption of new software.

These various factors contribute to the dynamic and innovative technology landscape of the STR industry, where operators and entrepreneurs strive to develop and implement software solutions that meet the market's evolving needs.

#### *4.1.2.2 Technology adoption*

In 2022, Transparent Intelligence and Rentals United's global STR report found that approximately 74% of respondents were already utilizing or considering implementing property management systems (PMS), channel managers, keyless entry systems, dynamic pricing tools, and data providers. These five tools are considered "fundamental" technology for property managers. In 2023, that percentage has grown to 80%, indicating a positive trend toward technology adoption in the industry (Transparent Intelligence, 2023b). They found a positive correlation between the number of properties managed and technology adoption. Larger property managers exhibit the highest adoption rates compared to smaller property managers.

This finding is consistent with the literature review conducted by Cocola-Gant et al. (2021). The author highlights that property management software, channel manager, and market analysis software (dynamic pricing tool) are three essential digital tools for the effective functioning of a professionalized short-term rental property management company. The alignment between these findings and the literature further strengthens the understanding of the key technological requirements for property managers.

When examining the geographic aspect of technology adoption, both reports from 2022 and 2023 show that North American property managers exhibit the highest levels of adoption. These reports demonstrate that an overwhelming majority, approximately 75%, of property managers in North America have embraced the utilization of the five “fundamental” technologies. The 2023 research report states that property managers from Europe and Latin America display similar levels of adoption, with Europe slightly ahead, as approximately 63% of respondents in this region utilize the “fundamental” technologies (Transparent Intelligence, 2023b).

Approximately 47.5% of property managers have their own dedicated IT teams (Rentals United, 2020). CEO of Feriepartner. dk in the podcast “The Secret Sauce of Property Managers” with Rentals United (Rentals United, 2019b) shared that it is common for property management companies to develop their own technology solutions in-house. These IT teams could be small, but they must be clever. Feriepartner's IT team is formed by 14 people, and this team created a PMS, channel manager, revenue management system, additional website facilities, a task management tool, and many others. The CEO shared that at Feriepartner, it took them three years to develop the PMS with all the other tools integrated, and they are still improving and enhancing it.

At Sykes Holiday Cottages, they have almost 100 engineers working for them (Rentals United, 2019c). Evolve Vacation Rentals CEO also shared (Rentals United, 2021a) that they need to custom build their booking engines and other operational tools because the third-party PMS they worked on did only 65% of what they needed. Hence, they need the technologies to adapt to their unique business model. They built their own website and have their own dynamic pricing tool integrated into their PMS, which calculates and pushes new prices every single night for every property. This PMS then stores the data in the cloud software they work with. At Evolve, they have 25 to 30 developers.

An interesting finding from the Rentals United report (Rentals United, 2020) is that among property managers who have built their own property management systems (PMS), a significant 61% have also developed an accounting module. This indicates a notable gap in the availability of third-party tools that adequately address the challenges associated with accounting in the STR industry. This gap

becomes particularly apparent for property managers operating in multiple markets, as they must navigate diverse accounting regulations and requirements (Rentals United, 2021a). These findings suggest that the main drivers behind the inclination towards having an internal team are the restricted availability of third-party tools in specific domains and the imperative for personalized solutions tailored to their distinct needs.

Conversely, the market is witnessing a growing trend of outsourcing tools like task management, payment schedules, and guest communications to third-party services (Rentals United, 2020). City Relay is an example of a company that outsources all technologies to different third-party providers (Rentals United, 2019a). Since the beginning of their business, they have considered themselves a tech-enabled property management company. The CEO of City Relay explains that it is sometimes more cost-efficient to use external software and that there are a lot of good tools on the market. City Relay shared all the technologies they use for their operations. For example, they use Rentals United as their channel manager, Lodgify as their PMS and website builder, Wishbox as their guest communication tool, Breezeway as their task management and cleaning app, and Outswitch as their dynamic pricing tool, which in 2019 they acquired (Stevens, 2019).

Now, concerning specific technology adoption rates, findings consistently suggest that property management system (PMS) stands as the most popular technology in the STR professional management sector (Lehmann, 2020; Rentals United, 2020; The Accommodation Show by iBooked.Online, 2022; Transparent Intelligence and Rentals United, 2022). Among property managers who participated in the 2023 survey conducted by Transparent (Transparent Intelligence, 2023b), 80% of respondents reported using a PMS. According to Ortegon a PMS is what runs the business (Host B2B, 2021), and property managers often call a PMS the engine room (The Accommodation Show by iBooked.Online, 2022). In order to streamline their day-to-day operations and enhance the guest experience, they need this software.

A clear pattern emerges when examining PMS usage based on property managers' size. A trend identified in the three Global reports of the STR industry is that as the size of property management operations increases, there is a noticeable increase in PMS adoption (Rentals United, 2020; Transparent Intelligence and Rentals United, 2022; Transparent Intelligence, 2023b). Notably, an overwhelming 98% of the largest respondents (50+ properties) reported using a PMS (Transparent Intelligence, 2023b).

According to the industry's technology providers maps, the category of PMS providers emerges as the most competitive. The AJL Atelier's report has highlighted that out of 400 providers, 150 offer PMS

solutions (AJL Atelier, 2023), and the Wheelhouse map features 29 providers out of 170 who specialize in PMS offerings (Wheelhouse, 2023). It was interesting to see in the AJL Atelier report that there are many types of all-in-one PMS providers. For example, there are PMS with a channel manager; PMS with a channel manager and revenue manager; PMS with a website builder, and PMS providers that were hotel-focused and became hybrid providers.

Another piece of essential technology for STR property managers is the Channel Manager (Cocola-Gant *et al.*, 2021). Channel management software is the second most adopted technology. 74% of property managers use it (Transparent Intelligence, 2023b). They need a channel manager to effectively manage multiple distribution channels and ensure maximum visibility for their properties (Host B2B, 2021). Most PMSs now on the market have built-in channel management functionalities (AJL Atelier, 2023). However, one notable finding from Rentals United is that property managers often opt to outsource the complex task of channel management rather than developing in-house solutions. 57% of property managers use an external Channel Manager in conjunction with their PMS. Usually, these specialized Channel Managers have better channel connections and have partnerships with major OTAs (Rentals United, 2020).

Among the various technologies, keyless entry systems in 2023 have experienced the most significant surge in adoption. 64% of respondents from the Transparents' survey indicated that they use keyless entry technology, and once again, property managers with 100+ properties demonstrated the highest likelihood of adoption (Transparent Intelligence, 2023b). Furthermore, in Vrtech and AJL Atelier's industry technology map (Vrtech, 2021; AJL Atelier, 2023), there are currently a lot of keyless entry providers on the market, confirming that this segment is booming. City relay CEO (Rentals United, 2019a) asserts that keyless locks are great and should be considered a must, despite the challenges of implementation, especially in large cities. However, Sykes CEO has shared that keyless access is not necessary for all the property managers because some guests still like face-to-face interactions (Rentals United, 2019c). Ortegon, as the industry advisor also states that these home automation tools can improve guest safety and provide a better experience (Host B2B, 2021), just like the conclusion from Law *et al.*'s study (2020). Hence more and more property managers are implementing these.

Among the STR property managers who participated in the Transparent survey of 2023, 59% reported using dynamic pricing tools, a technology that also experienced growth in adoption rate. The report observed varying levels of adoption across different factors, such as portfolio size and location. Consistently, they noticed a trend of increased adoption with larger property management operations. Property managers not only use them they also build these technologies internally

(Cocola-Gant *et al.*, 2021). Sykes Holiday Cottages has 14 people in the revenue management department, and they built their yield management model in 2 years (Rentals United, 2019c). Evolve CEO (Rentals United, 2021a) shares that the dynamic pricing tool, in his opinion, changed the industry the most because it helped to grow revenue. However, revenue management is about more than just technology. At Evolve, they also have revenue managers who analyze the data and adjust the data calculated because there are still details that technology cannot pick up yet.

Additionally, the usage of data analysis providers has seen a remarkable rise globally (Göppinger and Luque, 2022; Transparent Intelligence and Rentals United, 2022). A data provider is a comprehensive platform that offers insights and intelligence for the short-term rental industry, it is adopted from PropTech (Göppinger and Luque, 2022). Unlike a dynamic pricing tool, which concentrates on optimizing pricing strategies using real-time data to maximize revenue, a data provider tool primarily serves to provide a wide range of datasets and information for analysis and decision-making. These tools can complement each other in a business's overall strategy, with dynamic pricing tools utilizing data from data provider tools to make well-informed pricing decisions (Friedman, 2022).

Transparent's 2023 report states that property managers with 100 or more properties are more inclined to invest in data providers, and the likelihood of utilizing such services decreases with the size of their operation. Property managers who actively engage with data to inform their strategies experienced an impressive average revenue growth of 85%, whereas their non-adopting counterparts only achieved a growth rate of 49% (Transparent Intelligence, 2023b). As the CEO of Sykes Holiday Cottages (Rentals United, 2019c) states, "It is all data-driven (STR business), and that's the thing. It is all about how we turn data into insight then into action".

#### 4.1.2.3 *Guest Experience technologies*

The technologies highlighted in the above subsection correspond with those examined in the literature review of STR technologies, encompassing PMS, channel manager, dynamic pricing tools, data providers, and keyless solutions, thereby making a substantial academic contribution. The technologies discussed in this segment of guest experience technologies are those that have not yet been academically explored.

The CEO of Sykes Holiday Cottages and Feriepartner both share that property managers need to invest in technology because guests' needs are changing (Rentals United, 2019b, 2019c). Furthermore,

numerous emerging teams are consistently crafting remarkable technological innovations. This sentiment is echoed by the authors of Wheelhouse (Wheelhouse, 2023b), who wrote that creating a STR software market map can be challenging, as it may already appear somewhat outdated at the time of writing.

The industry currently spots importance and growth in guest experience digital solutions (AJL Atelier, 2022). At the start of the property management businesses, companies usually paid little attention to these technologies because it was not the thing that was needed the most (Rentals United, 2021a). However, as businesses scale up, property managers gradually start paying more attention to these technologies, as they become essential to the growth and branding of the company. Guest experience technology can help property managers optimize guest retention, deliver a consistent world-class experience, and grow revenue (AJL Atelier, 2022). This progression aligns with the digital development paths observed in the hotel industry. As identified through the literature review, once the hotel industry achieved operational efficiency and established reliable distribution systems, they began leveraging technology to enhance the guest experience (Pelet, Lick and Taieb, 2021).

Ortegon, in his speech, mentions that smart locks, home automation solutions, 3D tours, chatbots, intelligent concierge services, and noise monitoring solutions are emerging technologies, and they all have to do with guest experience (Host B2B, 2021). Furthermore, both Vrtech (2021) and AJL Atelier (2023) spot an increase in innovation and a focus on customer experience technologies, such as access control and automation technologies.

According to research conducted by Rentals United in 2020, the study revealed the adoption rates of various emergent technologies, which have to do with guest experience, among property managers. Around 13% of property managers had implemented chatbot systems to provide automated customer support and answer frequently asked questions. Approximately 12% of property managers had integrated home automation solutions into their rental properties. These technologies include smart devices and systems that enhance comfort, convenience, and energy efficiency. Roughly 9% of property managers had adopted noise control devices in their rental properties. These devices help mitigate noise disturbances and ensure a peaceful environment for guests.

A small percentage, about 3% of property managers, had implemented voice concierge services (Rentals United, 2020). These services utilize voice-controlled assistants to provide information, recommendations, and assistance to guests. CEO of Sykes Holiday Cottages and CEO of Feriepartner on the Secret Sauce Podcast (Rentals United, 2019c, 2019b) both stated that voice-activated travel assistance would be a must in the future of the short-term rental industry, whether in the property or

just user-based platforms. Sykes Holiday Cottages is investing a lot of time and money into better-utilizing voice in properties and home searching processes. In the opposite opinion, the City Relay CEO (Rentals United, 2019a) does not think that robot voice assistance is necessary as human interaction is more important.

Other guest experience technologies include guest apps and conversion rate optimization tools. Evolve Vacation Rental CEO shares that they have a Guest App (Rentals United, 2021a), where guests can manage their reservations and purchase other guest services. Additionally, Evolve strives to make the app much more robust and drive a more prominent mobile presence. Conversion rate optimization tools (CRO) are designed to enhance user experience and increase the conversion of website visitors into paying customers, it is a tool frequently used in the hotel industry (Nazir *et al.*, 2023). Sykes Holiday Rentals, for instance, has developed its own CRO tool, which provides testing and visualization features to improve the overall user experience (Rentals United, 2019c). CRO tools work in conjunction with digital analytics software to track visitor behavior and gather valuable insights. By analyzing user interactions, businesses can identify areas for improvement and implement changes that lead to higher conversion rates (Nazir *et al.*, 2023).

#### 4.1.2.4 Consolidation and fragmentation

One primary trend in the industry is the consolidation of STR property management companies, which are acquiring smaller players or merging with each other to gain economies of scale, access to more distribution channels, and better operational efficiency (Hostaway, 2021). Rentals United's host shared in the podcast that STR management companies are craving more properties in their portfolio, and acquisition is the fastest way to grow (Rentals United, 2019c). In the US, very big consolidations of property management companies are currently happening. These are power brands that are looking to take over. One notable example is the growth strategy implemented by Vacasa (a leading property management company in the U.S.) which involved the acquisition of over 200 local management companies across the country (Masson, 2022).

The CEO of Sykes Holiday Cottages (Rentals United, 2019c) acknowledges their active role in industry consolidation. They actively seek out promising businesses and technologies worldwide to enhance their platform and provide added value. Sykes Holiday Cottages follows a growth strategy through acquisition, targeting small local property managers with exceptional accommodations and locations. Upon acquisition, Sykes retains the brand and personnel of the acquired company, offering them

access to Sykes technologies such as PMS and revenue management tools. Additionally, Sykes assists in developing a new and improved website for the acquired company that integrates with the Sykes database and distribution channels. Feriepartner. dk (2019b) shares a similar business model in Denmark. They operate a Feriepartner academy that provides training on the technology offered, including booking and task planner tools, to their local partners.

CEO of Sykes Holiday Cottage and Feriepartner believe consolidation within the property management industry can benefit guests (2019c, 2019b). According to the CEO of Sykes Holiday Cottage, larger companies can offer standardized and professional services that individual hosts may struggle to provide, including exceptional guest service. The CEO also predicts that larger companies will continue to grow while smaller players may face challenges (Rentals United, 2019c).

However, City Relay's CEO (Rentals United, 2019a) has a different perspective. While acknowledging the presence of consolidation, the CEO believes that the short-term rental industry is community-based and requires local expertise. He argues that non-local businesses acquiring companies from different locations may need more efficient management and understanding of the local market. He sees consolidation in the property management industry as potentially detrimental to guests. He values the importance of being local in this business, as it allows property managers to understand and provide personalized services. The CEO cites examples of clients who prefer working with smaller companies, as larger companies may lose personal touch and control over service quality.

Furthermore, Hostaways' (2021) blog post states that the ongoing consolidation within the overall industry poses potential risks such as reduced innovation, increased prices, and lower levels of customer service. When companies undergo mergers and acquisitions, they often prioritize operational savings and synergies, which can negatively affect customers. This pattern has been observed in the case of Streamline and Liverez, PMS companies, which were both acquired by Inhabit IQ a larger PMS company (Hinote, 2021). Inhabit IQ introduced a new pricing model for the PMSs within its portfolio, resulting in higher software expenses for its customers. If the trend continues, customers might experience declining customer service, limited innovation, and rising expenses.

In terms of technology providers, larger technology companies have also acquired smaller, specialized firms to expand their service offerings and enhance market share. The STR industry has undergone a significant transformation from a linear model to a more interconnected and collaborative model, as explained by Lehmann (2020). In the keynote, he discusses the evolution of the STR ecosystem and that there is an increase in competitiveness in the industry, impacting both supply and demand. He created a visual representation illustrating the intricate interconnections among various stakeholders

in the STR industry, with property managers as a pivotal role in bridging property owners and guests. The graph then highlights the technologies employed by property managers, including PMS, distribution platforms, and other tools, which contribute to the heightened complexity of this ecosystem. With this, he states there is fragmentation in the technological part of the industry due to various software solutions in the market, each offering specific functionalities (Lehmann, 2020).

In Enso Connect and their guests' webinar (Barak, 2023), they discuss the negative impact of fragmented technology on operations and guest experiences. For example, technology fragmentation poses challenges for property managers who must navigate and integrate multiple platforms. The lack of communication between systems often results in property managers having numerous logins to access third-party tools. As stated by guest speaker Whyte, the current emphasis within STR technologies should center on innovation, aiming to interconnect various technological components and streamline business scalability. Speakers also state that another approach to overcome fragmentation is for companies to build their own technology solutions tailored to their specific needs. However, this option is typically more feasible for larger companies.

Integration and connectivity among various technology solutions are emphasized by stakeholders to overcome challenges and support the growth of the hospitality industry (Law *et al.*, 2020; AJL Atelier, 2023; Barak, 2023). In the STR technology sector, integration involves seamlessly linking different systems for efficient data sharing and enhanced functionality. Examples include integrating a PMS with a channel manager to synchronize property information across platforms, connecting smart locks with guest communication tools for streamlined check-in, and linking accounting software with a PMS to automate financial tracking. Throughout the secondary research, I spotted that many all-in-one PMSs can perfectly integrate with other third-party technology providers. Furthermore, connection providers such as Operto and Enso Connect are also emerging to solve these issues. Hence, the problem of fragmentation is slowly being solved.

According to Enso Connect's podcast episode (Barak, 2023), software companies in this space must offer full-service offerings to meet the demand. The technology providers and STR brands that adapt quickly to changing consumer expectations and use unified solutions will come out on top. Lehmann (2020) strongly believes that the STR technology sector's fragmentation will result in consolidation. Players with specialized digital solutions will eventually want to expand their value propositions, for example, smart lock companies are moving into the home automation sector (Operto, 2023). Enso Connect and speakers (Barak, 2023) suggest that consolidation is necessary to meet the increasing consumer expectations and industry standards for alternative accommodations.

### 4.1.3 Industry player's articles on STR "tech stack" recommendations

Many third-party technology service providers in the short-term rental industry have websites and resource pages where they post their blogs and articles. Creating a "tech stack" is one of the first steps a vacation rental property manager should consider at the beginning of their business. The term "tech stack" for short-term rental property managers refers to the combination of technologies and software applications that are utilized to manage and operate their rental properties (Magyar, 2021b). Big players have shared "tech stack" recommendation articles in order to help with new joiners or improve the "tech stack" of existing businesses. These articles are useful to identify the list of technologies that STR property managers will use. See Table 10 for the "tech stack" recommendations from top technology providers in the vacation rental industry.

It is important to note that the specific technologies recommended for property managers may vary depending on factors such as the property management company's size, the properties' location, and the target guest demographics (The Accommodation Show by iBooked.Online, 2022).

Technology	Rentals United (CM)	Operto (Home automation)	Hostaway (PMS)	Rented (PMS)	Hostfully (PMS)	Wheelhouse (RM)
Property management system	X	X	X	X	X	X
Channel management	X	X	X	X	X	X
Revenue management	X	X	X	X	X	X
Guest experience (e.g. Chatbot, digital guidebook)	X				X	X
Home automation (e.g. Smart locks, noise monitoring)	X	X			X	X
Cleaning and maintenance	X	X			X	X
Market and data intelligence	X					X
Insurance and ID verification	X	X			X	
Digital check-in		X				
Customer relationship management			X	X		
Accounting			X	X	X	X
Email collection				X		
Marketing tools (Direct booking tool)				X	X	X
Digital guidebooks					X	X

Table 10 – “Tech Stack” examples from STR service providers

Source: Own elaboration based on Friedman, 2022; Hostaway, n.d.; Hostfully, 2022; Magyar, 2021; Operto, 2022; Rented., 2021:

The technology recommendations provided by these established service providers reflect their experience and expertise in the short-term rental industry. The most highly recommended software in the vacation rental industry includes channel managers, property management systems (PMS), revenue management tools, and home automation software like keyless entry systems. These findings align with the Transparent report (2023b), which identifies these as “fundamental” technologies for property managers. The discrepancy here is that service providers did not recommend the data analysis tools much.

Apart from recommendations from technology providers, The Urban Butler, a property management company from New Zealand, shared his “tech stack” and recommendations. The Urban Butler shared with iBooked.Online in an interview (The Accommodation Show by iBooked.Online, 2022), that they utilize Guesty as their all-in-one software solution, which encompasses various functionalities such as a PMS, Channel Management System, guest messaging software, task management tool, and an app for communication with staff regarding cleaning and maintenance management. Guesty also provides a data analytics tool allowing property managers to analyze their company's past data for insights and

decision-making. Initially, The Urban Butler did not utilize the data analysis tool extensively, but after the COVID-19 pandemic, they found it extremely valuable for their business. They have also developed their own website and incorporated the Guesty API plugin to enable direct bookings. Furthermore, like Hostaway and Rented (Hostaway, no date; Rented, 2021), The Urban Butler also recommends property managers employ Customer Relationship Management (CRM) software to gather guest data and facilitate a seamless guest experience.

Comparing Urban Butler's "tech stack" with recommendations from Table 10, he did not mention the software of Guest verification software, Digital check-in, Accounting, and Email collection. However, he uses 360 virtual tour software to provide property walkthrough videos for potential guests from far away, which none of the service providers recommended.

Many industry players recommend keyless locks, cleaning and maintenance management software, and accounting software (Friedman, 2022; Hostfully, 2022; Magyar, 2021; Operto, 2022). Keyless locks, for instance, are advised due to their ability to streamline guest check-in and check-out processes, bolster security measures through advanced access control, and enhance overall operational efficiency by expediting property turnovers (Operto, 2022). Complementary to this, the integration of cleaning and maintenance management software is encouraged, primarily for its capacity to centralize scheduling, ensuring systematic and timely property upkeep between guest stays. This, in turn, contributes to elevated guest satisfaction by maintaining high standards of cleanliness and functionality (Friedman, 2022). Furthermore, industry professionals stress the adoption of accounting software. This software aids in revenue tracking, expense management, and tax compliance, offering comprehensive insights that empower well-informed decision-making and safeguarding against potential legal and financial complexities (Hostfully, 2022). Many of these solutions on the market now can connect to the PMSs through connection providers such as Operto (Operto, 2023).

#### **4.1.4 Conclusion**

In conclusion, the short-term rental industry has undergone rapid growth and significant technological advancements in recent times. Sykes CEO (Rentals United, 2019c) confirms that STR's management business is technology driven. Secondary research highlights the escalating adoption of digital solutions by property managers to enhance operational efficiency and maintain a competitive edge.

Some property managers develop proprietary in-house tools, while others outsource specific functions to specialized third-party providers.

This study has identified a comprehensive array of 23 software technologies and 13 gadgets, compiled in Tables 8 and 9, showcasing the extensive toolkit employed by property managers. This underscores the industry's innovative attitude and emphasizes the importance of technology in the successful management of STR businesses. PMS, channel management, dynamic pricing tools, data collection systems, and smart locks have emerged as essential technologies as proven by both academic and industry players.

A significant trend within the STR industry is the emphasis on guest experience technologies (AJL Atelier, 2022). Property managers increasingly recognize the strategic value of deploying innovative solutions to heighten guest satisfaction, optimize operations, and drive revenue growth. The market map of these technologies is continually evolving, with newer teams constantly developing impressive advancements (Wheelhouse, 2023b). The industry is also witnessing consolidation, with larger entities growing further, yet the complex technological ecosystem has also led to market fragmentation (Lehmann, 2020; Hostaway, 2021). As more and more technology started to emerge, the need for a unified, integrated solution has become evident (Barak, 2023). The prevailing trend is toward integration and connectivity, demonstrated by the rise of all-in-one PMS solutions that seamlessly integrate various operational and guest experience tools. Lehmann's (2020) perspective highlights that technology companies are expanding their value propositions, underlining the drive for comprehensive integration.

In this dynamic environment, property managers must remain informed of the latest trends and innovations within the STR industry to make the right decisions regarding technology adoption. Technology providers play a pivotal role, offering resources that enable property owners to enhance their "tech stack." These recommendations, drawn from the wealth of experience within the technology service sector, guide property managers in identifying technologies best suited to their unique STR businesses.

In summary, technology continues to drive significant changes and innovations in the short-term rental industry. Property managers are increasingly adopting fundamental technologies to stay competitive and meet guest expectations. As the industry grows, challenges related to consolidation, fragmentation, and guest experience will require continuous innovation and integrated solutions to ensure sustainable growth and enhanced service delivery. It is evident that technology will remain a

critical factor in shaping the future of the short-term rental industry. These insights form a robust foundation for future research and analysis in subsequent stages of this dissertation.

## 4.2 Interviews

This section will examine the discoveries made during the interviews. By analyzing the interview data, I uncovered crucial information regarding the technologies employed by property managers and the features that participants found particularly beneficial.

This section begins by discussing the findings related to the topic of integration, which emerged prominently during both the secondary research and the interviews. The theme of integration not only holds significant importance in the industry but also serves as a crucial foundation for the understanding of the next sections, where I will extensively discuss integrated and connected technologies.

Following that, a comprehensive table is presented, summarizing the various technologies utilized by the participants in their day-to-day operations. The section is further divided into subsections, each focusing on a specific technology which allows for a thorough exploration of why and how the participants employ the technologies. In addition, my interviews with STR software companies have unveiled additional valuable features of the technologies, some of which property managers may not have mentioned in their interviews. This inclusion of insights from software companies has proven to be an enlightening aspect, enriching the understanding of digital tools. By dissecting each technology separately, a comprehensive comprehension of its distinct objectives and advantages is reached. During the comprehensive exploration of these tools, I conducted comparisons between the information gathered through secondary research and the statements provided by property managers. This comparative analysis aims to illuminate any discrepancies between the actual experiences of the users and the information available from online sources.

### 4.2.1 Integration

The topic of integration was prominently emphasized in the secondary sources, particularly in the section addressing consolidation and fragmentation within the industry. Industry players have suggested that integration is the best solution for resolving the fragmented state of STR technology (Barak, 2023). Moreover, many of the technologies to be presented in the following section are integrated solutions such as all-in-one PMS, making it a relevant topic to grasp and understand before delving into the various technologies.

Operto and Enso Connect are two software companies that work on integration and connection solutions, especially helping property managers connect third-party software to their PMSs. According to the secondary research and confirmed by the participants from Operto and Enso Connect during my interview with them, it is evident that the technology industry in STR is highly fragmented. The participant from Enso Connect highlighted that the reason behind this fragmentation is the diverse nature of vacation rental property management. Each company operates with varying portfolio sizes, different property types, and locations, resulting in distinct needs for technology solutions. The interviewee from Enso Connect emphasized that without effective communication and collaboration among tech companies, fragmentation becomes inevitable, leading to the emergence of numerous isolated systems. Therefore, integrating and connecting different software solutions are crucial in the industry. During my interview, I learned that companies such as Operto and Enso Connect play a significant role in the industry by bridging the gap between these fragmented systems. They provide solutions that seamlessly integrate various software applications and gadgets into the property manager's PMS, enabling property managers to utilize their technology stack efficiently.

An Application Programming Interface (API) acts as a tunnel between two systems, facilitating the exchange of information in one or both directions (Helmond, 2015). APIs enable software to share their data with other applications and developers for various purposes. Enso Connect's participant extensively discussed the concept of APIs during the interview, emphasizing that "Every system in the world has an API, but it's just that some expose it, and some don't. For example, we have a system with information, and if you call our API, you can access that information, but whether we make our API available is up to us."

Hostify, as an all-in-one PMS software company, their participant also disclosed that they have their own API to establish connections with various distribution channels. The participant emphasized that online travel agencies (OTA) offer official APIs, such as Airbnb's API. For PMS companies aiming to integrate with OTA platforms and operate as channel managers, it is imperative to utilize the official APIs provided by each specific channel. This ensures a reliable and secure connection between the PMS and the distribution channels. The custom API developed by PMS companies serves as a middleware or bridge between their PMS and various distribution channels, streamlining the integration process and delivering added value to their clients. Hostify's participant stated that their API is designed to be very open, enabling adaptation for integration with other partners. For example, they can connect to other third-party software such as PriceLabs for dynamic pricing (2023) and Duve for Guest Management purposes (2023).

According to the Rentals United report (Rentals United, 2020), a channel manager is a complex technology that requires integration with APIs from multiple channels. Rentals United, for instance, addresses this challenge by offering its own robust API that connects to various platforms. The participant from Rentals United stated that as they are a software company specialized in channel manager, they can connect to over 60 channels.

Developing and maintaining such an API demands technical expertise, resources, and ongoing support, making it a significant undertaking for an all-in-one PMS company. For example, Hostify has its own API and only focuses on integrating with Airbnb, Booking.com, Vrbo, Expedia, and TripAdvisor, the participant said that for them “It is better to focus on only a few channels, do them really well and understand exactly how to work with them”. Like this, they can use the resources and technical expertise also on other functions.

Moving on to connections to third-party guest experience solutions, which have seen significant growth according to AJL Atelier (2022). Integration companies like Enso Connect and Operto have experienced a surge in business demand, particularly after the COVID-19 pandemic. The participant from Enso Connect highlighted that the pandemic presented an opportunity for digital guest experiences as people preferred contactless interactions. However, implementing a digital experience in the vacation rental segment posed challenges due to its fragmented nature. As a result, property managers began seeking solutions to connect guest experience technologies with their PMS to automate tasks and improve operational efficiency. These integration companies have embraced partnerships with hotels, evolving into hybrid providers. As highlighted by the participant from Operto, for example, their services now cater to both professional STR companies and hotels. This is due to the growing resemblance between these two industries, marked by shared attributes like standardized cleaning protocols, guest communication practices, and aligned guest experience expectations.

The primary solutions offered by Enso Connect and Operto revolve around assisting property managers in linking their PMS with various guest experience solutions available in the market through their APIs. This integration results in the creation of a distinctive all-in-one PMS. For example, property managers can use Enso Connect or Operto to integrate their PMS with smart lock systems and automatically send key codes to the guests rather than dealing with isolated solutions or building integrations. Both Enso Connect and Operto need to connect to property managers’ PMSs as they require real-time reservation details such as guest name, date, and location to pass this information on to third-party guest experience solutions. The interviewee from Operto stated that they can

seamlessly connect 60 PMS to guest experience solutions such as 14 smart lock providers as well as other digital check-in apps, smart thermostats, noise monitors, and guest verification software.

Overall, as discussed in the secondary research, in the competitive and diverse STR property management landscape, integrating different software solutions becomes crucial. It allows property managers to enhance operational efficiency and deliver added value to their clients. During the interviews, I was able to understand more in-depth the technical side of the integrations such as understanding that Application Programming Interfaces (APIs) play a crucial role in enabling communication between systems and facilitating data exchange. Furthermore, I learned that most of the software companies in the STR industry have an API so more and more STR technologies are now connected. With the surge of guest experience digital solutions in the industry, the integration of third-party providers with PMSs has become increasingly popular. This trend is driven by the desire for better guest experiences and enhanced operational efficiency within the realms of vacation rental and hospitality sectors. The role of Operto and Enso Connect in facilitating the seamless integration of various software applications enables property managers to optimize their technology stack efficiently. This section holds significance for comprehending the subsequent segments, as numerous technologies referenced by participants are integrated and interconnected solutions, particularly given that all participants employ all-in-one PMS platforms.

#### **4.2.2 Technologies used by property managers**

Based on the interview data, a table has been created to capture the technologies used by property manager participants (Tabel 11).

Property management company	Casas d'Almedina	Home Me	The Lisbon Concierge	+351Lisbon	Homing	Feels like home	Italian Way	Lovely Stay	Guest Ready
<b>PMS (All-in-one)</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>Channel manager</b>	Yes <sup>1</sup>	Yes <sup>1</sup>	Yes <sup>1</sup>	Yes <sup>1</sup>	Yes <sup>1</sup>	Yes <sup>3</sup>	Yes <sup>3</sup>	Yes <sup>3</sup>	Yes <sup>3</sup>
<b>Dynamic Pricing</b>	Yes <sup>1</sup>	Yes <sup>2</sup>	Yes <sup>1</sup>	No	Yes <sup>2</sup>	Yes <sup>2</sup>	Yes <sup>2</sup>	Yes <sup>3</sup>	Yes <sup>3</sup>
<b>Data Provider</b>	-	-	-	Yes	-	-	Yes	Yes <sup>3</sup>	Yes
<b>Digital Keyless access</b>	No	No	No	Yes (only some listings)	Yes (only some listings) <sup>2</sup>	Yes (only some listings)	Yes (only some listings) <sup>2</sup>	Yes (only some listings) <sup>2</sup>	Yes (only some listings) <sup>2</sup>
<b>Task Management</b>	Yes	Yes <sup>1</sup>	Yes <sup>1</sup>	Yes <sup>1</sup>	Yes <sup>2</sup>	-	Yes <sup>3</sup>	-	Yes <sup>3</sup>
<b>Guest Communication</b>	-	-	Yes <sup>1</sup>	Yes	Yes <sup>1</sup>	-	Yes <sup>3</sup>	Yes <sup>3</sup>	Yes <sup>3</sup>
<b>Internal communication</b>	No	No	Yes	No	No	-	Yes <sup>3</sup>	No	-
<b>Website and Direct Booking page</b>	Yes <sup>1</sup>	Yes <sup>1, 3</sup>	Yes	Yes <sup>1, 3</sup>	-	Yes <sup>2</sup>	-	-	Yes <sup>3</sup>
<b>Guest verification</b>	-	-	-	-	-	-	Yes <sup>3</sup>	Yes	-
<b>Payment and Accounting</b>	Yes	Yes	Yes <sup>3</sup>	Yes <sup>1</sup>	Yes <sup>1</sup>	-	Yes <sup>3</sup>		Yes <sup>3</sup>
<b>Human Resources management</b>	-	Yes	-	-	-	-	-	-	-
<b>Quality and Reputation Management</b>	-	-	-	-	-	-	Yes	-	Yes <sup>3</sup>
<b>Other in-room gadgets implemented by the company</b>	No	No	No	No	No	-	-	No	No

Key:

- : Did not share any information on this technology
- 1 : Functionality from All-in-one PMS
- 2 : Third-party tool integrated into PMS
- 3 : Technology built in-house

Table 11 - Technology used by participants.

Source: own elaboration from interviews

All of the participants use all-in-one PMS solutions, however, five of the interviewed companies use an outsourced PMS solution, while four others have developed their own in-house technology. Many property managers have integrated third-party providers into their PMS platforms, while only a few mentioned isolated technologies. These discoveries contrast with the fragmented technology landscape of operational and guest experience solutions found in the secondary sources which reveals that some players in the industry report a lack of communication between systems (Barak, 2023).

The technologies that participants described in the interviews mostly constitute features offered by all-in-one PMS solutions especially the channel manager and dynamic pricing functionality. I have divided this section into specific technologies, I will be talking about them separately although they are all-in-one PMS features. I am doing this because they were traditionally isolated technologies. This approach helps gain a deeper understanding of why the participants opt for these functionalities and how their integration has streamlined property management processes.

There were instances where some companies did not provide any information about their usage of some specific technologies. It is unclear whether these companies do not have those software solutions in place or if they simply chose not to share that information during the interviews. To reflect this, some cells in table 11 are left blank, indicating that certain companies did not share information about specific technologies.

In the subsequent sections, all the technologies will be explained from the perspective of the property managers and software companies interviewed, providing insights into their usage and significance.

#### 4.2.2.1 *Property management software*

Property Management Software (PMS) is a comprehensive tool for managing reservations, bookings, guest communication, and property listings (Cocola-Gant *et al.*, 2021). Modern PMS solutions are typically cloud-based, allowing property managers to access their systems across different devices and tablets through dedicated apps or websites. During the interviews, many participants showcased their PMS interfaces through screen sharing, providing a visual demonstration of their respective systems' functionality and user interface.

As mentioned before, all the participants in the study utilize all-in-one PMS solutions. However, out of the nine interviewed companies, five of them opted for outsourced solutions, while the remaining four have chosen to develop their in-house technology. In the vacation rental industry, many PMS solutions have evolved into all-in-one platforms, offering property managers the convenience of controlling various features within a single dashboard. This consolidation of functionalities helps save time and optimize operations (AJL Atelier, 2023).

Hostify's participant explains that as an all-in-one PMS software company, they provide a range of features such as listings and reservations management, channel connections, guest messaging, payment processing, website building capabilities, and integrations with various third-party providers like pricing tools, data providers, and guest verification tools. In addition to these standard features, some property managers who have developed their own all-in-one PMS solutions have included in-house dynamic pricing tools using their own data, like those created by Lovely Stay, one of the largest property management companies in Portugal.

The participant from Home Me, a Porto local property management company, mentioned that in the initial stages of their business, they were able to handle reservations using an Excel spreadsheet. However, as their property portfolio grew to more than ten properties, it became unmanageable to continue using this manual approach. Consequently, they decided to implement an outsourced all-in-one PMS. During the interviews, all participants expressed satisfaction with their chosen all-in-one PMS solutions. This indicates that the adoption of these comprehensive property management tools effectively addressed their needs and provided a more efficient and streamlined approach to managing their properties and reservations.

Guest Ready, a rapidly growing global STR management company, and Italianway, the largest Italian STR property management company, have developed highly advanced in-house PMS solutions, and now they have started to sell the PMS to other property managers. Guest Ready's all-in-one PMS, known as Rentals Ready, offers a range of automated tools similar to those found in typical all-in-one PMS solutions. Notably, being property managers themselves, they leverage their firsthand experience to tailor their software to the specific preferences and requirements of property managers, thereby affording more attention to these needs. The participant from Italianway, on the other hand, highlights that their PMS is particularly well-suited for the Italian market, taking into account specific reporting requirements and regulations mandated by local authorities. They emphasize their focus on API integrations, which allow seamless connectivity with other systems and software solutions.

Participants from Home Me, Lisbon Concierge, and +351Lisbon are property managers from Portugal, they stated that they use Portuguese all-in-one PMS solutions. They expressed their preference for Portuguese PMSs as they offer more features tailored to the specific needs of the STR industry in Portugal. For instance, they can automatically report guest details and tourism tax to Portuguese authorities. Home me Participant said “The PMS we have now works the best for us because it is Portuguese, and the communication was much better with the company’s customer service as they have an office here (in Portugal). It also works for us in terms of costs as its cheaper” Hence, other reasons for choosing a Portuguese PMS are the improved communication, customer service, and cost.

Other all-in-one PMS features that received significant mention among companies, were government reporting capabilities, and a user-friendly dashboard for property managers and owners. In many European countries, it is mandatory for paid accommodation establishments to register guest stays and collect identification details from both EU and non-EU citizens. All participants stated that their PMS has established direct integrations with reporting authorities and can communicate guest details automatically. This feature proves to be highly helpful for them as it streamlines the reporting process. They can set up automated messages to be sent to guests, asking them to provide their passport information, which is then directly forwarded to the relevant authorities. This automation significantly simplifies and expedites the reporting procedure, making it more efficient and hassle-free for the property managers.

Property managers highly value the user-friendly dashboard of a PMS webpage. It serves as a centralized hub where they can access essential information about their reservations and business activities. Participants from +351Lisbon emphasized the convenience of their having the PMS mobile app, which enables them to view reservation details, guest messages, and calendars directly on their mobile phones.

In addition to the property manager dashboard, these PMSs also provide a dedicated landlord dashboard and app for the operations team. For example, all participants' PMS allows landlords to log into their accounts on the PMS website to check reservation details, guest names, revenue statistics, and graphs. Furthermore, the participant from Casas D'almedina, a Lisbon local property management company, showed that they can review the duration of their clients' (landlord) activity on the webpage. This information is valuable in understanding the client's level of interest and engagement. As an additional feature, some PMSs even provide dedicated apps specifically designed for landlords, as seen in the case of Guest Ready and their landlord-

oriented PMS. However, it is important to note that owners typically cannot modify reservation data themselves, they would need to communicate with their account manager for any changes.

Participants mentioned several additional features of their all-in-one PMS that enhance task management and streamline operations. Hostify's PMS software has an app for the operations team, including cleaners and maintenance personnel. For instance, a common functionality is automatically creating cleaning tasks on the check-out date after a reservation is confirmed. This feature will be elaborated on in the task management section.

Another notable feature in some PMSs, such as Hostify, is the property creation capability. The participant from Hostify explained that property managers can create new listings directly within the PMS not requiring them to go to the OTA's website. They can add pictures, descriptions, amenities, and other details, and the PMS will then publish the property on Airbnb and VRBO. This automates the process of creating a property in every platform and improves efficiency for property managers. Hostify achieved this integration by developing its own API, allowing them to fill in the required information fields on Airbnb and VRBO. They are also working on launching a Booking.com integration for the property creation feature, which they have built from scratch.

#### 4.2.2.2 *Channel management software*

Channel management software is a valuable tool for property managers, enabling them to connect and synchronize their listings across various platforms such as Airbnb, Booking.com, and VRBO (Cocola-Gant *et al.*, 2021). Property manager participants emphasized the importance of using a channel manager to increase visibility, reach a wider audience of potential guests, and ultimately generate more profit. These channel management systems are typically also cloud-based and often integrate seamlessly with all-in-one PMS to enhance overall operational efficiency. Every participant has a channel manager integrated into their PMS, but most property managers did not delve into the specifics of the channel manager during the interviews. For them, it was considered a crucial and seamless software that efficiently handled the synchronization of calendars. Their focus mainly revolved around discussing other functions and features of their PMS.

Rentals United is a dedicated software company that specializes in channel management solutions. The participant from Rental United highlighted that once a channel manager is connected to distribution channels through an API, the software can push updates related to

content, rates, and availability. When guests make bookings on these platforms, the channel manager retrieves messaging and reservation details, enabling property managers to create customized workflows.

The Lisbon Concierge's participant shared their experience of initially using iCal to integrate calendars when they had fewer than ten apartments in 2014. iCal (iCalendar), which stands for Internet Calendaring and Scheduling Core Object Specification, allows for the synchronization of calendars between different platforms, calendaring, and scheduling applications (Mustacoglu, Wu and Fox, 2006). However, there were limitations with iCal as it only automatically refreshed every 3 hours. In order to have real-time synchronization, they had to manually refresh the calendars by clicking the "Refresh" button after receiving a booking. This reliance on iCal led to some instances of overbookings, where two reservations were made for the same property at the same time, resulting in the need to cancel one booking. They quickly transitioned to using a channel manager to avoid such issues and optimize reservation management.

During the interview, Rentals United emphasized that while many all-in-one PMS have direct connections with major channels, it can be challenging for them to integrate with a large number of channels. This is where Rentals United comes in by connecting with the PMS and offering access to its network of 60 channels. By helping PMS companies integrate with more channels, they can attract a broader range of clients (property managers). For example, Italianway has a PMS that utilizes Rentals United to connect with various distribution channels, providing Italianway with the option to list its properties on more than 60 channels.

Similar to the insight shared by the participant from Hostify, the participant from Guest Ready also expressed that channel management software is complex. In alignment with this perspective, their PMS, Rental Ready, incorporates a channel manager but with a strategic scope limited to select channels. Their primary concentration revolves around major platforms including Airbnb, VRBO, Expedia, and Booking.com, alongside niche platforms catering to upscale accommodations. It is important for them to understand how to effectively work with each channel and create a seamless connection with them.

#### 4.2.2.3 Pricing Optimization tools

Dynamic pricing software, also known as revenue management software, is a powerful tool that optimizes pricing and maximizes revenue by analyzing demand patterns, market trends, and

other influential factors related to short-term rentals (Bosma and van Doorn, 2022). Its primary purpose is to assist property owners and managers in setting competitive prices and increasing profitability. All participants use a dynamic pricing tool or a third-party data provider software that is integrated into their all-in-one PMS. Data provider tools gather valuable insights about the short-term rental market. It does not necessarily do daily calculations and updates of prices to all the platforms, it provides information such as pricing trends, guest demographics, and local competition (Cocola-Gant *et al.*, 2021). During the interviews, I found out that these data provider tools' main purpose for the property managers is to pricing insights for pricing strategies.

The participant from Italianway emphasized the significance of a revenue management tool and data provider stating “it is important together with the PMS to have a good revenue management tool. The more units you manage the more you will need to have data regarding your local competitors listing. (...) it is important to also have something like AIRDNA or PriceLabs to be able to both perform a good pricing strategy regarding the properties you manage but also in order to provide estimates to property owners (landlord).”

Among the participants, the two most frequently mentioned tools are PriceLabs (2023) for dynamic pricing and AirDNA (2023) for data analysis. The interview shows that bigger property managers use both dynamic pricing tools and data provider software. Guest Ready and Lovely Stay has both developed their own pricing optimization tool. Their IT and revenue management departments are capable of creating algorithms for price calculations and syncing them to channels. Guest Ready partners with AirDNA to access additional data resources and Lovely Stay stands out by only using their internal database, encompassing 8 years of data covering the entirety of Portugal. The participants from Lovely Stay claim that they are the sole provider in Portugal utilizing their proprietary database to generate in-depth analyses.

On the other hand, smaller property managers, utilizing a dynamic pricing tool, do not use a data provider as the dynamic pricing tool already incorporates a data collection algorithm within the software. Their dynamic pricing tools are all third-party software integrated with an all-in-one PMS. Despite utilizing dynamic pricing software, Homing and Feels Like Home, two property management companies from Lisbon, still maintain a revenue management team consisting of 2 or 3 individuals. Their responsibility involves monitoring prices on various platforms, performing their own calculations, manually comparing prices, and utilizing the dynamic pricing tool to make necessary adjustments. The digital tool serves also to automate tasks such as

updating prices, ensuring that when they update the price in the system, it gets synced across all platforms for guests.

+351 Lisbon is the only property manager that solely relies on data provider software to gain insights into pricing trends and does not use a dynamic pricing tool. Once they formulate a pricing strategy, they manually input the prices into their PMS, which then automatically synchronizes the prices across all platforms. Although this data provider software is not integrated with their PMS yet, they prefer this approach as it allows them to actively participate in the pricing strategy rather than solely relying on a dynamic pricing tool.

Every participant acknowledged the importance of using dynamic pricing software. The majority of participants express satisfaction with their dynamic pricing solutions and consider it a key factor in successful business operations and revenue growth. These comments are aligned with the findings in the secondary research stating that property managers implementing these tools see a growth in revenue (Host B2B, 2021). However, the interviewee from Homing mentioned that their dynamic pricing tool is expensive, but they firmly believe it is worth the investment.

#### 4.2.2.4 *Digital keyless access*

Digital keyless access solutions are designed to offer guests a secure and convenient way to access a property using various technologies, including smart locks, or mobile apps (Law *et al.*, 2020). These solutions eliminate the reliance on physical keys and streamline the check-in process for guests. Smart locks are also a technology that can be connected to an all-in-one PMS to create automated lock actions. As stated by Operto's participant in the interview this digital solution encompasses both software and hardware components. First, it is essential to have an Internet of Things (IoT) software infrastructure in place to ensure the smart locks remain connected to the all-in-one PMS. Then, physical smart locks need to be installed on the doors to enable seamless access control.

Secondary research indicates a growing trend in the adoption of smart locks among various industry players (Transparent Intelligence, 2023b). Enso Connect and Operto's participants also highlight that smart lock integrations are currently in high demand among property managers. However, primary research findings from the property manager's side present a different perspective. It reveals that three participants do not install smart locks in their listings. Among

those who have this technology, it becomes apparent that not all of their properties are equipped with smart locks.

Casas d'Almedina, Home Me, and The Lisbon Concierge are property management companies that do not utilize smart locks in the properties they manage. Instead, they prefer to conduct on-site check-ins to personally verify guests, obtain their identification, and provide a personalized check-in experience. This approach is particularly important for The Lisbon Concierge, as they position themselves as a premium management service. The other two company's participants mentioned that their small size makes smart locks unnecessary. Additionally, as their listings are in close proximity, they can easily assign check-in staff to deliver keys.

Throughout the interview the 6 participants that use a digital lock mentioned that NUKI and Salto are their preferred brands. These brands are specialized STR and residential lock manufacturers and can be seamlessly integrated with their all-in-one PMS. These smart lock systems can be operated through a computer or a mobile app. They function in two ways, the first way is when a guest arrives at the apartment, they contact the management company, and the welcome team assists them over the phone. The team then uses the smart lock software to remotely open the door and provides the guest with a code for access. The other way is by automatically sending a link with a unique code to the guest as their check-in time approaches. Each new check-in is assigned a new code to ensure safety and security.

Although these 6 companies do not have smart locks in all their listings, some still expressed the usefulness of these technologies. For example, the participant from Lovely Stay said, "We are currently striving for keyless access, because before we had in-person check-in but once we grew too big, there was not enough human resources to deliver the keys." To avoid the extra cost of manpower and offer a self-check-in experience, some companies have begun implementing smart locks. Furthermore, during the interview, the interviewee from Homing mentioned that, in collaboration with their account manager at Booking.com, they have noticed a significant trend among guests using the "self-check-in" filter when searching for apartments. This indicates a growing preference for self-check-in options, where guests can access the property without having to engage with the management company or owner.

These participants stated that the cost of the smart lock itself is borne by the landlords, while the management company covers the installation expenses. Companies such as Homing, Lovely Stay, Guest Ready, and Italianway connect the installed smart locks to their PMS once they are in place. During the onboarding process with landlords, the participants present the option of

installing a smart lock and highly recommend its implementation based on considerations of operational efficiency. They emphasize the benefits that smart locks can bring to the management and guest experience. Certainly, after setting the locks up, landlords are granted permission to use the smart lock app to open the door.

However, the participants highlighted various limitations associated with the installation of smart locks. The participants from +351 Lisbon, Homing, and Italianway mentioned that smart locks cannot be installed in all houses due to factors such as the house's condition, location, and building structure. In the case of old houses, the doors may not be suitable for smart lock installation, making it challenging to adopt this technology.

Furthermore, participants emphasized that smart locks rely on Internet of Things (IoT) technology and Wi-Fi connectivity. If the Wi-Fi connection fails, it can disrupt the functionality of the smart locks. This limitation applies to all smart locks in general, as they operate as all-in-one cloud-based smart access solutions designed for residential living.

#### 4.2.2.5 *Task management software*

Task management software is utilized to schedule and oversee cleaning and maintenance tasks for properties (Friedman, 2022). Here I find a discrepancy between the primary and secondary research. Secondary sources find that task management software is not considered fundamental by property managers (Transparent Intelligence, 2023b) whereas, in my primary research, the participants consider this tool very important. The majority of participants mentioned that they use some form of digital task management tool and most of them are integrated solutions from their all-in-one PMS.

The property managers I interviewed state that they do not use third-party technology that is specialized for task management. Instead, they utilize the task management solution developed by their all-in-one PMS or an in-house solution developed by their own IT department. These PMS task management solutions generally provide an app specifically designed for the operations team. Through this app, the operations team members, including cleaners, can have access to listing details, checklists, and due dates, upload before-and-after photos, and mark tasks as completed. However, pricing or financial details are typically excluded. During the interview, Operto's participant explained that their software, Operto Teams, seamlessly integrates with property managers' PMS, aiming to automate various tasks. For example, it

automatically generates cleaning schedules upon check-out times. The software efficiently organizes tasks, including priority assignments, and employee responsibilities.

Hostify, as a PMS provider, offers two separate apps—one for property managers and another for the operations team, including cleaners and maintenance staff. To communicate with cleaners, automated messages are sent through SMS rather than using the app, as cleaners may not be tech-savvy. The automation process involves sending checklists, time, and location details directly to their mobile phones.

Interestingly, six out of nine participants explained that their primary mode of communication with cleaners, as well as among the cleaning team members, is through WhatsApp. For instance, at Lovely Stay and Home Me, cleaners have access to the PMS, and the operations director plans the cleanings. However, internal communication is predominantly carried out via WhatsApp, as it is considered a more convenient and efficient method of communication.

Home Me distinguishes itself as a property management company explicitly asserting that they do not use any task management tools. The participant mentioned that although their PMS includes a task management feature, they do not use it due to their small scale, as the cost does not justify its implementation. Casas d'Almedina, for the same reason, opted for a third-party scheduling tool, the participant said “Our PMS has a cleaning management tool integrated but we only have a few apartments, so we feel that is too expensive to have this feature as PMS charges the fees per month and per apartment. So, we use a third-party scheduling software which we schedule cleaning tasks manually and for free. This software also has an APP I can easily open the app to see my cleaning schedule.”

#### *4.2.2.6 Guest communication and Reputation management software*

Guest messaging systems are crucial as they are the primary means of communication with guests. All-in-one PMS solutions like Hostify offer various messaging options, including channel messaging, WhatsApp integration, email, and SMS. According to the participant from The Lisbon Concierge, their PMS is connected to Airbnb and other platforms through an API, allowing messages sent from the PMS to reach Airbnb for guest communication. These messaging features often include automation, scheduled messages, and customizable templates tailored to each apartment.

It is important to note that establishing a connection between the PMS and distribution channels is necessary to enable guest messaging features. However, some PMS solutions may require an additional fee for this feature. For instance, the participant from +351 Lisbon stated that the PMS they work with charges an extra amount for direct guest communication through the PMS. The interviewee from Homing mentions that the PMS they use only recently developed and published the guest messaging feature, enabling their guest team to send messages directly through the PMS. However, when it comes to Airbnb, they prefer to communicate directly through Airbnb's messaging system, as it is user-friendly, and they receive the majority of their reservations through Airbnb. For other platforms, messaging is conducted through PMS for convenience.

One other tool that is associated with managing guest communication is reputation management tools, also known as reviews management tools. These tools monitor and enhance the online reputation of STR listings and companies. They track and respond to guest reviews, manage ratings, and cultivate a positive brand image, contributing to market reputation. This tool surfaced only during primary research and was not identified in secondary research. Notably, Italianway is the only participant actively utilizing this tool. This suggests its limited adoption among property managers.

Italianway employs Qualitendo, a third-party Italian software, for reputation management. Qualitendo administers pre-check-in and pre-check-out surveys triggered by guest Wi-Fi connection. This aids in feedback collection and email acquisition for future marketing (Rented, 2021). By proactively addressing concerns, Italianway mitigates potential negative reviews. They employ goodwill gestures, like gifts or calls, to resolve issues before soliciting reviews. This proactive approach fosters improved guest experiences, subsequently encouraging positive reviews.

While reputation management technology may not have been widely discussed in the secondary research, Italianway's utilization of Qualitendo showcases its proactive approach to managing its online reputation and guest experiences. It is possible that other property managers may not be aware of or have yet to explore the benefits of reputation management tools in their operations.

#### 4.2.2.7 *Website and direct booking page*

In today's digitally driven world, having a company website is immensely crucial, serving as a fundamental pillar of establishing an online presence. Throughout the interviews, when I asked the participants to describe their websites, a recurring topic was their direct booking page. This is because most property managers enable direct bookings through their website. Lovely Stay's participant expressed their preference for direct bookings as these reservations allow them to avoid OTA commission fees. The participant stated that they strive to optimize their website, aiming to make it more user-friendly.

Every participant that has a direct booking page highlighted its seamless integration through an API with their PMS. It is a feature directly provided by the PMS. This strategic integration guarantees that reservations originating from the direct booking page are promptly synchronized with the calendars of other platforms.

The Lisbon Concierge stands out as an exception, as they do not have a dedicated direct booking page. Their primary focus lies in property management and distribution through various channels. Consequently, their website primarily serves as a platform to attract potential landlords and assist property owners.

#### 4.2.2.8 *Guest verification software*

Guest verification software, also known as guest screening software, is a digital tool that plays a crucial role in protecting the company and property by verifying the identity of guests and conducting background checks. This was a tool recommended by some industry players in their blogs to STR property managers (Magyar, 2021b; Hostfully, 2022; Operto, 2022). While only two property managers mentioned this software during the interviews, they both highlighted the significance of using third-party software specifically designed for guest verification. This software is seamlessly integrated with their property management systems (PMS) to enhance the check-in processes.

Operto, for instance, collaborates with guest verification companies and emphasizes the integration of such software into their digital check-in systems. The guest's profile is thoroughly analyzed across various platforms to detect any anomalies. This software conducts checks of guest data such as linked online profiles, phone numbers, and email addresses through

authoritative databases. They are looking to prevent problematic guests that might cause danger or damage to the property and its surroundings. Additionally, guests are requested to upload their identification documents and provide a biometric picture. If there is a discrepancy or a poor match, the check-in process is deemed invalid, ensuring enhanced security measures for the property and the company.

In early 2023, Airbnb required all users to verify their identity before booking a reservation on its platform. For every booking, the guest needs to upload their government ID and sometimes a selfie matching the ID photo (Airbnb, 2023b). Even though Airbnb has its own ID check process, property management companies still verify guests using partner software for internal purposes. The participants shared that guest verification software is an essential component of the check-in process, ensuring a safer and more reliable experience for property managers and guests alike.

#### 4.2.2.9 *Payment and accounting software*

Payment software is a digital tool designed to handle financial transactions, including accepting payments and processing refunds. This software is particularly useful when property managers need to collect direct payments from guests. Rentals United report (Rentals United, 2020) was the only one that mentioned this technology.

During the interviews, the participants from +351 Lisbon and Italianway shared that they utilize payment software, which is integrated into their website reservation page, to facilitate direct payments from guests. These software solutions provide a point-of-sale (POS) app that allows guests to make payments directly in the apartment using their credit cards with a staff member. This feature ensures convenience and flexibility for guests, whether it's for security deposits, additional services, or any other payment requirements. Moreover, the software can generate payment links, enabling property managers to send payment requests to guests. With payment software, property managers can process payments securely and efficiently, regardless of the location, providing a seamless and convenient experience for both guests and property owners.

Three property managers mentioned using third-party accounting software in their day-to-day operations. This software is instrumental in managing financial statements, receipts, and invoices. The participant from The Lisbon Concierge specifically mentioned that the software

assists with accounting and provides valuable statistics, such as average costs and expenditures on products and labor per apartment.

It is not a tool directly involved in the operational aspects of property management. However, it plays a crucial role in maintaining accurate financial records and analyzing financial data for the property manager's business. During the secondary research, four out of six industry players mentioned that accounting software is a must-have (Hostaway, no date; Rented, 2021; Friedman, 2022; Hostfully, 2022).

#### *4.2.2.10 Human resources software*

Human resources software is to manage employee information, track attendance and time-off, handle payroll, and holidays, and streamline HR-related tasks within the short-term rental management company. This software helps in effectively managing the company's workforce and HR operations.

The software for managing holidays and staff timetables is not commonly mentioned in secondary research, likely because it is not a tool used by property managers daily. However, the participant from Home Me stated their experience with this software during the interviews. They use this particular software as a planner for managing staff holidays and sick days, providing a simple and effective solution for small teams. It is especially useful for property management companies seeking a free tool to streamline their staff scheduling processes.

#### *4.2.2.11 Other in-room gadgets*

During the interviews, property managers mentioned that they don't implement many in-room gadgets in their listings because each apartment is unique and the decision to have additional gadgets often depends on the individual property owners' preferences and willingness to incur expenses. According to the interviewee from The Lisbon Concierge, some apartments may have smart TVs or Netflix, but this is determined by the owners, and these gadgets are not directly related to the property managers' day-to-day operations. As the participant says, "some gadgets are just nice to have amenities for guests, we don't use them during our operations".

Insights from software providers also shed light on some in-room gadgets used by property managers. For instance, Enso Connect mentioned that some US property managers use smart thermostats to reset the temperature after a guest stays, considering environmental and cost purposes, as energy expenses can be significant. Operto Tech's integration with Guesty allows for improved guest comfort, savings, and sustainable stays through the use of centralized temperature-controlling AC and digital dashboards. Additionally, noise sensors can automatically send reminders to the property manager and the guest when excessive noise or parties are detected.

These in-room gadgets are guest experience solutions which have been extensively mentioned during the secondary research (AJL Atelier, 2022). However, the usage of in-room gadgets varies among property managers, with decisions being influenced by the owners, budget considerations, and the specific needs of each property.

### 4.2.3 Conclusion

In conclusion, the interviews with various property managers and software companies shed light on the key technologies and tools used in the short-term rental (STR) industry. These insights provide valuable information about the industry's operational aspects and the role of technology in streamlining processes, improving efficiency, and enhancing the guest experience.

In the secondary research, the current trending topic in the industry is that there is a fragmented technological landscape of STR operational and guest experience solutions and players are striving for more integrated and connected solutions (Barak, 2023). During the interviews I saw this phenomenon is confirmed were property managers greatly value the interconnected all-in-one PMS solutions. They empower property managers to automate tasks, optimize distribution, enhance guest communication, and drive business growth. These PMS can integrate key functionalities such as reservations management, channel management, dynamic pricing integration, guest messaging, reporting to government authorities, and user-friendly dashboards.

For smaller enterprises seeking suitable technology solutions, the abundant array of service providers in the market highlights the need to find tools with seamless integration into their PMS. This stresses the industry's emphasis on unified solutions. Conversely, larger firms possess the capability to develop in-house systems that can harmoniously integrate with their PMS. This

gives a significant advantage, granting them independence from third-party providers and allowing them to maintain complete control over internal data.

It is worth noting that while some technologies and tools were commonly used among the participants, others were specific to certain companies or not widely mentioned. This emphasizes the diverse approaches and preferences within the industry. +351 Lisbon's participant highlighted their contentment with the existing set of software they use. They believe that their reservation, calendar, platform, pricing, cleaning, maintenance, access, and payment management tools adequately meet their needs considering the size of their operations.

Cocola-Gant et al. (2021) identified in their study that PMS, channel managers, and market analysis (dynamic pricing) software are the three fundamental digital tools for the functioning of a professionalized STR property management company. The interview results underscore a significant finding: PMS, channel managers, and dynamic pricing as the three core technologies embraced by the participants. These interviews have contributed to the academic understanding of why property managers opt for these technologies and underscore their significance. Notably, the discussions highlighted that the integration of all-in-one PMS has streamlined the adoption and usability of many of these technologies.

Two tools that the participants showed the most interest and value were smart locks and task management. First, the use of smart locks was prevalent among the participants, enabling self-check-in and improving operational efficiency. However, it was noted that the suitability of smart locks varied depending on the property's age and construction. Then, the task management tool was a technology that was not very noticeable in the secondary sources. Property managers stated that task management tools were widely used to schedule and track cleaning and maintenance activities, while communication with cleaning staff often relied on applications like WhatsApp.

The interviews revealed another trend regarding the technologies is that property managers seek digital solutions that align with their local market requirements and preferences. It reflects the importance of adopting solutions that are tailored to the specific needs and regulations of the respective regions in which the property managers operate.

In conclusion, the participants all understand the importance of technology in their day-to-day operations. However, one comment made by the participant from Feels like Home stood out, they emphasized a combination of software solutions and human resources. They recognize the

value of integrating software tools to assist with various aspects of their business, while also acknowledging the essential role played by their dedicated team members. Nonetheless, as technology continues to evolve, property managers need to stay informed and leverage these solutions to stay competitive and meet the ever-changing demands of the market.



## 5 Conclusion

This dissertation provides compelling evidence of the growing adoption of technologies within the short-term rental professional property management industry. Throughout the dissertation's chapters, I have extensively explored and discussed the array of technologies employed by these property managers. This concluding chapter will share the significant findings of my research and effectively address the outlined research objectives.

The first objective of this study is to delve into the current technological landscape within the STR industry. This exploration is evident from the initial stages of secondary research, where I investigated industry reports, blogs, and online materials to understand prevalent trends. The fast-growing STR technology landscape is fueled by the emergence of larger players which demands robust software to maintain professional standards, and low entry barriers enable technological entrepreneurs to enter the market (Wheelhouse, 2023b). My research indicates that many technologies in the STR sector, like Property Management Systems (PMS) and channel managers, originated from the hotel industry, which gave the STR industry a good base to start with. Some technology service providers initially focused on hotels, have transitioned into hybrid providers for STR and vice versa. Conversely, STR's data collection tools are adopted from PropTech, as leveraging publicly available data from listing platforms for market studies is very important real estate industry (Göppinger and Luque, 2022). This finding confirms prior research, which indicated that the STR industry represents a convergence point between the hotel and real estate sectors (Cocola-Gant *et al.*, 2021). It underscores the idea that the STR industry represents a fusion of elements from both the hotel and real estate domains, highlighting the interconnectedness of these traditionally distinct sectors.

The industry reports notably illuminated the escalating embrace of “fundamental” technology by property managers. PMS, channel managers, keyless entry systems, dynamic pricing tools, and data providers have experienced notable growth in adoption rates (Transparent Intelligence and Rentals United, 2022). Impressively, market report research revealed that a substantial 75% of participating property managers have wholeheartedly embraced all five “fundamental” technologies, underlining the industry's robust technological integration (Transparent Intelligence, 2023b). Particularly noteworthy is the resurgence of PMS, securing its position as the most widely employed technology among property managers (Rentals United, 2020). However, I must mention that Transparent Intelligence is a data provider software company,

and therefore, I felt that it was their marketing technique to include data provider tools in this list.

Next, digital guest experience technology, which is booming in the industry as STR companies started to be able to focus on providing better guest experiences (AJL Atelier, 2022). Various innovative technologies, such as smart locks, 3D tours, chatbots, home automation solutions, noise control devices, and voice concierge services, are being adopted to enhance the guest experience. Keyless entry systems stand out as the most used gadget technology (Transparent Intelligence, 2023b). These systems are seamlessly integrated with PMSs and streamline the process through automated code generation. Additionally, the emergence of voice assistants is viewed by the major industry players as highly advantageous in the property and on online home searches (Rentals United, 2019c).

Consolidation within the industry emerged as another significant trend, with companies like Sykes Holiday Cottages and Feriepartner.dk (Rentals United, 2019c, 2019b) actively engaging in acquisitions to scale their business. While some see consolidation as beneficial for guests due to standardized and professionalized services, others like City Relay's CEO (Rentals United, 2019a) emphasize the importance of local knowledge and personalized service that smaller property managers can offer. Fragmentation in STR technology was also discussed as a challenge faced by property managers (Barak, 2023). The presence of multiple software solutions with specific functionalities creates complexity, and there is a growing need for integrated technology solutions to streamline processes and improve guest satisfaction. Hence integration and connection between systems became the main propriety of many property managers, this topic is then extensively explored during the interviews.

The second objective of this study involves exploring how and why property managers effectively utilize these technologies. This investigation unfolds through an in-depth analysis of the interview transcripts, where insights from property managers and software companies shed light on the pivotal role of these technologies in shaping the STR industry.

The interviews provided an illuminating glimpse into the operational dynamics, with property managers generously sharing their screens and dashboard interfaces of their PMSs. This hands-on experience unveiled a significant trend as property managers clearly expressed a strong inclination towards interconnected all-in-one PMS solutions as all of them use one. These holistic platforms are designed to streamline various facets of property management. By seamlessly integrating key functionalities such as reservations, channel management, dynamic pricing, guest messaging, and government reporting, these PMS technologies empower

property managers to effortlessly automate tasks, optimize distribution, enhance guest communication, and grow within the industry. This revelation highlights the transformative impact of interconnected PMS platforms in reshaping the STR landscape.

Among the larger property management firms I interviewed, the implementation of smart locks has been instrumental in streamlining self-check-in processes and enhancing operational efficiency. However, several participants noted the challenges of deploying smart locks on a large scale due to varying property characteristics and owner receptiveness.

The interviews revealed that cleaning and maintenance operations have emerged as pivotal aspects within the industry, necessitating dedicated technological solutions for efficient scheduling, maintaining records, and confirming task completion. Seven out of nine property managers reported using these tools, highlighting their significant importance in the industry. This finding makes this tool one of the “fundamental” technologies.

By combining insights from secondary research with the interview discoveries, I identified that the five "fundamental" technologies shaping the industry are Property Management Systems (PMS), channel managers, keyless entry systems, dynamic pricing tools, and task management tools.

The main reason for embracing digital technology lies in its capacity to enhance the efficiency of property management and commercialization, which are pivotal aspects from a business perspective. Digital tools enable property managers to automate tasks, streamline operations, and reach a global audience through online platforms like OTAs. This efficiency boost not only saves time and resources but also ensures a seamless digital experience for guests, aligning with modern expectations. Ultimately, embracing digital technology is essential for staying competitive and successful in the fast-paced short-term rental industry.

With the contemporary shift towards digital platforms, where properties are listed on OTAs and various distribution channels, property managers are compelled to pivot towards digitalization to thrive in this evolving ecosystem. Moreover, the lodging experience itself has undergone a significant digital transformation, primarily driven by younger generations often referred to as digital natives (Bhalla, Tiwari and Chowdhary, 2021). These tech-savvy users engage in every aspect of their journey through smartphones, from initial property bookings to seamless door access. In response to this evolving trend, property managers must adapt to provide a seamless and immersive digital experience to remain relevant and competitive in the short-term rental industry.

The research shows the existence of varied approaches and preferences of technology adoption within the industry, which depends on different companies. The current market offers an array of technologies, allowing property managers the flexibility to engage in trial and error until they identify the most fitting "tech stack" for their specific business needs.

The current study marks the initial step towards the integration and adoption of technology within the STR industry. In the course of secondary research, a comprehensive description comprising 36 software and gadgets was identified, presenting a wide array of technological tools. However, due to the extensive nature of this list, a detailed exploration of each technology was unfeasible within the scope of this study. Moreover, the secondary sources utilized in the research consist of publicly available marketing materials from technology companies. These materials primarily aim to attract potential customers and may lack a dedicated academic focus.

Moving forward, potential advancements in this field could entail a more targeted and focused approach. Firstly, an in-depth analysis could center on the integration of all-in-one PMS within the short-term rental industry. This comprehensive study would delve into the profound implications of integrated solutions, examining how the adoption of all-in-one PMS impacts operational efficiency, guest experiences, and overall business growth. A geographical lens could further illuminate the diverse effects of integrated systems across different regions and property types.

Secondly, a deeper exploration might concentrate on the significance of online booking channels in the STR industry. While platformization was extensively discussed in the literature review as a common theme across related industries (Shaw, 2020; Bosma, 2022), its presence in secondary research was relatively subdued due to its nature primarily as a distribution channel rather than a direct operational technology. Property managers only explained using channel managers to facilitate the distribution of their properties across multiple OTA platforms. Investigating the motivations behind this dual approach and analyzing the advantages and disadvantages of OTAs versus direct bookings could provide insights into strategic decision-making and guest preferences, enhancing our understanding of distribution dynamics within the STR industry.

Furthermore, an examination of guest perceptions and preferences about technology-driven enhancements in short-term rentals would yield valuable insights. This is a study widely done by the hotel industry with many academics focusing on the impact of technology use on guests (Jung, Sunny Kim, and Farrish, 2014; Shin and Jeong, 2022; Morosan and Dursun-Cengizci, 2023). This inquiry could delve into how technology influences booking decisions, guest satisfaction levels, and guest loyalty.

In conclusion, STR property managers are increasingly adopting technologies to stay competitive and meet guest expectations. As the industry grows, challenges related to consolidation, fragmentation, and guest experience will require continuous innovation and integrated solutions to ensure sustainable growth and enhanced service delivery. It is evident that digital technology will remain a critical factor in shaping the future of the short-term rental industry.



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