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# **The Role of Digital Platforms in Shaping the Future of Environmentally Sustainable Smart Cities**

School of Management  
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**Title of the Thesis:** The Role of Digital Platforms in Shaping the Future of Environmentally Sustainable Smart Cities  
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**Supervisor:** Ausrine Silenskyte  
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**ABSTRACT:**

This thesis analyzes the role of digital platforms in shaping the future of the environmental sustainability of smart cities. The research aims to address how digital platforms can enable innovative business models that contribute to the environmental sustainability of smart cities. The study was conducted using qualitative case study methodology. The findings suggest that digital platforms have substantial potential on environmental sustainability in smart cities. However, the effect of digital platforms on environmental sustainability is highly dependent on user engagement and adoption. Furthermore, this study contributes to a deeper understanding of digital platforms and their interlink to environmental sustainability and business development opportunities in smart cities.

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**KEYWORDS:** Digital platforms, Smart city, Sustainability, Business models, Case study

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**ABSTRAKTI:**

Tämä tutkielma tarkastelee digitaalisten alustojen roolia älykaupunkien ympäristöllisen kestävyuden muovaamisessa. Tutkimuksen tavoitteena on selvittää, kuinka digitaaliset alustat voivat mahdollistaa innovatiivisia liiketoimintamalleja, jotka edistävät älykaupunkien ympäristöllistä kestävyttä. Tutkimus toteutettiin kvalitatiivisena tapaustutkimuksena. Tulokset viittaavat siihen, että digitaaliset alustat voivat edistää ympäristöllistä kestävyttä huomattavasti älykaupungeissa. On kuitenkin huomioitava, että käyttäjien sitoutumisella ja käyttöönotto prosentilla on suuri vaikutus digitaalisten alustojen mahdollisuuksiin edistää ympäristöllistä kestävyttä älykaupungeissa. Lisäksi tutkimus syventää ymmärrystä digitaalisten alustojen ja ympäristöllisen kestävyden sekä liiketoimintakehityksen mahdollisuuksien välisestä yhteydestä älykaupungeissa.

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**KEYWORDS:** Digital platforms, Smart city, Sustainability, Business models, Case study

**Contents**

1 Introduction	7
1.1 Research questions and objectives	8
1.2 Delimitations	9
1.3 Structure of the thesis	9
2 Literature review	10
2.1 Conceptualization of digital platforms	10
2.2 Conceptualizations of Smart Cities	15
2.2 Digital Platforms and Their Contributions to Smart Cities	21
2.2.2. Digital platforms for sustainability in smart cities	34
3 Methodology	37
3.2 Research strategy	39
3.2 Research design: Comparative case study	40
3.3 Case selection	41
3.4 Data Collection	42
3.5 Data Analysis	44
3.6 Validity and Reliability	44
4 Findings	47
4.1 BlaBlaCar	48
4.2 SHARE NOW	53
4.3 Vinted	57
4.4 Comparative case analysis: Comparing the environmental sustainability impacts	60
5 Conclusion	67
5.2 Theoretical contributions	68
5.3 Practical implications	69
5.4 Limitations and implications for research	69
References	74

## Tables

Table 1. Functional classification of digital platforms.	14
Table 2. Smart city layers (Based on Zygiaris (2013)).	19
Table 3. Core areas for business development in smart cities.	31
Table 4. Case study database.	43
Table 5. Four design tests (Yin, 2014).	45
Table 6. Case digital platform's core areas for BD in SCs.	47
Table 7. CO <sub>2</sub> Emissions Savings generated by the case digital platforms.	63
Table 8. Key future research themes for BD of digital platforms specialized in smart city markets (Author's own elaboration).	70

## Abbreviations

DP	Digital platform
AI	Artificial intelligence
P2P	Peer-to-Peer
SC	Smart city
BD	Business development



## 1 Introduction

This thesis focuses on the role of digital platforms in smart cities and how they can contribute to environmental sustainability in this context. Smart cities, defined as urban areas that integrate information and communication technologies to improve urban management and enhance quality of life for citizens, are an emerging topic both in the academic and business environment (Albino et al., 2015). Cities strive to be “smarter” around the globe by implementing smart solutions to their ecosystem to reduce costs, improve sustainability, and be more efficient (European Commission, 2024). Digital platforms, defined as building blocks that provide an essential function to a technological system and serve as a foundation upon which products, technologies, or services can be developed (Spagnoletti et al., 2015). Digital platforms enable innovative ways of promoting sustainable business development opportunities in smart cities and they can connect various actors within the smart city ecosystems. Most of the literature in the field has focused on other technologies such as IoT when considering how technology can make cities “smarter”. Digital platforms have not been studied as much by scholars in the field. Therefore, it is essential to study how digital platforms can contribute to broader sustainability initiatives in the smart city context. Digital platforms are important because almost anyone can access this technology via smartphones and computers. Digital platforms can reach millions of people and therefore it is important to understand how they can contribute to sustainability in smart cities.

The research question, “How can digital platforms enable innovative business models that contribute to the environmental sustainability of smart cities?” was chosen because prior research has primarily focused on digital applications in general, especially IoT, and how they are used in smart cities without focusing solely on digital platforms (Anttiroiko et al., 2014). Prior studies have highlighted the role of digital platforms as integrators but often overlook the possibilities they offer for fostering sustainability and providing opportunities for business development (Rehm et al., 2021). In prior studies, the role of digital platforms is often overlooked as a brief

passage section before diving into other technologies in smart cities; the main focus and contributor is usually other technologies like IoT sensors (Thangavel & Sudhaman, 2018).

That is why it is important to focus on digital platforms. This research question examines holistically sustainable business development opportunities in smart cities enabled by the use of digital platforms as a business model. The research question contributes to the study of strategic business development providing important insights for business development and diving deeper into the effects of digital platforms in smart cities.

### **1.1 Research questions and objectives**

The research question “How can digital platforms enable innovative business models that contribute to the environmental sustainability of smart cities?” aims to study the characteristics of digital platforms that contribute to the environmental sustainability in smart cities and what implications can be found for business development in the field. The study’s main assumption is that digital platforms enable innovative environmentally sustainable business models that contribute significantly to the overall environmental sustainability of smart cities (DiVito & Bohnsack, 2017).

To investigate the research question mentioned above, the thesis sets the following objectives:

1. To understand what a digital platform is
2. To reveal what are smart cities
3. To understand what the role of digital platforms in smart cities is
4. To understand whether and how digital platforms can enable environmental sustainability in smart cities.

To investigate the issues above, the thesis uses case study approach (Yin, 2014). The case studies are compared and the similarities and differences of the cases are analyzed and then the implications for sustainability and business development are identified. The above-mentioned methodology was chosen because of the low amount of literature focused on digital platforms in smart cities, because case studies allow exploring new or emerging topics.

## **1.2 Delimitations**

This thesis is focused on how digital platforms can enable innovative business models that contribute to environmental sustainability in the context of smart cities. The thesis does not delve into digital platform strategy development but rather examines how digital platforms contribute to environmental sustainability in smart cities and the implications for business development in this context. Furthermore, the core areas include analyzing how digital platforms can help to foster environmental sustainability, enabling innovative business models and enhancing citizen participation and circular economy in smart cities.

## **1.3 Structure of the thesis**

This thesis contains seven sections: 1. Introduction, 2. Literature review, where the most relevant literature about smart cities and digital platforms is reviewed. 3. Methodology, where the methodology of this study is explained thoroughly. 4. Findings, this section provides a short introduction and analysis of all of the chosen case studies and the findings. 5. Conclusion, where all of the key findings, practical implications, limitations and implications for research are concluded.

## **2 Literature review**

### **2.1 Conceptualization of digital platforms**

Scholars have defined digital platforms from technical-, non-technical viewpoints, and also based on their business model. The first viewpoint emphasizes the technical elements and processes that shape the digital platforms. For instance, Spagnoletti et al. (2015, p. 364) provide insight into the conceptualization of a digital platform. According to their definition, a digital platform can be characterized as “a building block that provides an essential function to a technological system and serves as a foundation upon which complementary products, technologies, or services can be developed.” The technical viewpoint emphasizes the technical developments and functions that lay the groundwork, providing a foundation for the development of complementary products and services (Ceccagnoli et al. 2012). As an example, research adopting this perspective has conceptualized a digital platform such as TikTok which is often analyzed in terms of its core functionalities and the contributions made by third-party content creators. Moreover, this viewpoint considers digital platforms as the core which can be extended through additional contributors.

The second viewpoint scholars have conceptualized digital platforms is the non-technological viewpoint. These studies have defined digital platforms as marketplace platforms or commercial networks that connect the market actors and enable transactions between them. These market actors can be business-to-business (B2B), business-to-consumer (B2C) or consumer-to-consumer (C2C) (Tan et al., 2015). For example, Booking.com is a B2C digital platform that connects consumers, and travelers in this case directly with businesses (hotels, hostels, vacation rentals, etc.). The platform connects individual consumers and service providers in the travel industry and facilitates transactions between them.

From a non-technological viewpoint, platforms can be dissected further into two-sided- and multisided platforms. Two-sided platforms connect two distinct groups of actors

together and enable interactions and transactions between them (Koh and Fichman, 2014). For example, Uber rides is a two-sided platform. It connects the consumers (riders) to service providers (drivers). Therefore, Uber rides can be identified as a two-sided platform as it connects two groups of actors together. The riders and drivers use the same platform to perform transactions. Riders book the rides from the application and riders accept rides from the application.

In contrast, multi-sided platforms connect two or more different groups. The previously mentioned booking.com can be defined as a multi-sided platform as it connects multiple actors such as consumers, service providers as hotels but also other intermediaries such as travel agencies and airlines. The multi-sided platforms serve as intermediaries between these "sides" (Trabucchi & Buganza, 2020). In multisided platforms, the external contributors can freely interact with the end-users without interacting with the product owner. However, the product owner can impose rules and terms that dictate how these sides can interact with each other, this includes matching different sides in a way that maximizes value for all participants (Asadullah et al., 2018). Multi-sided marketplaces are conceptualized as platforms that serve to connect two or more sets of entities, mediating interactions and transactions among them. These platforms are characterized by network effects that arise between different "sides" of the market, where the benefits to one side depend on the size of the other side (Nambisan et al., 2019).

Furthermore, digital platforms can be dissected based on their business model into three different categories: the integrator, the product, and the multisided platform business models (Boudreau and Lakhani 2009). As discussed previously, multi-sided platforms connect two or more different groups and acts as a intermediary between them but has less control and monitoring regarding the users. One example of this is Airbnb where the hosts and end-users can interact freely via messages and finish the transaction without any involvement of the product owner. It has to be noted that

there is no clear-cut and widely accepted definition among scholars regarding multi-sided platforms (Van Damme et al., 2010).

In contrast, the integrator platform acts as an intermediary connecting external contributors with end users while having a higher degree of control over the interactions between different user groups (Hagiu, 2007). Integrator platforms are not so much transaction facilitators but rather connectors of different technologies, applications, or systems enabling the creation of unified service offerings (Gawer, 2014). A well-known integrator platform is Shopify, which provides a platform where external merchants can set up their online stores and connect them with the end-users. Shopify facilitates the interaction between merchants and customers by offering website hosting, security measures, marketing tools, shipping and customer support (Lin, 2022). Integrator platforms monitor the transactions and profits from the transactions on the platform between the two actors.

Meanwhile, a product platform acts as a building block that can be built upon. The platform owner provides tools and core technology, and external contributors can create and distribute their products on the platform (Boudreau and Lakhani 2009). One of the core elements of a product platform is the reusability of core elements, which allows for economies of scale. Product platforms enable customisation where individual products differ from each other but while still sharing the same core components (Hein et al., 2020). One example of a product platform is GitHub where developers can create, store, change, merge, and collaborate files or code. GitHub provides the infrastructure and tools for creation, collaboration, and distribution. Hence, it is considered a product platform.

Boudreau and Lakhani (2009) also provided additional classification where digital platforms can be dissected into collaborative and competitive platforms based on the type of interactions they execute. Collaborative platforms enable collaboration between individuals or teams. Users can share their ideas or offer solutions to specific

problems. Collaborative platforms typically provide tools and services for communication, project management, document sharing, and real-time collaboration (Falco et al., 2017). One example of a collaborative platform is the workplace platform Slack where teams can work and communicate remotely. Slack offers tools for collaboration such as chat rooms (channels) that can be organized by topic or team, private groups, and private messaging. Comparatively, competitive platforms external actors create or offer products and services and end-users can select their desired offering based on their preferences and needs. Typical features of competitive platforms include competitive pricing, reviews, and quality. These aspects create a dynamic marketplace with high competition between sellers where the best offerings ideally are the most popular (Rietveld & Schilling, 2020). One example of a competitive platform is Fiverr, where freelance sellers can offer their services in various categories. Overall, Fiverr is a competitive platform where sellers compete for the attention and selection of buyers, and the platform owner has less control over the interaction between external contributors and end users. Table 1 briefly summarizes the existing types of digital platforms and their key features.

**Table 1.** Functional classification of digital platforms.

Functionality	Type of digital platform	Example companies	Description	References
Facilitating multi-party transactions	Multi-sided platform	Booking.com, Airbnb	Multi-sided platforms connect multiple groups, such as consumers, service providers, and intermediaries, facilitating interactions between them.	Trabucchi & Buganza (2020), Asadullah et al. (2018)
Mediating value exchange	Integrator platform	TikTok, Shopify	Integrator platforms act as intermediaries connecting external contributors with end-users.	Gawer (2014)
Providing development platform	Product platform	GitHub, WordPress	Product platforms provide a foundation for developers to create and distribute their products, offering tools and core technology.	Hein et al. (2020)
Enabling collaboration	Collaborative platform	Slack, Trello	Collaborative platforms enable cooperation between multiple users remotely, facilitating real-time collaboration and idea sharing.	Falco et al. (2017)
Facilitating market competition	Competitive platform	Fiverr, Upwork	Competitive platforms allow users to select services based on their preferences while sellers compete for buyers' attention and selection.	Rietveld & Schilling (2020)

This table lists and conceptualizes the essential digital platform types for the development and operation of smart cities. Each type of digital platform contributes significantly to the smart city ecosystem. Multi-sided platforms can connect multiple actors and stakeholders in smart cities, such as service providers, municipal authorities, and citizens. Therefore, contributing to the smart city ecosystem. Integrator platforms enable the use of different tools and technologies to streamline the value exchange between different actors in smart cities. Product platforms can be used for development and innovation in smart cities to find solutions to diverse urban challenges. Collaboration platforms can help with the implementation of smart city initiatives and citizen participation. All of these digital platforms are relevant to

different smart city themes such as sustainability, citizen engagement and well-being, and economic development.

## **2.2 Conceptualizations of Smart Cities**

The term “smart city” was first used in 1990s to describe how ICT technology could be used to make cities more technologically advanced and efficient (Alawadhi et al.,2012). The term “Smart city” has gained a lot of popularity in academic literature and urban development in the last two decades. The reason for that is clear, cities are considered to be one of the key components of the “future”. Cities have become principal actors in social and economic aspects worldwide, and have a huge impact on the environment (Mori & Christodoulou, 2012).

The role of cities in global development is bound to increase even more in the future. According to the United Nations, currently around 55% of the world's population lives in cities, by 2050 this number is expected to be 68%. In total that equals to 2.5 billion more people living in urban areas (United Nations, 2018). Most common problems in cities are pollution, poverty, and a cost-of-living crisis and these problems will multiply unless smart city development is implemented in cities. Especially rapidly growing cities in Africa and Asia are extremely polluted which decreases the quality of life dramatically in these cities. These two regions are urbanizing faster with the proportion of urban habitats increasing by 1.3 and 1.1 percent annually between 2015 and 2020 (United Nations, 2018).

However, smart cities are integrating promising digital platform solutions to combat pollution and enhance environmental sustainability. One example of these solutions is digital platforms that utilize Internet Of Energy (IOE) technologies. They function by aggregating data from various sensors that monitor temperature, light, sound, heat, and humidity and furthermore manage energy distribution and consumption in a smart environment. IOE digital platforms can reduce carbon dioxide emissions and prevent

environmental damage in smart cities. Li et al. (2020) found that the implementation of IOE resulted in improved air quality in the cities of Beijing, Zhongwei, and Yan'an. By leveraging digital platform smart city solutions these cities were able to improve the quality of life of their residents.

The current conceptualizations of smart cities include social, economic, and environmental dimensions of urban development. In the past decades the conceptualizations of smart cities emphasized the technological aspects far more, overlooking the environmental and social aspect of smart cities (Albino et al., 2015). According to Harrison et al. (2010), the term "smart city" signifies an "instrumented, interconnected, and intelligent city." The term "instrumented" describes the ability to collect and combine real-time information using tools like sensors, meters, and personal devices. "Interconnected" refers to linking this data through a computing system that enables different city services to share and exchange it. Finally, "intelligent" involves applying advanced analytics, modeling, and visualization techniques to support more effective decision-making (Harrison et al., 2010). According to the European Commission "A smart city is a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business" (European Commission, n.d, para. 1). We can already see that more up to date definitions of smart cities involve the societal factors. According to Caragliu et al. (2011) technology is only one of the many dimensions of urban development, and that social and environmental dimensions are equally important. In the same study they ranked European smart cities based on "demography, social aspects, economic aspects, civic involvement, training and education, environment, travel and transport, information society, culture and recreation.". Evident from the study, smart cities entail a lot more than just the "smart" technology implementation.

Subsequently published framework regarding modern smart cities is the Smart City Reference Model created by Zygiaris (2013). The framework was created so smart city

planners could use the reference model to define the conceptual layout of a smart city while addressing global sustainability challenges in a local context. In the sense of strategic business development, the framework is relevant for realizing business opportunities at every layer of smart city development, it also helps to discover different business ideas and fields of expertise. It is evident that businesses can contribute at every layer of the framework.

The framework consists of six different layers: Layer 0 “city” layer, meaning that the smart city notions must be grounded to the context of a city. City planning need to start with the basic urban elements, including districts, infrastructure, and citizens. These elements collectively shape the socio-economic and cultural aspects of cities and are crucial for effective city planning and development. Layer 1 the green city layer meaning that the city's sustainable future is mutually attached to smart city structures. This layer creates an ecosystem where smart city infrastructure reduces greenhouse gas emissions, promotes alternative energy sources, and enhances green transport and building standards and together create significant positive environmental impacts. The green city layer is connected to green governance, policy integration, and allocation of financial resources to develop green urban ecosystems within the cities. Layer 2 The Interconnection Layer. This layer refers specifically to the innovation support capability of the telecommunications infrastructure in linking individuals, smart nodes, workstations, and other embedded devices, and delivering high-speed network connectivity across the entire city (Zygiaris, 2013).

A previously mentioned quotation by Harrison et al. (2010), saying that a smart city is an “instrumented, interconnected, and intelligent city” Is especially relevant to this layer, as these technologies connect the whole city. Smart cities should have comprehensive broadband coverage throughout the city including less developed areas. The interconnection layer is closely connected with the green city layer because both emphasize leveraging technological advancements to create sustainable, interconnected, and smart urban environments. The green city layer sets the

foundation for sustainability initiatives, and the interconnection layer leverages telecommunications infrastructure to enhance connectivity and integrate smart services. Layer 3 The instrumentation layer meaning that smart cities consist of real-time connection outlets such as radiofrequency transmitters, traffic signals and IOT sensors. All these applications are connected to the smart city ecosystem and with the real-time system responses smart cities function effectively. Layer 4 The open integration layer means that smart city applications should be able to intercommunicate and share data between them. One of the key elements of a successful smart city is the use of open and distributed information storage for all of the smart city platforms. This storage infrastructure enables smart city platforms to visualize urban space, capture embedded information and support intelligence applications such as smart energy grids. It essentially serves as the backbone for urban operational systems. Layer 5 The application layer enables the practical implementation of technology to improve urban sustainability and enhance the quality of life in cities. Layer 6 The innovation layer means that smart cities should empower innovation, they should become innovation hubs where the system “feeds” itself. A lot of intellectual capital should be located in smart cities fostering constant innovation (Zygiaris, 2013).

According to Zygiaris (2013) in order to enable this, smart cities should “transform the quality and efficiency of public infrastructures and services.”. Secondly, smart cities must have an attractive environment for doing business. In this way, smart cities foster an innovation ecosystem that generates economic value through the acquisition, processing, and utilization of information. This serves as a clear indication that smart cities also function as information economies on a smaller scale and when smart cities are being developed this needs to be taken into account. Table 2 below summarizes key elements of the smart city.

**Table 2.** Smart city layers (Based on Zygiaris (2013)).

Layer	Description	Example
<b>0. City layer</b>	The city is a city before a “smart city”. City planning starts with basic urban elements such as districts, infrastructure, and citizens. City layer also shapes socio-economic and cultural aspects.	Planning and development of urban districts, infrastructure management, citizen engagement initiatives.
<b>1. Green city layer</b>	Integrates smart city structures for a sustainable future. Promotes green initiatives, reduces emissions, and enhances green transport and building standards. Integrates green governance and policy for environmentally sustainable urban ecosystems.	Renewable energy adoption, greenhouse gas reduction strategies, green infrastructure development.
<b>2. Interconnection layer</b>	Utilization of telecommunications to connect individuals, devices, and networks. Facilitation of broadband coverage and integration with green initiatives for smart, interconnected urban environments.	High-speed internet access, IoT connectivity, smart grid deployment.
<b>3. Instrumentation layer</b>	Installation of smart infrastructure like sensors etc. Enables real-time data collection and system responses for effective smart city operations.	Traffic monitoring systems, air quality sensors, IoT-enabled

Layer	Description	Example
		infrastructure.
<b>4. Open integration layer</b>	Facilitates data sharing and communication among smart city applications. Utilizes open information storage to support intelligent services like smart grids.	Urban data platforms, interoperable systems, open-source software solutions.
<b>5. Application layer</b>	Implements technology to enhance urban sustainability and quality of life. Deploys smart solutions for various sectors including energy, transportation, and governance.	Smart energy grids, intelligent transportation systems, e-governance platforms.
<b>6. Innovation layer</b>	Fosters innovation and entrepreneurship within smart cities. Creates an environment for business opportunities and continuous improvement.	Innovation hubs, startup incubators, technology accelerators.

As discussed in this chapter, the concept of Smart Cities has developed a lot in the last three decades. Condensing the key findings from up-to-date academic literature regarding smart cities, the definition of a smart city is an environmentally and socially sustainable interconnected city that utilizes various technological applications to create social and economic value for all of its stakeholders while guaranteeing the same opportunities for future generations. This definition follows the United Nations' guidelines for urban growth. The United Nations states that urban growth is strongly connected to the three pillars of sustainable development: social, economic, and

environmental. Effective urban planning and the use of smart city technologies can enhance the advantages of high population density while reducing environmental harm and other negative effects associated with increasing urban populations (United Nations, 2018). The megatrends of urbanization, demographic changes, the rise of technology, and climate change/resource scarcity will be major factors in the business landscapes of smart cities (Radosław & Janowska, 2018).

Platform developers can leverage the megatrends in the future, the population will grow rapidly in cities and thus the demand for products will increase in order to ensure that cities operate in a smarter way. The rise of the aging population in developed countries provides business opportunities for platform developers in the e-health sector. Sustainability-oriented digital platform multinationals (SO-DPMs) will play a significant role in smart cities. SO-DPMs are focused on tackling social and/or environmental sustainability issues while also ensuring economic value capture (Kolk & Ciulli, 2020). Unquestionably, the rise of technology is a key factor in seizing lucrative business opportunities in smart city contexts. The next section will discuss further how digital platforms can be utilized in smart cities for creating social, environmental, and economic value for all stakeholders.

## **2.2 Digital Platforms and Their Contributions to Smart Cities**

Digital platforms provide a lot of pathways for urban development in smart cities. Digital platforms are the core of sustainable smart city ecosystems. They can contribute to data collection and management, citizen engagement, and service delivery, as well as promoting integration and seamless communication between different systems and technologies (Bokolo et al., 2021). This integration and interoperability enable smart city infrastructure to work together effectively, driving innovation and sustainable development (Zygiaris, 2013). Interoperability and scalability are critical yet challenging aspects of digital platforms in smart cities. Many systems suffer from a lack of compatibility with other platforms or technologies, creating silos that hinder

integration. Furthermore, vendor dependency and scalability issues limit the ability to expand smart city solutions effectively (Santana et al., 2016). These technical constraints can limit innovation and reduce the overall efficiency of smart city infrastructures. Digital platforms provide a lot of positive potential in smart cities but face significant challenges related to security and privacy. The reliance on high-dimensional data increases the risk of breaches and failures in the event of cyberattacks, undermining trust and operational stability (Braun et al., 2018).

As digital platforms are a rapidly developing topic. The academic literature is quickly outdated. One example of this is that most academic papers prior to 2020 is preoccupied with centralized, profit-driven platforms like Uber. The prior literature has overlooked the rapidly growing section of alternative platforms such as sharing economy platforms (Sutherland & Jarrahi, 2018). Decentralized, open-source, non-profit, and cooperative platforms are particularly relevant in the context of smart cities, as they can foster citizen engagement, service delivery, integration and interoperability, and innovation. It is evident that centralized profit-driven platforms are important in the context of smart cities but not as much as the prior academic literature has focused on them. However, smart city initiatives often encounter planning and implementation challenges. Stakeholder resistance, organizational inefficiencies, and economic constraints are frequent barriers, leading to underutilized digital services and low levels of citizen engagement (Angelidou, 2017).

Digital platforms drive citizen engagement in smart cities. One example of this is a digital platform for citizen participation called Decidim which is used in Barcelona. The platform is used for open democratic participation where community members can set up consultation processes such as participatory budgets, public surveys, or calls for ideas. Urban residents can discuss and debate about selected topics, vote, sign addresses and affect the decision-making at the municipal level this way (European Commission, 2020).

Decidim is a perfect example of how digital platforms can be used in smart cities, it is coded via the previously mentioned collaborative platform GitHub and it is used for citizen engagement in a smart city. For instance, by using Decidim Barcelona inhabitants voted on the project on “strategic plan for the city's coastal areas” in Barcelona. Community members voted to redesign the coastal front as a quality public area, open and enjoyable for all citizens (Decidim Barcelona, 2018). Similar citizenship participation platforms are being adopted globally among smart cities constantly.

Urban planners have called for more active citizen engagement and participation for decades (Desouza & Bhagwatwar, 2014). With the rise of digital platforms and technological advancements, citizen participation happens at many different levels. For example, citizens participate in societal discussions using social media in addition to the specifically designed citizen participation platforms.

Falco and Kleinhans (2018) discuss that currently there is an abundance of digital platforms used for citizenship participation, but local governments are hesitant to use these digital platforms. They discovered the following challenges affecting the implementation of digital citizen participation platforms: “1. Contextual: internet accessibility, digital illiteracy and the digital divide” meaning that not everyone has access to the internet and the digital divide between population. This hinders the fact that the opportunities for citizen participation should be equal and open for everybody. “2. Contextual: institutional framework” meaning that there are institutional regulations that need to be considered such as the accessibility of digital platforms by people with disabilities, privacy and data protection, and availability of information in different languages to name a few. “3. Technological advancements and data management” meaning that the speed of technological advancements is rapid, and governments need to stay up to date in this regard. Governments also face problems with the completeness and accuracy of the data coming from the public. Government agencies also need to guarantee the objectivity of their data, quality, integrity, and openness. Many of these challenges link back to previously discussed characteristics of smart cities, especially to the interconnectedness. In order to

function properly and provide opportunities for citizen participation smart cities need to be properly interconnected. Modern digital citizen participation platforms need to take into account the above-mentioned challenges. Digital platforms designed for citizen engagement face accessibility challenges due to skill gaps among certain demographics. Limited digital literacy and concerns over data misuse exacerbate public mistrust, reducing participation and equity in smart city initiatives (Balfaqih & Alharbi, 2022). Addressing these disparities is essential to creating inclusive and effective urban systems.

According to Simonofski et al. (2021) a good digital platform for citizen participation should have an easy and intuitive interface that is designed for the citizens, not for government officials. The wording should be easily understandable and not use too political or technical language. The interface should be fast to keep the users engaged as any good digital platform is. The platform should be straightforward and made just for citizen participation and nothing else. Data privacy is an important topic in the citizen participation realm. The government organization that uses the platform should be the owner of the data collected. It is important to the trustworthiness of the government organization that the data of the citizens does not end up with third parties. Lastly, the whole process should be transparent, and the citizens should have access to the developments of the project in real-time (Simonofski et al., 2021).

In this regard, Leclercq and Rijshouwer (2020) provide policy and practice recommendations for enabling citizen's rights to the smart city through digital platforms. They argued that smart cities should create an environment of "openness" which allows participants to reframe the initiatives around their concerns and desires. Smart cities should support citizens in articulating and implementing their political hopes and aspirations for the future of smart city life. This is done by granting citizens and other stakeholders' decision-maker positions through the use of citizen participation platforms like Decidim for example. For this to happen smart cities need to be able to find solutions for the challenges mentioned above such as equal access to

the platforms for all citizens, especially minorities and other marginalized groups. Smart cities should actively be open and inviting citizens to take part in decision-making. Leclercq & Rijshouwer (2020) also found that while digital citizen participation platforms actively address supporting citizens' engagement and empowerment in smart city development their contribution to providing participants with the opportunity to sustainably reframe and remake the smart city is fairly limited because of budget and time constraints and preference for relying on experts and specialized knowledge at the expense of broader public input or democratic processes. In conclusion, political actors in smart cities should decentralize the decision-making in the city.

Digital platforms can leverage data from various sources such as sensors and IoT devices (Machado et al., 2023). For example, the TomTom application utilizes government road sensors, accident data and GPS measurements of the app users to predict traffic congestion in advance (TomTom, 2024). These kinds of digital platforms are essential for the more seamless functioning of sustainable smart cities. City authorities can dynamically adjust traffic signals, optimize traffic flow, and alleviate congestion in real-time (Rizwan et al., 2016). With historical and real-time data gathered from millions of individuals, traffic congestion can be reduced, and city residents can choose the correct choice of transportation accordingly and evaluate the time needed for the journey. This is one example of how digital platforms can improve the lives of urban residents. Digital platforms are important for individuals, but they are especially important for the functionality of the cities themselves. With the available data, cities can systematically manage the city, reduce emissions, and improve the satisfaction of the residents (Sousa, 2022).

Digital platforms play a big part in the transportation sector in smart cities. The demand for travel in smart cities has created several challenges such as emissions, energy consumption, traffic congestion which all slow the sustainable development in smart cities (Diao, 2019). In addition to the digital platforms that individual smart city

residents can use such as TomTom, are the digital platforms that are used to control the traffic in the city-level. One example of this is Singapore's intelligent transport system that can monitor all traffic lights, form a "green wave" (GLIDE) for motorists and pedestrians depending on the traffic, monitor expressways (EMAS), monitor intersections (J-Eyes system), provide parking assistance (Liu et al., 2019). Singapore is one of the leading smart cities in intelligent transportation. It is a perfect example of how the densely populated island state has been able to tackle the typical sustainability issues in smart cities. Singapore's digital transport platform consists of 27 electronic panels that are located in the city area and key shopping areas in addition to 320 cameras on the roads. Because of the successful implementation of the digital transportation platform, Singapore is the only megacity in the world without traffic jams. Furthermore, the cost savings have been significant. As a whole Singapore has discouraged private motorized mobility, promoted public and shared mobility. All of these runs smoothly because of digital platforms. Data from the sensors and cameras are gathered for the digital transportation platform and then the traffic is managed accordingly. Public transportation can be monitored, and tickets bought from a mobile application (Hin & Subramaniam, 2012; Haque et al., 2013). This is a perfect example of how the integration and interoperability of data and smart city applications can work together and enable a highly operating interconnected smart city infrastructure. These examples highlight efficiency gains in smart cities, but the integration of digital platforms can also increase the pre-existing issues, such as management errors (Pogorelova et al., 2019). In cases like this, the implementation of digital platforms just automates the inefficiency.

Another field that has emergent developments is digital public services platforms. More and more public services are being digitalized constantly. The most common examples are healthcare, education, and social services (Vasilieva, 2020). Smart learning is becoming common in smart cities. Digital learning platforms are used at every level of education from primary schools to universities (Zhuang et al., 2017).

After the pandemic digital learning methods such as remote teaching increased rapidly (Kerres & Buchner, 2022). The use of digital platforms in education in smart cities improves access to information and resources. Students and teachers can use e-books and other educational material more easily and learning is not tied to a physical location. Learning can also be personalized with the use of data and tailor content according to the learner, this can enhance the learning. The use of digital platforms also allows greater collaboration and communication to happen. This enables knowledge-sharing to happen in a global context. Learning is not limited to the classroom and the learning methods are broader compared to typical methods. For example, the use of mobile game-based apps for learning in smart learning city environments is increasing. Pombo (2023) found that students found digital platform learning more advantageous for learning due to their familiarity and accessibility. Apps also significantly impact authentic learning experiences, particularly in fostering conservation and sustainability habits among users. The same study discusses The EduCity project that involves leveraging innovative pedagogies, such as mobile game-based learning with augmented reality (AR), to promote sustainable attitudes and citizen engagement within urban environments.

Next important section of digital public services in smart cities is smart health. In smart health, digital platforms can be used to collect and analyze health-related data. This data can be used to monitor patient health, predict disease outbreaks in smart cities, and inform public authorities. Furthermore, the collected data can be used in research and development in the healthcare sector. Telemedicine is a growing sector in digital platforms. Digital health platforms can be used to evaluate and diagnose patients remotely. This results in cost- and time-savings (World Health Organization, 2021). One example of this is Vitalsense which is used to collect and analyze data from wearable health devices such as health watches. Vitalsense can be connected to various digital platforms such as Apple Health, Google Fit, Microsoft Health and other web-based platforms. It uses fog and edge to deliver data processing for patients and health authorities. The users benefit from the fast transaction of data, especially when it

comes to critical medical complications. Vitalsense removes the typical part of normal healthcare procedure where the patient first needs to contact healthcare authorities. With Vitalsense the healthcare authorities are informed right when the complication happens and this way many lives can be saved. In addition to the vital sign monitoring the application can monitor track citizens location and warn individuals and healthcare authorities about large-scale exposures to infectious diseases for example. Vitalsense also uses the smart city ecosystem to its advantage such as Radio-Frequency Identification (RFID) city portals that can track if a person leaves or enters certain region. This way authorities can react preliminary to public health risks such as pandemics (Rodrigues et al., 2023). In conclusion, digital health platforms can make smart cities better at protecting their residents and also help citizens to be healthier and act quickly in case of an emergency.

The data gathered from the use of digital platforms themselves and various smart city applications can be used to drive environmental sustainability in smart cities. Digital platforms can enhance data-driven decision-making, smart resource management, citizen engagement and participation, mobility solutions, and environmental monitoring and protection (Anthony et al., 2021; Gao et al., 2023; Johnson et al., 2021; Reuver et al., 2018). Digital platforms can collect data from sensors, IoT devices, and user interactions. The integration of the Internet of Things (IoT), Big Data, Cloud Computing, and Cyber-Physical Systems (CPS) technologies is fundamental to developing digital sustainable smart city platforms. These technologies enable efficient data collection, processing, management, and sharing, which are key to enhancing city services and improving the quality of life for citizens .Furthermore, this data can be used to optimize resource allocation, such as energy and water usage (Rosário & Dias, 2023). Digital platforms can continuously monitor environmental data to track air and water quality. One example of this is Aclima. Their digital platform monitors and analyzes air quality and tracks climate-changing pollution. Aclima utilizes roving and stationary sensors that measure air pollution and greenhouse gases at low-level scales and block-by-block resolution. The digital platform helps to translate big data into

usable environmental data for all stakeholders in smart cities from authorities to companies, and communities (Aclima, 2023). Moreover, Aclima collects, processes, manages, and shares data to improve sustainability in smart cities.

Previously discussed citizen participation platforms also play a big part in improving sustainability in smart cities. Citizens habits have a big effect on overall emissions. That is why it is important to work towards more sustainable practices using citizen participation platforms. Hellemans et al. (2022) discuss in their paper that digital platforms play a significant role in the sustainability of smart cities, especially sustainability-oriented digital platforms (SODPs). They found that digital platforms lower barriers to sharing information and enable collaboration between multiple stakeholders from different fields. Digital platforms also lower barriers to access and reach, allowing more people to take part in economic activities and furthermore helping people to improve economic and social wellbeing, hence playing a critical role in the emerging "sharing economy." Digital platforms also harness collective intelligence and can connect multiple actors and thus accelerate innovation and co-creation of solutions for sustainability issues in smart cities. This can be done through collaborative crowdsourcing platforms. Digital platforms also play a key role in addressing sustainability issues. They generate and spread important information about various environmental and societal issues and consequently narrow the knowledge gaps between people.

One example of a digital platform that advances sustainability in smart cities and generates profit is ResQ. It is a Finnish digital platform that helps to lessen food waste in cities. Restaurants and grocery stores can list items that are nearing the expiration date and end-consumers can buy the items for a reduced price. This reduces food waste, and businesses can also limit their losses (ResQ Club, 2024). Resq can be characterized as a sustainability-oriented digital platform multinational (SO-DPM) as the platform addresses a significant environmental issue (food waste) while creating economic value through the utilization of digital platforms to connect different parties.

It is a viable example of a sustainable business model for business developers to consider in the realm of smart cities.

Digital platforms often act as intermediaries in many smart city applications by collecting data from multiple sources, such as IoT devices, sensors, and citywide data systems, and then translating this big data into a usable form. Bibri (2021) suggests that digital platforms play a crucial role in smart cities in facilitating the synergy between urban planning, design, management, and operational functioning and enabling advanced forms of decision support through data-driven and model-driven systems, integrating and harnessing various scientific and technological components to enhance city sustainability, efficiency, resilience, equity, and quality of life. Other scholars have also had the same kind of suggestions about the role of digital platforms in smart cities. Zambom Santana et al. (2016) discuss the role of digital platforms in handling data management, offering external data access, and managing services using cloud computing and big data technologies. The keyword when discussing digital platforms in smart cities is “interoperability”, which refers to the ability for two or more systems or components to exchange information and to use the information effectively.

The insights of this section and their implications for business development can be grouped into several core areas and their contributions to smart cities and their key business opportunities. The core areas are 1. Infrastructure and Integration, 2. Data management and analytics, 3. Citizen engagement, 4. Sustainability 5. Mobility and transportation, 6. Openness and decentralization. Table 3 below summarizes these insights and conclusions from the literature on smart cities and digital platforms overview.

**Table 3.** Core areas for business development in smart cities.

<b>Core area</b>	<b>Core contribution</b>	<b>Business opportunity</b>
1. Infrastructure and integration	Integration and interoperability of different smart city applications with the use of digital platforms	Development of digital platforms that connect various smart city applications and infrastructure
2. Data management and analytics	Utilizing the data gathered from smart city applications, enabling data-driven decision-making and smart resource management	Development of digital platforms for data analytics, predictive modeling, and intelligent systems that can interpret and utilize data for planning, management, and optimization
3. Citizen engagement and service delivery	Improving citizen engagement and enabling collaboration. Providing service delivery through digital platforms. Eg. e-health	Development of digital platforms for citizen participation, decentralized municipal decision-making and public services
4. Sustainability	Improving social, economic, and environmental sustainability. Eg. food waste reduction, reducing energy usage	Development of digital platforms that foster social, economic and environmental sustainability initiatives
5. Mobility and transportation	Managing traffic flow, reducing congestion, and promoting sustainable mobility options.	Development of digital platforms for intelligent transportation solutions, ride-sharing, and green urban mobility
6. Openness and decentralization	Moving beyond centralized, profit-driven platforms to embrace decentralized, open-source, and cooperative models that prioritize community benefits and collective intelligence.	Development of digital platforms that utilize new business models that emphasize collaboration, openness, and shared value creation. Especially in the context of the sharing economy and community-driven initiatives.

This table provides a framework for the core areas for digital platform business development in smart cities. The smart city applications and infrastructure provide many business opportunities for platform developers. The study focused on smart cities in the field of strategic business development with the main focus on the

intersection of data management, interoperability of digital platforms, citizen engagement, service delivery, green mobility and sustainability.

The integration and interoperability of different smart city applications provide various opportunities for business development. As discussed before, many smart city applications utilize digital platforms to transform the data into usable form. The use of such digital platforms allows to make decisions and anticipate events based on evidence rather than reacting to them after they have happened. In conclusion, they help the cities become “smarter”. One example is the Cisco Kinetic For Cities digital platform. The platform utilizes data from the connected things and IOT and allows cities to connect various devices across the city and manage them from a single interface. Furthermore, the platform supports environmental monitoring and for example, helps to respond to air quality issues (European Commission, 2023). This is a perfect example of a digital platform that combines both core areas 1. Infrastructure and integration and 2. Data management and analytics. Platform developers can dive deeper and develop more niche digital platforms for integration and interoperability, but the focus should always be on making the platforms compatible with other systems and applications throughout the city to create an attractive product for the smart city markets.

The third core area for business development 3. Citizen engagement and service delivery provides endless opportunities for platform developers. Smart cities aim to improve citizen engagement and therefore there is demand for such digital platforms that increase citizen participation and promote healthy urban relationships and welfare (Praharaj et al., 2017). In the context of service delivery, businesses can contribute to public service delivery. One example of this is Doctor On Demand by Included Health. It is a digital platform that provides remote consultations with board-certified physicians, psychologists, and other healthcare professionals (Pifer, 2021). The company contributes to the well-being of the citizens and also provides tailored services for

marginalized or underrepresented populations, specifically the LGBTQ community, while simultaneously reducing the pressure on public healthcare resources.

The fourth core area for business development in smart cities 4. sustainability is connected to all of the other core areas. Sustainability core area provides opportunities for app developers focused on creating digital platforms that provide solutions for social, economic, or environmental sustainability issues in smart cities. Digital platforms focusing on sustainability promote waste reduction, energy conservation, and eco-friendly practices. In general, digital platforms should help to foster at least one of the sustainability initiatives of social, economic, or environmental to be considered “smart” in the modern business landscape (Zarra et al., 2019).

The fifth core area for business development 5. Mobility and transportation creates business opportunities in smart cities for platform developers leveraging the demand for sustainable transportation. Traffic congestion and emissions are a big challenge in smart cities. Digital platforms that provide solutions such as car-pooling and enhance the efficiency of public transportation are in high demand (Meneguette et al., 2016). One example of such a digital platform is BlaBlaCar. The two-sided platform connects drivers with empty seats to passengers looking for a ride thus helping to reduce the occupancy of vehicles on the road, in result decreasing traffic congestion and emissions per passenger (BlaBlaCar, 2023). The business model is interesting in the context of business development since it tackles contemporary challenges such as sustainability and the digital platform’s potential for scalability across different smart cities.

The sixth core area, 6. Openness and decentralization emphasizes community-driven and open-source platforms that prioritize collaboration between the users and shared value creation rather than centralized, profit-driven models. For example, Decentraland utilizes blockchain technology to create a decentralized metaverse where users control governance and operations collectively (Guidi & Michienzi, 2022). Such platforms highlight the potential for digital solutions to empower communities and foster collaborative innovation in smart cities.

### **2.2.2. Digital platforms for sustainability in smart cities**

Sustainable digital platforms are in high demand in smart cities. The demand is set to increase because of the pressure from the public but also from the sustainability initiatives and requirements implemented by governments and organizations globally. One example of such a digital platform is OhmConnect. The digital platform is focused on reducing energy usage. The platform monitors the user's home energy usage and sends out a notification to save energy for a short period, known as "OhmHours." The users are encouraged to save energy during peak periods. Users who successfully save energy during these periods get points that can be redeemed for money or prizes (OhmConnect, 2024). OhmConnect's business model is incentive as the participation for the users is free and as a result, they save money from unrealized energy consumption and on top of that get monetary prizes. OhmConnect in turn generates profits from the payments from utilities for unrealized energy consumption and energy savings (Mahboubi-Moghaddam et al., 2018). This full cycle caused by the multi-sided platform results in energy savings and unrealized usage of potentially "dirtier" energy during peak energy consumption periods when there might not be enough sustainable energy available to cover the demand. This is a good example of how a smart city business landscape can provide multidimensional sources of profit while also enhancing sustainability.

As indicated in Table 3, the sixth core area for business development in smart cities of Openness and decentralization focuses on moving beyond centralized profit-driven platforms to embrace decentralized, open-source, and cooperative models that prioritize community benefits. One of the most relevant topics for this core area is sharing economy. The sharing economy refers to forms of exchange facilitated through online platforms, encompassing a diversity of for-profit and non-profit activities that all broadly aim to open access to under-utilized resources through what is termed

'sharing'. The sharing economy constitutes an apparent paradox. It has been framed both as part of the capitalist economy and as an alternative (Richardson, 2015).

The sharing economy provides opportunities for business development regarding digital platforms for example in the fields of marketplace platforms, service-sharing, and goods rotation (Sutherland & Jarrahi, 2018). Most of the digital platforms in the sharing economy sector are centered on transactions between individual people meaning that they are mainly open and decentralized. This drives sustainability and reduces waste. One example of a sharing economy platform is Depop. It is a digital platform that allows users to sell their clothes and apparel that are often second-hand. Depop operates on a peer-to-peer model like many other sharing economy digital platforms. Depop is a typical sharing economy platform; it promotes sustainability, improves community benefits, and on top of that gathers valuable user data on market insights (DiVito & Bohnsack, 2017). In this case, the platform enhances sustainable fashion and promotes community benefits by giving small local entrepreneurs a platform where to promote and grow their businesses and enabling collaboration between different actors. All these equals contributing to social and environmental sustainability initiatives.

It is evident that digital platforms are central to realizing the vision of data-driven smart sustainable cities by providing the technological foundation for urban computing and intelligence capabilities. Nevertheless, it needs to be noted that many of the studies overlook the possibilities that digital platforms offer in smart cities and business development contexts and only see them as integrators. The main study gap is how digital platforms can be utilized in contributing to economic and environmental sustainability in smart cities. Digital platforms offer transformative potential for smart cities, but there are also significant challenges, such as security, management and interoperability. These factors are very important for ensuring sustainable urban development. Future research should focus on solutions that address the challenges regarding security, management and interoperability while maximizing the benefits of

digital platforms. Based on the extensive literature review and identified research gaps, this study focuses on the following research question: *How do digital platforms enable innovative business models that contribute to the economic and environmental sustainability of smart cities?*

### 3 Methodology

During the literature review, it was identified that digital platforms can contribute to environmental sustainability in smart cities by increasing citizen participation, working as a bridge between different smart city applications, and also collecting big data. A comparative case study methodology was chosen to identify the key factors on how digital platforms as a business model can contribute to environmental sustainability in smart cities. According to Yin (2014) the logic of literal and theoretical replication indicates that each case should predict similar results (literal replication) or contrasting results (theoretical replication). Although in the case of contrasting results, the results should come from predictable reasons. The similarities between the chosen case digital platforms are that they are digital platforms that offer peer-to-peer services. There is no intermediate between their supply and end-user (Quarta, 2020). They are all focused on environmental sustainability and a commission-based business model. These similarities provide a suitable basis for literal replication. The prediction is that all case digital platforms have a positive environmental impact in smart cities.

The service type differentiates the case digital platforms: BlaBlaCar focuses on carpooling, FREENOW focuses on carsharing, and Vinted focuses on second-hand clothing circulation. This difference between the digital platforms provides the basis for theoretical replication. Although they have differences, they have similar outcomes on environmental sustainability, but the difference in service type can show where the different outcomes in environmental sustainability come from.

The digital platforms are analyzed with comparative case study analysis, which is a research method used to compare multiple cases to understand a phenomenon, identify patterns, and develop or test theories (Yin, 2014). The comparative case study analysis follows the Yin (2014) case study research design and methods. The methodology utilizes both quantitative and qualitative data. Data collection is conducted through secondary data gathered about the case study digital platforms. The cases are analyzed 1. within-case analysis, analyzing how each of the digital platform's business model and operations contribute to sustainability goals. 2.

Cross-case analysis, comparing findings across all of the chosen digital platforms to identify common themes and unique strategies. 3. Comparative logic, engaging in both "compare and contrast" analysis and "tracing across" to understand how these platforms operate at different scales and contexts (Yin, 2014). Then the findings from the cases are synthesized and reported to summarize the key impacts of each digital platform on environmental sustainability in smart cities. Then the implications for future business development are discussed. Finally, the thesis discusses reflective considerations. Considering the cultural, contextual, spatial, and temporal factors that might influence the generalizability of the findings and reflecting on the power dynamics and ethical considerations in conducting and presenting the research.

### **3.1 Research philosophy and approach**

According to Yin (2014) case study research can follow a positivistic trajectory. Meaning that the variables can be formatted into a concrete and measurable form. In this thesis, these measurable indicators are digital platform type, data integration capabilities, carbon emissions, and the potential for reducing carbon emissions in smart cities.

This research follows an abductive approach. The emphasis on the abductive approach is in focusing on the interlink between empirical observations and theoretical frameworks provided in the thesis. This approach ensures that the theories can be iteratively developed and refined during the research process. The research progress is cyclical; the data collection is done in cycles. This allows the analysis of the data, and if needed, the theories and the framework can be refined based on the findings if needed. The initial hypotheses of the thesis are simple but become more detailed when the research progresses (Dubois & Gadde, 2014).

### **3.2 Research strategy**

The research strategy follows the principles of systematic combining (Dubois & Gadde, 2014). The abductive approach recognizes the changing nature of digital platforms, environmental sustainability, and smart cities. However, the research strategy is based on identifying and analyzing recurring practices that guided the selection of case studies and the analysis of data:

Role of digital platforms in smart cities: A digital platform is “a building block that provides an essential function to a technological system and serves as a foundation upon which complementary products, technologies, or services can be developed” (Spagnoletti et al., 2015).

Digital Platforms as Marketplaces: Digital platforms also function as marketplaces or commercial networks that connect various market actors and enable transactions (Tan et al., 2015).

Digital platforms and environmental sustainability: Digital platforms can be used to drive environmental sustainability in smart cities. Digital platforms can enhance data-driven decision-making, smart resource management, citizen engagement and participation, mobility solutions, and environmental monitoring and protection (Anthony et al., 2021; Gao et al., 2023; Johnson et al., 2021; Reuver et al., 2018).

These recurring practices helped to organize the analysis and pointed to the relevant contextual conditions that would be described and explained further. The study examines how digital platforms enable innovative business models that contribute to environmental sustainability in the context of smart cities. The study aims to see if these practices repeat across different digital platforms. If they do, there is a chance they will also repeat in other cases, allowing for the generalization of theoretical patterns. However, the abductive approach ensures that these propositions are not

strictly followed but are continuously refined and adjusted based on emerging data (Dubois & Gadde, 2014).

### **3.2 Research design: Comparative case study**

This study uses multiple-case design. Yin (2014) states that case study research is suitable to “how” and “why” questions. The evidence gathered from multiple cases is often considered more compelling and the study can be considered more robust (Yin, 2014). Multiple cases should be considered as “multiple experiments”, this done through following a “replication” design. This way a single identified finding can be replicated through multiple different cases, and we can see if a single finding can be duplicated in the other cases as well. Only then would the original finding be considered robust. Each selected case should either be a.) predict similar results (literal replication, b.) predict contrasting results (a theoretical replication). In this thesis three different cases were chosen. This is designed to pursue two different patterns of theoretical replications. If the cases contradict each other, the initial propositions must be revised and retested with another set of cases (Yin, 2014).

The logic underlying these replication procedures should not just predict that the chosen cases should simply be similar or different but also reflect some theoretical interest. In this thesis, BlaBlaCar, SHARE NOW, and Vinted were chosen to determine whether the use of digital platforms can help develop innovative business models that contribute to environmental sustainability, the research is predicting theoretical replication. Yin (2014) states that some theory development as a part of the design phase is desired. The theory can be plain and simple like the theoretical propositions presented above. The five components that are needed for research design are questions, propositions, units of analysis, the logic connecting data to prepositions, and criteria for interpreting the findings. These components illustrate how complete research design embodies a “theory” of what is being studied (Yin, 2014).

The research question "How can digital platforms enable innovative business models that contribute to the environmental sustainability of smart cities?" guides the entire study, focusing on identifying the characteristics and implications of digital platforms on environmental sustainability in smart cities. The units of analysis are digital platforms BlaBlaCar, SHARE NOW, and Vinted. Each platform is analyzed to determine how its business model and operations contribute to environmental sustainability within smart cities. To link the data to the propositions both within-case analysis and cross-case analysis are used during the research. Within-case analysis examines each platform individually, while cross-case analysis compares findings across all three platforms. Criteria for interpreting the findings include identifying each digital platform's key impacts on environmental sustainability in smart cities and combining findings to summarize the key impacts. Furthermore, the implications for future business development are discussed in a separate section.

### **3.3 Case selection**

Literal replication can be ensured if the cases have enough similarities (Yin, 2014). The similarities of BlaBlaCar, SHARE NOW, and Vinted are that they all operate in circular economy in central- and western Europe. This ensured that the case digital platforms have enough similarities and are therefore eligible for comparisons and prediction of similar results. The cases were analyzed individually through within-case analysis to understand how their business models and processes impact environmental sustainability

Each case's context and practices were analyzed individually. Within-case analysis was followed by cross-case comparison to identify similarities and differences between the cases. This allowed the identification of broader patterns and variations between the cases and how different digital platforms contribute to environmental sustainability. Vinted was chosen as a case digital platform to ensure that the findings can be replicated in other fields as well than just carsharing or carpooling.

Furthermore, Blablacar and SHARE NOW were chosen for literal replication to predict similar results. The aim here was to confirm the findings and enhance the validity of the study. Some common themes identified between the case digital platforms during the analysis were data-driven decision-making, smart resource management, and user engagement to enhance environmental sustainability. In addition, the business model and operational strategy of the company had a big impact on environmental sustainability.

### **3.4 Data Collection**

Data collection was done through gathering secondary data from sustainability reports of BlaBlaCar, SHARE NOW, and Vinted, along with relevant academic papers from databases such as Google Scholar, JSTOR, and ScienceDirect.

The data collection follows the four principles of data collection provided by Yin (2014). Principle 1: Use multiple sources of evidence. This was ensured by utilizing multiple sources of evidence to enhance the reliability and validity of the findings. Also a case study database was created to systematically organize and document the collected data. Principle 3: Maintain a chain of evidence. Maintaining a chain of evidence involves keeping a clear link between the research questions, the data collected, and the conclusions drawn. In this research, documentation was kept at every stage of the data collection and analysis process. For example, by connecting each insight to the case evidence, the research becomes more transparent and trustworthy. Lastly, principle 4: Exercise care when using data from electronic sources. This was ensured by using mainly only peer reviewed and trustworthy sources during the whole study.

Table 4. summarizes the analyzed cases, and the sources of data used for their analysis.

**Table 4.** Case study database.

<b>Case study</b>	<b>Data source</b>	<b>Data type</b>	<b>Key information collected</b>
<b>BlaBlaCar</b>	BlaBlaCar Reports (BlaBlaCar, 2023a; BlaBlaCar, 2023b)	Company reports	Annual environmental impact reports, user statistics, business model details.
	Shaheen, S., Stocker, A., & Mundler, M. (2017)	Academic article	User behaviors, platform practices, and environmental impacts.
	BlaBlaCar (2019)	Online report	CO2 emissions savings and platform impact.
<b>SHARE NOW</b>	(SHARE NOW, 2024a)	Company report	Service descriptions, pricing models, and operational data.
	Fromm, H., Schmid, D., & Ailton, N. (2019)	Working paper	Impacts on modal shift, vehicle ownership, and CO2 emissions.
	SHARE NOW (2024)	Online resource	History, business model, and operational details.
<b>Vinted</b>	(Vinted, 2024a), (Vinted, 2024b)	Company resource	User engagement data, and business model specifics.
	(Vaayu, 2021).	Company report	Environmental sustainability impact of Vinted
	(Palomo-Domínguez et al., 2023)	Academic article	User behavior and business model

This database includes all relevant documents and academic papers related to the case studies of BlaBlaCar, SHARE NOW, and Vinted. The database of the research ensures transparency and allows for the replication of the study by other researchers.

### **3.5 Data Analysis**

The data analysis process was conducted using a case study qualitative method to identify key themes and patterns related to the environmental sustainability of the case digital platforms and their operations. This study uses an abductive approach to capture the iterative interplay between empirical data and theoretical frameworks. The abductive approach helped to identify new patterns and furthermore refine the emerging data to explain the role of digital platforms in enabling environmentally sustainable business models in smart cities. The above mentioned initial theoretical propositions were tested against the empirical data. This led to the development of new hypotheses and theoretical insights. This iterative process ensured that the theories were focused in empirical evidence. This method was used to develop theoretical explanations based on the observed data. The empirical data and theoretical propositions were compared iteratively to understand how digital platforms contribute to environmental sustainability in smart cities. A pattern matching method was used to compare the patterns found in the data with the expected patterns based on the theoretical framework (Yin, 2014).

### **3.6 Validity and Reliability**

Research design is supposed to consist of a logical set of statements. According to Yin (2014) four tests can be used to establish the quality of any empirical social research. A case study research focused on the environmental impact of digital platforms is highly affected by the social phenomena in regards the user engagement, therefore these

tests can be applied. Table 5 summarizes the key steps taken to ensure the quality of this research.

**Table 5.** Four design tests (Yin, 2014).

Tests	Case study tactics	In which phase the tactic occurs
Construct validity	Multiple sources, Chain of evidence	Data collection and composition
Internal Validity	Pattern matching, Explanation building, Addressing rival explanations, Logic models	Data analysis
External Validity	Use of replication logic	Research design
Reliability	Use of case study protocol, Development of case study database	Data collection

Construct validity refers to the identification of correct operational measures for the concepts being studied. Multiple sources of evidence were used in the data collection phase to ensure construct validity, such as company reports, academic articles, and industry publications. The research used the triangulation method to cross-verify information from different sources. Furthermore, the chain of evidence is used throughout the whole study to provide clear links between the research question, collected data, and conclusions (Yin, 2014).

Internal validity refers to the establishment of a causal relationship. Meaning that certain conditions are shown to lead to other conditions, as distinguished from spurious relationships. In this thesis pattern matching and explanation building were used throughout the case study research to ensure internal validity. Pattern matching was done when comparing the cases and their differences and similarities. Likewise, explanation building was done by comparing empirical findings with the initial

theoretical propositions to refine the theory (Yin, 2014). Rival explanations are addressed throughout the study, mostly regarding the main functions and possibilities for digital platforms in smart cities. Logic models were used mainly in building the tables in this thesis. Furthermore, these tables guided the research planning and design, data collection and analysis.

The external validity of this thesis was ensured with the use of replication logic. Literal replication was used to test all three cases, and findings were confirmed across cases. This ensured the robustness and credibility of the results through repeated verification. Furthermore, the research examined how the theoretical propositions held across different contexts and that results are not due to specific case idiosyncrasies but are consistently reproducible. Reliability was ensured through the use of case study protocol and database. This protocol entailed the procedures for selecting cases, collecting data, and analyzing results (Yin, 2014). The case study database can be seen above, and it guided the whole data collection to ensure reliability.

## 4 Findings

Digital platforms create numerous opportunities for the development of environmentally sustainable business models within smart cities. Smart cities can be seen as a market in this context, as they differ a lot from traditional cities. The business opportunities and the demand for certain types of digital platforms is unique in smart cities.

As explained in Table 3. the key opportunities for developing digital platforms with sustainable business models are in the following sections 1. Infrastructure and Integration, 2. Data Management and analytics, 3. Citizen engagement and service delivery, 4. Sustainability, 5. Mobility and transportation, 6. Openness and decentralization. Table 6. lists the case digital platforms core areas for business development in smart cities.

**Table 6.** Case digital platform's core areas for BD in SCs.

Digital Platform	Core areas for BD in SCs	Service type
BlaBlaCar	4. Sustainability 5. Mobility and Transportation 6. Openness and Decentralization	Carpooling
SHARE NOW	4. Sustainability 5. Mobility and transportation	Car sharing
Vinted	4. Sustainability 6. Openness and Decentralization	Digital second-hand apparel marketplace

The following case study digital platforms of BlaBlaCar, SHARE NOW and Vinted were chosen because they are closely related to multiple key business development areas within the smart city context as can be seen from the table. All of the chosen platforms share similarities in the core areas of business development that they operate but there are meaningful differences that provide a rich basis for comparative analysis and contribute to a deeper understanding of the impacts on sustainability of digital platforms in smart cities.

#### **4.1 BlaBlaCar**

BlaBlaCar is a French carpooling digital platform founded in 2006 by Nicolas Brusson and Frederic Mazella. The digital platform aims to connect drivers with empty seats to passengers heading to the same destination. The main focus is on the C2C segment, and the digital platform operates as a multi-sided platform (Saxena et al., 2020). The digital platform follows the typical framework of a multi-sided platform. All of the sides benefit from each other, and the value of the platform grows when the number of users increases. The riders benefit from the payments from the passengers, resulting in lower travel expenses. The riders benefit from lower travel costs compared to typical transportation options such as buses, trains, and individual car travel. In addition to flexibility, carpooling offers a more flexible timetable and pick-up location compared to typical mass transport. BlaBlaCar business model generates profit from the transaction fees the passengers pay on top of the travel fee that goes directly to the driver. BlaBlaCar has two separate business segments: BlaBlaCar and BlaBlaCar Daily. BlaBlaCar is focused on longer trips on average the trip length is 300km. For example, typical BlaBlaCar itineraries could be Manchester-London, Valencia-Barcelona or Lille-Paris. BlaBlaCar Daily is focused on shorter trips maximum of 80km travel, it is most often used for daily commutes. The typical itinerary is the following: A. Driver takes off to work from their home, B. picks up the passenger along the way from their home, C. drops the passenger to their workplace, and then the driver drives to their workplace. BlaBlacars matching algorithm matches the users that have matching

commutes so that the itinerary can go smoothly from point A to C without any significant detours. BlaBlaCar Daily is more relevant in the context of Smart Cities (BlaBlaCar, 2023a).

BlaBlaCar is most evidently connected to the 5. mobility and transportation core area for business development in smart cities but it is closely tied to the 6. Openness and Decentralization core area because it is essentially a sharing economy platform. One typical element of sharing economy platforms is that they have a positive effect on sustainability (Cheng et al., 2021). This is the case as well with BlaBlaCar, the maximizing of vehicle occupancy results in unrealized carbon emissions and reduced traffic congestion, this is why BlaBlaCar is linked to 4. Sustainability as well. We can see how multi-sided BlaBlaCar is and how it affects a lot of different stakeholders.

BlaBlaCar benefits from network efforts in the way mentioned above where both sides of the platform create economic benefits for each other. These benefits are known as cross-side network externalities, meaning that the value of the platform for passengers depends on the availability of the rides offered by the riders. Simultaneously, the value of the platforms for riders depends on the number of passengers looking for rides.

From a technological viewpoint, the platform combines many typical applications such as matching algorithms and data analytics. The algorithms are used to mediate interactions between the users, which is essential for the platform's value creation. Data analytics is a key technology that is utilized in BlaBlaCar's business model. BlaBlaCar has organized the nascent carpooling market leveraging data to 1. claim 2. demarcate and 3. control the market. BlaBlaCar has used data analytics strategically to build and extend the community of users by understanding their behaviors and preferences (Casprini et al., 2019). In 2022 BlaBlaCar's digital platform had 26 million active users and 100 million total users globally (BlaBlaCar, 2023a). The extensive amount of platform users provides BlaBlaCar with access to vast amounts of data about the most often driven routes and it also allows BlablaCar to identify new

patterns and behavior changes of the market in a fast manner. This gives BlaBlaCar a unique competitive advantage in the market and allows it to make informed decisions.

The user interface works as a two-sided marketplace where passengers can search for rides and then book the rides. On the driver's side, they can list their route, and the platform sets the price based on the itinerary and real costs incurred by the driver. The prices are non-negotiable and the same for all carpoolers. Drivers can adjust the price within reason, for example, a possibility for a detour or the comfort of their car. The price cannot exceed the maximum price set by BlaBlaCar. This is done to make sure that the drivers cannot make a profit. The number of passengers also adjusts the price. As a result, the price per passenger decreases when the occupancy of the vehicle increases (BlaBlaCar, 2023b). This pricing model is a perfect example of a sharing economy digital platform, all of the users benefit equally from each other and therefore the platform treats everybody fairly.

From the sustainability viewpoint, BlaBlaCar has a profound impact on environmental sustainability. A study by BlaBaCar conducted with French research institute Le BIPE (2019) states that BlaBlaCar's environmental impact globally was a total of 1.6 million CO<sub>2</sub> saved by carpooling in 2018, which equals to the yearly CO<sub>2</sub> emissions by road traffic in Paris. Furthermore, the average BlaBlaCar car occupancy was 3.9 people, in comparison a normal car occupancy is on average 1.9 people. As stated by IPCC (2018) report to stabilize global warming at 1.5°C, CO<sub>2</sub> emissions need to be reduced by 45% from current levels. This indicates that there is a huge market opportunity for businesses to capitalize on the shift to more sustainable services and products. BlaBlaCar is tapping into this segment and as a result, it helps to lower CO<sub>2</sub> emissions by reducing the total amount of vehicles in traffic while maximizing vehicle occupancy. While BlaBlaCar contributes to reducing emissions and optimizing transport efficiency, the environmental benefits are sometimes offset by increased long-distance travel and reliance on private vehicles. Furthermore, the platform's operational focus on

cost-sharing may inadvertently shift demand away from public transportation, reducing its overall sustainability impact (Zafar et al., 2022).

From a business development perspective when BlaBlaCar was first established in 2003 the carpooling market was extremely nascent. In the nascent markets the scope of such a market is not well-defined. Companies have problems establishing their identity. Furthermore, other actors operating in traditional markets see companies operating in nascent markets as illegitimate. This creates a situation where it is harder to get investors and gain customers (Casprini et al., 2019). This situation is very typical in the sharing economy platforms. BlaBlaCar experienced these typical problems at the start as there were not any well-established companies operating in the carpooling sector back then. However, this enables companies in nascent markets to be the first movers and gain competitive advantage this way. BlaBlaCar did exactly this and has been the market leader since then, especially in Western Europe. But despite this the scalability of BlaBlaCar's business model is constrained by regional differences in user behavior and economic conditions. For instance, studies reveal that BlaBlaCar's market penetration varies significantly. It has higher adoption in densely populated areas and among specific demographics like students or lower-income groups (Casprini et al., 2019). Additionally, balancing cost-sharing with profitability poses ongoing challenges as the platform expands into new markets (Hanchuk et al., 2023). Another problem with nascent markets is that the legal framework may not be well-defined. For example, in Spain in 2015 lawsuit was filed by the Spanish Confederation for Bus Transport (Confibus) against BlaBlaCar stating that it was in effect providing the services of a transport company and that it was unfair competition. In the end, BlaBlaCar won the lawsuit based on the argument that it is not a transport company but an intermediate that connects drivers and passengers to share the cost of travel (Saxena et al., 2020). This example shows how the perceptions of nascent market actors play out in practice.

The actors in traditional market actors see the nascent market actors as illegitimate and that the companies have problems establishing their identity. This is important when considering developing digital platforms that enable innovative business models within smart cities. Companies operating in this niche segment may face similar problems in their journey. To continue the business development perspective, BlaBlaCar differentiates itself from its competitors by focusing on two different segments: inter-city travel and daily commutes in the cities. Another key differentiator is the pricing model and the fee structure. BlaBlaCar does not allow users to make a profit. The platform is not designed for profit-making but merely as a sharing economy platform where all of the users benefit from each other. The fee structure differentiates it from competitors who might offer a more static pricing model. BlaBlaCar charges a percentage of the trip fees along with a variable fixed amount depending on the booking time. The fee varies from 7.9% to 12.5% and the variable fixed amount from 0.7€ to 1.2€. BlaBlaCar has also made acquisitions to deal with the competition. For example, they have bought competitors carpooling.com and AutoHop (Saheen et al., 2017). Despite its environmental and cost-saving benefits, BlaBlaCar faces challenges in building trust among users and ensuring consistent adoption across regions. Research highlights that trust between drivers and passengers remains a critical factor for platform success, particularly when carpooling involves sharing rides with strangers (Setiffi & Lazzer, 2018). Limited user participation in less urbanized areas further restricts the platform's scalability (Saxena et al., 2020).

When considering the integration of BlaBlaCar to the smart city ecosystem as discussed before the company links to the following core areas for business development in smart cities: 4. Sustainability, 5. Mobility and transportation and 6. Openness and decentralization. The most established and well-defined sector of the above-mentioned sectors is 5. Mobility and Transportation. BlaBlaCar's role in the larger ecosystem of smart city transportation is being an alternative for public transport and individual transportation, especially BlaBlaCar daily which is a direct alternative for public transport or ride-hailing services. BlaBlaCar is not a direct

competitor of these services, because of this they complement each other in building efficient smart city transportation systems.

The co-existing results in preventing the overcrowding of public transportation and lower waiting times for ride-hailing arrivals, and BlaBlaCar's purpose in this ecosystem is to lower CO2 emissions and reduce traffic congestion. In Smart Cities where there are millions of inhabitants, daily hundreds of thousands of individuals take the same commute every day. BlaBlaCar can enhance its service offerings and also contribute significantly to reducing traffic congestion and emissions by leveraging the dense urban populations to foster a sustainable, efficient, and highly interconnected transportation network. This aligns with core areas for business development in smart cities of 4. Sustainability, 5. Mobility and transportation and 6. Openness and decentralization. Furthermore, aligning with broader environmental goals positions itself as a pivotal player in the future of urban mobility. In achieving this goal, data utilization plays a key part as in many other smart city digital platforms.

## **4.2 SHARE NOW**

SHARE NOW is the leading car-sharing digital platform in Europe and operates in Austria, France, Germany, Italy, Netherlands, and Spain. The company was founded as a joint venture between BMW Group and Mercedes-Benz Mobility AG in 2019, as a result of a merger between Car2Go and DriveNow (SHARE NOW, 2024a).

The digital platform aims to connect people needing a car with available cars nearby. The cars are "free float" meaning that the users can end their rental anywhere within the car's home area. From a technological viewpoint, the digital platform operates as an integrator platform connecting users with available cars. The app interface is easy to use, the user opens the map where all of the available cars are. Then the user can reserve the car for a short period. The map shows the user the route to the car and then when the user arrives at the car, they can rent it with just one click. The app

doesn't limit the usage or kilometers driven. After the usage, the user can end the rental anywhere within the car's home area and park the car to any public parking space.

SHARE NOW is directly linked with 4. sustainability and 5. mobility and transportation core areas for business development in smart cities. The platform combines sustainability and mobility and transportation by offering shared vehicles which are mostly EVs. Aiming to reduce emissions and improve the livable use of space in urban areas by reducing the amount of individually owned private cars. It also touches upon 6. Openness and Decentralization because it can be considered a sharing economy platform, but it has limited exposure in this sector due to its private nature and strongly profit-driven business model. The platform does not allow individuals to list their own cars to the platform for shared vehicles for example.

SHARE NOW pricing model is a dynamic pricing model, which allows the users to choose from per-minute, per-hour, and per-day rental options. This pricing model allows users to choose the appropriate pricing for both short- and longer trips. This is why SHARE NOW can gather users from all of the different itinerary demand segments and it is an attractive option for everybody seeking a carsharing service. For example, in Germany, depending on the car model the minute rate starts from 0.09€ up to 0.22€, the hourly rate from 9.99€ to 15.99€ and the daily rate from 19.98€ to 73.33€. Therefore, SHARE NOW car sharing can be a viable option for smart city transportation because of its low costs. The prices include free parking in the home area, free fueling and charging, and basic coverage (FREE NOW, 2024b).

From a sustainability viewpoint the main effects of SHARE NOW are reductions in vehicle holding, reductions in private vehicle kilometers traveled and increases in the use of other transport modes and CO2 emission reductions. In the study by (Fromm et al., 2019), 10,596 regular users of SHARE NOW participated in the survey. Varying from 3.6% to 16.1% of the survey participants reported that they have sold a car due to the

SHARE NOW carsharing service and Between 14.3% and 40.7% of respondents reported that they had suppressed the purchase of a vehicle because of the availability of SHARE NOW. The study also provides scenarios about potential CO<sub>2</sub> reductions because of the use of SHARE NOW: Conservative Scenario: Net CO<sub>2</sub> emission reductions per vehicle range from 8.8 to 17.9 tons per year and optimistic scenario: Net CO<sub>2</sub> emission reductions per vehicle range from 21.1 to 39.4 tons per year. The key factors in lower CO<sub>2</sub> emissions compared to privately owned cars come mainly from a reduction in private vehicle ownership. The lower amount of privately owned means fewer overall emissions associated with manufacturing, maintaining, and operating those vehicles. Carsharing often leads to more efficient use of vehicles resulting in a lower total of kilometers driven. Furthermore, the availability of carsharing can lead to a modal shift where users opt for carsharing in combination with public transit, walking, or biking, rather than driving their own car (Namazu & Dowlatabadi, 2015; Te & Chen, 2019; Liao, Molin, Timmermans, & van Wee, 2018). This not only reduces reliance on private vehicles but also supports more sustainable urban mobility patterns.

From a business development perspective, the key characteristics of SHARE NOW are the innovative business model, the multi-sided platform model, the use of data analytics, and the emphasis on sustainability.

The business model differs from its competitors mainly via the use of a free-floating fleet. Traditional carsharing services operate with a station-based model, where cars are picked up and returned to the same location (Wielinski et al., 2015). The use of a free-floating fleet allows SHARE NOW to differentiate from its competitors by being the most flexible carsharing option. The free-floating fleet allows users to rent cars impulsively, and they do not have to have a well-planned travel itinerary beforehand. This flexibility is one of the key factors in SHARE NOW's business model.

SHARE NOW operates with a multi-sided platform model. The platform exemplifies the typical characteristics of a multi-sided platform by creating value by facilitating interactions between different user groups that benefit from each other's participation. It connects the drivers with the available cars and the whole service is based on the mobile app. From the user's point of view, you only need a driving license and the mobile app to rent a car, this is another example of the flexibility the platform offers for its users.

Data analytics plays a big part in SHARE NOW's platform. Carsharing digital platforms collect wide range of data including vehicle usage, customer interactions, and app engagements (Mitropoulos et al., 2021). Furthermore, this data is used to optimize the distribution of the fleet and improve the operational efficiency in the cities where SHARE NOW operates. Data analytics also allows the company to maintain a competitive edge in the market by driving innovations within its service offerings by identifying trends and patterns first.

SHARE NOW emphasizes sustainability in all of its publications, which indicates it wants to be linked strongly with enabling sustainable transportation in smart cities. From a business development viewpoint, this strategic focus not only differentiates the company in a competitive market but also opens opportunities for partnerships with other actors in the urban sustainability sector. Aligning with the trend toward greener transportation enhances the company's appeal to investors and stakeholders interested in sustainable development.

When considering the integration of SHARE NOW to the smart city ecosystem as discussed before the company links to the following core areas for business development in smart cities: 4. Sustainability, 5. Mobility and Transportation and 6. Openness and Decentralization. SHARE NOW's role in the larger ecosystem of smart city transportation is being an alternative for public transport and individual car ownership. As the study by (Fromm et al., 2019) states significant amount of the users

of SHARE NOW have sold their car or halted the purchase of privately owned vehicles. This results in a lower number of cars in smart cities, which in turn enhances the livability in the smart cities and reduces traffic congestion and CO2 emissions. The purpose of FREE NOW in the smart city transportation ecosystem is to facilitate integrated mobility services that complement existing urban transport networks. As a result, it contributes to the overall goal of creating smarter, sustainable, and more livable urban environments.

### **4.3 Vinted**

Vinted is a digital platform where users can sell and buy second-hand apparel. Users can list their items for free to the platform. When the item is sold they can ship it with a prepaid shipping label. When the buyer confirms that the item has arrived in the same condition as listed the seller gets the money. It is an excellent example of how digital platforms can enable innovative and sustainable business models. The multisided platform operates on a community-driven model meaning that the usage of the app involves a lot of user-generated listings, community feedback systems, and peer-to-peer interactions (Palomo-Domínguez et al., 2023). The digital platform follows the typical framework of a multi-sided platform all of the sides benefit from each other, and the value of the platform grows when the number of users increases. The sellers have more potential buyers for their apparel. Consequently, buyers have more options available.

Vinted is linked to the following core areas for business development in smart cities: 4. sustainability and 6. Openness and decentralization. Vinted promotes sustainability by creating a market for second-hand apparel. Aiming to reduce fast fashion trends and encourage circular economy. Vinted is linked to openness and decentralization because it is a sharing economy platform where users sell apparel that they no longer need and the business model emphasizes collaboration, openness, and shared value creation.

From a sustainability perspective, Vinted keeps clothing recirculating longer and reduces the purchase of a new item. Research has shown that extending a garment's active life is one of the key components of reducing the environmental sustainability impacts of the clothing industry. (Goworek et al., 2020). 73% of used clothing is landfilled or incinerated globally, although their lifespan could be extended with the use of circular economy platforms like Vinted (Ellen MacArthur Foundation, 2017). This trend is prominent in developed countries, where the lifespan of clothing could be extended further, and the use of fast fashion reduced. The environmental sustainability impacts of Vinted were analyzed in an independently conducted report by tech start-up Vaayu. It was found that buying second-hand apparel from Vinted instead of new resulted in 1.8 kgCO<sub>2</sub>e savings per item. In total the net carbon emission saving enabled by Vinted was 453 kilotonnes CO<sub>2</sub>e in 2021, this equals to flying between London and Los Angeles and back approximately 275 000 times (Vaayu, 2021). Studies indicate that users of second-hand platforms often purchase items they would not have bought new, driven by the low prices that encourage overconsumption. On Vinted, this trend can undermine the platform's sustainability goals. Furthermore, Vinted's carbon emissions are primarily linked to global shipping, which may offset its positive environmental impact over time (Mak & Heijungs, 2022; Balińska et al., 2024). Additionally, research reveals that users primary motivation for engaging with Vinted is bargain hunting, rather than environmental sustainability. As a venture capital-backed unicorn, Vinted's primary focus is on financial performance, limiting its ability to drive broader shifts in consumption patterns (Palomo-Domínguez et al., 2023; Balińska et al., 2024).

The pricing model of Vinted differs from the industry norm in sharing economy platforms. Vinted employs a distinctive pricing model that primarily shifts the cost burden from sellers to buyers. The buyer pays a 0.70\$ "buyer-protection fee" and in top of that 5% variable fee based on the transaction amount. This fee structure ensures Vinted's revenue flow and keeps the platform free for sellers (Vinted, 2024a). Other revenue streams are in-app ads and "item bump" which is a feature where sellers can

increase the likelihood of getting their item sold. Item bumps are displayed higher in members' Newsfeeds and search results, for either 3 or 7 consecutive days. The last additional revenue stream is a feature called "closet spotlight". The feature allows sellers to promote their items in a separate section in the item feed/newsfeed and other members' catalog search results (Vinted, 2024b).

The key characteristics of Vinted from a business development perspective that differentiate them from competitors are the community-driven platform, scalability, mobile-first strategy, and sustainability focus. Users list their items independently and the transactions are carried out automatically. Secondly, the business model allows easy scalability. This enables Vinted to expand rapidly into new markets without having to differentiate the service offering majorly. Thirdly, Vinted has adopted a mobile-first strategy which has made the digital platform popular among younger generations. The focus on one technology area has resulted in higher user engagement and satisfaction. Lastly, the strong focus on sustainability has resonated with environmentally conscious consumers and aligns with global trends towards ethical and eco-friendly fashion. This has also made Vinted a sustainable and responsible company in the eyes of the consumers. From a branding perspective, they have done an excellent job of marketing their platform.

When considering the integration of Vinted to the smart city ecosystem as discussed before the company links to the following core areas for business development in smart cities: 4. Sustainability and 6. Openness and decentralization. In order for a smart city to be environmentally sustainable the consumption habits and carbon-oxide footprint of every citizen need to be on a sustainable level. Vinted enables important circular- and sharing economy aspects in smart cities that contribute to environmental sustainability at a personal level in smart cities. Vinted contributes to the circulation of second-hand apparel and is a direct alternative to second-hand stores in smart cities, offering a more flexible method for the circulation of second-hand apparel. This results in a longer lifespan for clothing and reduces the purchases of new clothing. The

promotion of sustainable consumption aligns with smart city goals to reduce waste and reduces the environmental footprint of urban areas. Vinted's digital platform can foster community engagement by encouraging residents to participate in a shared economy. Furthermore, Vinted can be part of a transformation for smart retail solutions by offering an alternative, sustainable shopping experience that utilizes technology to make second-hand clothing more accessible and appealing, thereby fitting into the broader smart retail ecosystem. Vinted contributes to the circular economy and environmental sustainability but challenges like increasing overconsumption and pollution linked to global shipping hinder Vinted's overall positive environmental sustainability. Addressing these issues is essential for maximizing its sustainability potential in smart cities.

#### **4.4 Comparative case analysis: Comparing the environmental sustainability impacts**

This section aims to answer the research question "How can digital platforms enable innovative business models that contribute to the environmental sustainability of smart cities?", this is done by investigating how digital platforms BlaBlaCar, FREE NOW, and Vinted enable innovative business models that contribute to the environmental sustainability of smart cities.

Common themes across all of the digital platforms that enable innovative business models that contribute to environmental sustainability in smart cities are the strong focus on 1. sustainability and environmental impact, 2. the utilization of multi-sided platforms, 3. Data utilization and technological integration, 4. Sharing economy model. Topical similarities between these digital platforms are the strong foothold in the Western-European major cities. They all utilize multi-sided platform model, and it is the basis of the whole business model for all of the digital platforms. Lastly, they all take part in sharing economy model in some extent.

Focus on sustainability and the environmental impact is the most common element among all of the case digital platforms. BlaBlaCar contributes to sustainability by reducing CO<sub>2</sub> emissions by increasing vehicle occupancy rates, thus reducing the number of vehicles in traffic. BlaBlaCar's environmental impact globally was a total of 1.6 million tons of CO<sub>2</sub> saved by carpooling in 2018. SHARE NOW promotes the use of shared vehicles that are mostly electric, resulting in lower emissions and traffic. Share Now's net CO<sub>2</sub> emission reductions per vehicle range from 8.8 to 17.9 tons per year in the conservative scenario, and 21.1 to 39.4 tons per year in the optimistic scenario. Both BlaBlaCar and SHARE NOW operate in 5. Mobility and Transportation sector, which is another common factor between them, and both affect the environmental sustainability by offering mobility solutions. Vinted contributes to environmental sustainability by extending the life cycle of clothing. Vinted's net carbon emission saving enabled was 453 kilotonnes of CO<sub>2</sub>e in 2021. The thesis highlights how each digital platform leverages its unique business model to drive significant environmental sustainability benefits in terms of reduced carbon emissions and more efficient resource utilization. The comparative analysis showcases the diverse ways digital platforms can contribute to the environmental goals of smart cities.

All of the case digital platforms have a different approach to making an environmental sustainability impact. BlaBlaCar is focused on carpooling in contrast to SHARE NOW which is focused on carsharing. Both methods have similarities in the sense of utilizing a lower number of individual cars and utilizing their usage rates. The difference is that BlaBlaCar utilizes their user's own cars and connects them with users looking for rides, resulting in higher vehicle occupancy rates. In contrast to SHARE NOW which utilizes its own fleet of cars and connects the users with available cars from their fleet. Their business models differ majorly in this sense. BlaBlaCar does not have its own fleet of cars compared to SHARE NOW which owns the cars that are used for carsharing. Also, BlaBlaCar aims to maximize vehicle occupancy, but this is not the goal of SHARE NOW, where the target in the sense of sustainability is to reduce the amount of individually owned cars and promote the use of electric vehicles. The similarity of BlaBlaCar and

SHARE NOW comes from the realization of the effectiveness of shared mobility and the circular economy model. Vinted operates in a completely different business area of second-hand clothing but has similarities to the other case study digital platforms in the sense of a circular economy model. Vinted promotes the sharing of goods but in a different way. In their business model, the ownership of the item transacts from one user to another, compared to BlaBlaCar and SHARE NOW. In their business model, the ownership of the item never changes. Vinted is a digital marketplace for transactions of second-hand clothing, SHARE NOW is a marketplace for rental cars, and BlaBlaCar is a marketplace for rides.

As we can see, all of the chosen digital platforms utilize unique strategies for promoting environmental sustainability. In conclusion, BlaBlaCar utilizes peer-to-peer carpooling model that maximizes vehicle occupancy, contributing to a reduction in CO2 emissions and traffic congestion. SHARED NOW utilizes a free-floating fleet of mostly EVs for shared vehicle usage, contributing to a reduction in emissions because electric vehicles produce zero tailpipe emissions. This results in lower air pollution in smart cities and a reduced number of vehicles in highly populated urban areas. SHARE NOW is also contributing to innovative urban mobility, facilitating a shift from private car ownership to shared mobility. Vinted promotes a circular economy through the online resale and reuse of apparel, resulting in waste reduction and a longer total lifespan for clothing. Which in turn improves the sustainability of the value chain of the item by lowering the total CO2 impact. Though operating in different domains (transportation vs. fashion), each digital platform highlights a facet of how digital platforms can drive sustainability. By comparing their strategies and outcomes, we can see the diverse impacts digital platforms can have on environmental sustainability. This analysis not only shows the effectiveness of each approach but also helps identify areas where combined efforts might lead to greater sustainability outcomes in urban environments. Table 7 compares the case impact on CO2 emissions.

**Table 7.** CO<sub>2</sub> Emissions Savings generated by the case digital platforms.

<b>Digital Platform</b>	<b>CO<sub>2</sub> Emissions Savings</b>	<b>Sustainability Contributions</b>
BlaBlaCar	1.6 million tons of CO <sub>2</sub> in 2018 (BlaBlaCar, 2019)	Maximizes vehicle occupancy and reduces traffic congestion.
SHARE NOW	8.8 to 17.9 tons per vehicle/year (Conservative) 21.1 to 39.4 tons per vehicle/year (Optimistic) (Fromm et al., 2019)	Promotes efficient and sustainable vehicle use and reduces the number of cars in urban areas.
Vinted	0.453 million tons of CO <sub>2</sub> in 2021 (Vaayu, 2021)	Increases apparel lifecycle, circular economy participation and second-hand clothing usage.

This section aims to answer the research question “How can digital platforms enable innovative business models that contribute to the environmental sustainability of smart cities?“, this is done by investigating how digital platforms BlaBlaCar, FREE NOW, and Vinted enable innovative business models that contribute to the environmental sustainability of smart cities.

Common themes across all of the case digital platforms are the strong focus on 1. sustainability and environmental impact, 2. the utilization of multi-sided platforms, 3. Data utilization and technological integration, 4. Sharing economy model. Topical similarities between these digital platforms are the strong foothold in the Western-European major cities. They all utilize a multi-sided platform model, and it is the basis of the whole business model for all of the digital platforms. Lastly, they all take part in the sharing economy model to some extent.

Focus on sustainability and the environmental impact is the most common element among all of the case digital platforms. BlaBlaCar contributes to sustainability by

reducing CO<sub>2</sub> emissions by increasing vehicle occupancy rates, thus reducing the number of vehicles in traffic. BlaBlaCar's environmental impact globally was a total of 1.6 million tons of CO<sub>2</sub> saved by carpooling in 2018. SHARE NOW promotes the use of shared vehicles that are mostly electric, resulting in lower emissions and traffic. Share Now's net CO<sub>2</sub> emission reductions per vehicle range from 8.8 to 17.9 tons per year in the conservative scenario, and 21.1 to 39.4 tons per year in the optimistic scenario. Both BlaBlaCar and SHARE NOW operate in 5. Mobility and transportation sector, which is another common factor between them, and both affect the environmental sustainability by offering mobility solutions. Vinted contributes to environmental sustainability by extending the life cycle of clothing. Vinted's net carbon emission saving enabled was 453 kilotonnes of CO<sub>2</sub>e in 2021.

All of the case digital platforms have a different approach to making an environmental sustainability impact. BlaBlaCar is focused on carpooling in contrast to SHARE NOW which is focused on carsharing. Both methods have similarities in the sense of utilizing a lower number of individual cars and utilizing their usage rates. The difference is that BlaBlaCar utilizes their user's own cars and connects them with users looking for rides, resulting in higher vehicle occupancy rates. In contrast to SHARE NOW which utilizes its own fleet of cars and connects the users with available cars from their fleet. Their business models differ majorly in this sense. BlaBlaCar does not have its own fleet of cars compared to SHARE NOW which owns the cars that are used for carsharing. Also, BlaBlaCar aims to maximize vehicle occupancy, but this is not the goal of SHARE NOW, where the target in the sense of sustainability is to reduce the amount of individually owned cars and promote the use of electric vehicles. The similarity of BlaBlaCar and SHARE NOW comes from the realization of the effectiveness of shared mobility and the circular economy model. Vinted operates in second-hand clothing but has similarities to the other case study digital platforms based on the circular economy model. In Vinted's business model, the ownership of the item is transferred from one user to another, compared to BlaBlaCar and SHARE NOW. Vinted is a digital marketplace for

transactions of second-hand clothing, SHARE NOW is a marketplace for rental cars, and BlaBlaCar is a marketplace for rides.

As we can see, all of the chosen digital platforms utilize unique strategies for promoting environmental sustainability. In conclusion, BlaBlaCar utilizes a peer-to-peer carpooling model that maximizes vehicle occupancy, contributing to a reduction in CO2 emissions and traffic congestion. SHARED NOW utilizes a free-floating fleet of mostly EVs for shared vehicle usage, contributing to a reduction in emissions because electric vehicles produce zero tailpipe emissions. This results in lower air pollution in smart cities and a reduced number of vehicles in highly populated urban areas. SHARE NOW is also contributing to innovative urban mobility, facilitating a shift from private car ownership to shared mobility. Vinted promotes a circular economy through the online resale and reuse of apparel, resulting in waste reduction and a longer total lifespan for clothing. Which in turn improves the sustainability of the value chain of the item by lowering the total CO2 impact. Though operating in different domains (transportation vs. fashion), each digital platform highlights a facet of how digital platforms can drive sustainability. By comparing their strategies and outcomes, we can see the diverse impacts digital platforms can have on environmental sustainability. This analysis not only shows the effectiveness of each approach but also helps identify areas where combined efforts might lead to greater sustainability outcomes in urban environments. Table 7 compares the case impact on CO2 emissions.

As shown in the table, these digital platforms have significant potential to impact environmental sustainability in smart cities by promoting sustainable consumption and mobility habits. They also help conceptualize circular economy solutions. The table highlights that a single digital platform can significantly influence environmental sustainability, leveraging its unique business model to address specific challenges in urban areas and contribute to broader goals of sustainable urban development.

However, all case platforms have limitations in influencing users' habits and systemic barriers to achieving environmental impact. For SHARE NOW and BlaBlaCar, the inability to incentivize a shift to more sustainable habits, such as adopting public transportation or active mobility (e.g., walking or cycling), may limit their long-term contributions to systemic changes in urban mobility. SHARE NOW mitigates this limitation to some extent by offering a fleet of electric vehicles and electric scooters. In Vinted's case, while the platform promotes circular economy practices, it risks encouraging overconsumption due to its low-cost model. Vinted's reliance on global shipping increases its carbon footprint, reducing the net environmental benefit.

## 5 Conclusion

This thesis analyzes “How can digital platforms enable innovative business models that contribute to the environmental sustainability of smart cities?” The purpose was to find the key elements that digital platforms that contribute to environmental sustainability in smart cities share. During the literature review, it was identified that the prior studies have focused mainly on other technologies than digital platforms, especially on IoT. Prior studies have also highlighted digital platform’s role as integrators rather than having a direct impact. During the analysis it was identified that digital platforms could enable much more than just integrating different technologies and systems. Digital platforms can also act as platforms for collaboration, sharing, and transactions and have a impact on overall environmental sustainability in smart cities (Sutherland & Jarrahi, 2018). Therefore, this study not only validates existing claims regarding digital platforms and sustainability but also challenges and expands the scholarly understanding of their role in urban sustainability, highlighting the diverse mechanisms through which these platforms contribute to environmental goals.

The comparative case study analysis analyzed the following digital platforms: BlaBlaCar, SHARE NOW, and Vinted. I chose these platforms because they characterize many elements of how digital platforms can enable innovative business models that contribute to environmental sustainability in smart cities. These platforms show the diverse opportunities that digital platforms offer and also indicate that partaking in the circular economy can be a viable business model. These platforms are growing businesses, and they show that the circular economy plays a big part in the future, especially when considering how smart cities can enhance their urban sustainability efforts.

All of the chosen digital platforms had common themes between them. Most notably the environmental impact and circular and sharing economy aspects. Their strategies on how they approach these challenges were unique to each other. BlaBlaCar focuses on ridesharing, SHARE NOW focuses on carsharing and Vinted focuses on enabling

transactions of second-hand clothing between the users. However, critical analysis reveals certain limitations. BlaBlaCar's impact depends heavily on user adoption, which can vary regionally, SHARE NOW's reliance on EV infrastructure limits its scalability in areas with underdeveloped charging networks, and Vinted faces challenges such as overconsumption and emissions from global shipping (Mak & Heijungs, 2022). Addressing these barriers will be crucial for amplifying the platforms' contributions to sustainability in smart cities.

## **5.2 Theoretical contributions**

This subchapter outlines the theoretical contributions of this research, focusing on how it extends current theories of digital platforms and environmental sustainability within smart cities. The main theoretical contributions of this thesis are contributions to environmental sustainability theories. During the comparative case study analysis, it was identified that the use of sharing economy platforms not only facilitates the sharing of resources but also significantly influences user behavior towards more sustainable practices. For instance, Vinted users reported a reduced reliance on fast fashion, indicating that digital platforms can encourage more sustainable consumption patterns (Palomo-Domínguez et al., 2023). This contributes to theories of the sharing economy by indicating that such platforms can also have a more profound impact in driving the shift towards environmental sustainability in smart city settings. Smart city ecosystems provide optimal settings for the development of environmentally sustainable digital platforms.

The findings suggest that digital platforms can have a real impact on environmental sustainability in smart cities. Digital platforms as a business model allow businesses to reach a wide user base with fairly easy scalability across different geographical areas. During the case studies it was found that the number of users correlates with the positive environmental impacts. For example, users who use Vinted take part in the circular economy but also reported that they had decreased their consumption of fast

fashion, and that the use of environmentally sustainable digital platforms encourages sustainable behavior in contexts outside the digital platform usage.

### **5.3 Practical implications**

The practical implications of this study are that businesses and municipalities should form partnerships and work together in order to realize sustainability initiatives in urban settings. Business can play a big part in making cities more streamlined and efficient. SHARE NOW is a good example of this, it shows external actors can contribute to a larger transportation and mobility ecosystem in smart cities. The practical implication for businesses is that digital platforms offer a business model with high potential for scalability and expansion while considering sustainable aspects as well. Digital platforms like SHARE NOW can be integrated to smart cities sustainability efforts. Municipalities and businesses must collaborate to address systemic barriers and integrate digital platforms into urban sustainability initiatives. For example, SHARE NOW's electric scooters and carsharing services can complement public transport systems, reducing reliance on private vehicles. Similarly, Vinted could minimize shipping emissions by partnering with local logistics providers, creating a more localized circular economy. These types of joint efforts also accelerate environmentally sustainable business development in smart cities

### **5.4 Limitations and implications for research**

The main limitation of this study is the limited amount of data regarding how digital platforms can enhance sustainability in smart cities. The chosen research methodology of comparative case study research also limits the scope of digital platforms analyzed. However, future studies could delve into this subject area further, exploring the role of digital platforms in smart cities. I will further discuss some of the potential areas to be

explored further. Table 8. summarizes the three key themes suggested for future research within the area of smart cities and digital platforms for sustainability.

**Table 8.** Key future research themes for BD of digital platforms specialized in smart city markets (Author’s own elaboration).

Aspect	Description
Integration with urban sustainability initiatives	The digital platform’s purpose can be integrated into urban sustainability initiatives.
Scalability and expansion	The business model of the digital platform offers easy scalability and expansion opportunities between smart cities.
Data analytics	The digital platform utilizes data analytics to enhance service efficiency and sustainability outcomes.

Based on the comparative case study analysis on BlaBlaCar, SHARE NOW and Vinted we can identify three key aspects for business development of digital platforms specialized in smart city markets. The first aspect “Integration with urban sustainability initiatives” can be linked to “The Urban Agenda for the EU”. This specific initiative was chosen for this topic because the case digital platforms predominately operate in the EU. The Urban Agenda for the EU includes many social, economic, and environmental sustainability aspects but this section focuses only on environmental sustainability as it is the most relevant aspect in contrast to the research question. The Urban Agenda's priority themes for cities regarding environmental sustainability are air quality, circular economy, climate adaptation, energy transition, sustainable use of land and nature-based solutions, and urban mobility. Regarding digital platforms, the Urban Agenda's priority theme of digital transition is also very important (European Commission, 2024). As we can see EU has a strong focus on urban sustainability. From a business development viewpoint, it is important that the digital platform can be integrated easily into urban sustainability initiatives. This ensures that there is a market for the digital platform and also the industry is backed and supported by the local governments. This helps to mitigate risks and creates a stable business environment.

The second aspect, “Scalability and expansion” is important for the ability of the digital platform to generate profits and be successful. The development of digital platforms is

expensive and takes a lot of resources and time. As we can see from the case digital platforms are very scalable and offer easy expansion to new markets. The business model should be designed so that it can cater to different market demands with little modification. Vinted is a great example of this, they have expanded to various European markets because of the scalability of their business model. Digital platforms enable the possibility of creating online marketplaces that operate solely online. This creates a situation where entering new markets becomes easier. When operating with a digital platform as a business model the infrastructure changes required to enter new markets primarily involve digital localization, such as language options and local payment methods. This makes the expansion more straightforward when there is no need for physical infrastructure changes (Jocovski et al., 2020). Vinted operates with a peer-to-peer model that enables easier scalability as more peers join the network the available resources capacities grow the network can withstand higher usage and accommodate more users without relying on centralized infrastructure, which could create a bottleneck (Kanade, 2023).

The third aspect of data analytics is evident in the case digital platforms. As identified from the case studies, all of the digital platforms utilize data analytics to a high degree. In the case of BlaBlaCar, the digital platform utilizes data analytics for optimizing ride matching, route optimization, and user behavior analysis. SHARE NOW uses data analytics for fleet management, energy consumption analysis and for dynamic pricing. In the case of Vinted, they can use data analytics for user engagement strategies. Data analytics can be used to improve environmental sustainability. One possibility is to create a sustainability dashboard that uses data analytics to provide insights into Key Performance Indicators such as carbon footprint, energy usage, waste generation, and resource utilization. The correct utilization of this data can lead to improved sustainability and cost savings. Scholars have discussed the use of data analytics for sustainability and cost savings. Bertsimas et al. (2014) state that the use of big data can help achieve environmental sustainability and cost savings by prescribing optimal decisions. Especially predictive analysis can help digital platforms to anticipate future

trends and user behavior. Data analytics can also help digital platforms integrate with urban sustainability initiatives by integrating their data systems with smart city infrastructures to enhance urban sustainability efforts.

Based on the literature review and comparative case study research, my strategic recommendation for future business development are to incorporate circular economy models into the business development of digital platforms. The circular economy has been identified as one of the key factors in implementing environmental sustainability into business (Ghisellini, 2016). Moreover, digital platforms provide an excellent platform for the implementation of the circular economy. All of the case digital platforms utilize circular economy elements in their business model. Firstly, digital platforms provide an opportunity to leverage the peer-to-peer network. Smart cities can be viewed as huge markets with millions of inhabitants looking to share resources, rather than opting to own these resources individually. SHARE NOW is an excellent example of this. In smart cities where infrastructure and resources are broadly available it is easy to integrate circular economy to this ecosystem. The opportunities are limitless for business developers in this area. Key opportunities in this area could include developing resource sharing platforms, services that extend the lifecycle of products, digital platforms for products as a service (PaaS) and digital platforms that take part in collaboration with municipalities.

From a technological viewpoint, digital platforms should utilize blockchain technology, AI in their operations. Blockchain technology integration can provide businesses with enhanced security and transparency, smart contracts, and identity verification. All of these factors will make the digital platform safer and more trustworthy in the eyes of the users. Smart contracts can reduce overheads and eliminate the need for intermediaries, making transactions faster and less costly. Lastly, identity verification systems enabled by blockchain ensure that all participants are verified and reliable. This is very important in the context of resource sharing platforms for example. AI can be used to analyze user behavior, resource usage patterns, and external data. This will

streamline the business operations and also help automatize the strategy creation in digital platform businesses. AI can also personalize user experience which is a highly valued attribute in the most popular digital platforms. One example of this is TikTok, the user experience is unique to each user, contributing to the success of the platform. Combining blockchain technology and AI digital platforms can automatize a large proportion of their operations and for example, automate decision-making to maximize environmental sustainability.

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