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Summary of WP Student Team

Assessing the Viability of Drone Technology for E-commerce Last-Mile Deliveries:

A Dual Perspective Analysis of Businesses and Customers

Group constitution:

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Work project carried out under the supervision of:

Advisor: João Castro

A Work Project, presented as part of the requirements for the Award of a Master's degree in
Management from the Nova School of Business and Economics.

ASSESSING THE VIABILITY OF DRONE TECHNOLOGY FOR E-COMMERCE LAST-
MILE DELIVERIES:
AN ANALYSIS OF CUSTOMER PERSPECTIVES- Theresa Marie Munker

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Group Abstract

The integration of drone technology in logistic systems is a rapidly growing area of scientific research. This work project reports findings from expert interviews and a survey on the viability of drone technology as a method for last-mile deliveries in the e-commerce industry alongside a comprehensive review of existing academic literature in this domain. Several influencing factors were used to discuss results from a business and customer perspective on an economical, technological, and operational dimension. Overall, the results indicate that drones are not feasible for last-mile e-commerce deliveries, combining infeasibility from a business perspective and feasibility from a customer perspective.

Individual Abstract

The integration of drone technology in logistic systems is a rapidly growing area of scientific research. This work project reports findings from expert interviews and a survey on the viability of drone technology as a method for last-mile deliveries in the e-commerce industry alongside a comprehensive review of existing academic literature in this domain. Several influencing factors were used to discuss results from customer perspective on an economical, technological, and operational dimension. Overall, the results indicate that drones are a feasible solution for last-mile e-commerce deliveries from a customer perspective.

Keywords: drone technology, e-commerce, last-mile delivery, logistics

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1. Introduction

“It will work, and it will happen, and it’s going to be a lot of fun”. With these words, Jeff Bezos, founder and former CEO of e-commerce and delivery company *Amazon*, confidently announced in 2013 that the company's drone delivery service *Prime Air* would autonomously deliver packages to customers within the next four to five years (Kovach 2013). Today, a decade later, drone deliveries in e-commerce remain rare. Despite high expectations, *Prime Air* managed to deliver packages to fewer than 10 houses within a month of its launch in December 2022 (Wayt 2023). Other significant players in the e-commerce and parcel delivery space like *DHL*, *UPS*, and *JD.com* have also entered the drone delivery space, but their success remains uncertain due to several obstacles that must be overcome. Amid these challenges, the surge in online shopping has led to an increased need for efficient and prompt delivery methods, as the growth of e-commerce has complicated transportation systems, requiring streamlined logistics, optimized delivery routes, and innovative last-mile delivery solutions. The increasing adoption and innovation of Artificial Intelligence (AI) and the Internet of Things (IoT) have led to the emergence of smart technologies and intelligent transport systems. These include autonomous vehicles like drones, which have gained popularity in revolutionizing last-mile deliveries (Sorooshian et al. 2022). In sectors such as healthcare or food delivery, drones have already been successfully deployed for delivering goods (Ayamga, Akaba, and Nyaaba 2021). However, despite the promising idea and hype surrounding this innovation, the limited practical success of delivering parcels to customers raises questions about the feasibility of deploying drone technologies for e-commerce last-mile deliveries. Thus, this work project explores the complex dynamics of leveraging drones as vehicles for last-mile deliveries, assessing the feasibility and implications for businesses and consumers in the e-commerce sector. The scope of this research is specifically focused on business-to-consumer (B2C) logistics, concentrating on the final leg of deliveries (last-mile deliveries). Within technological innovations in this space, the study narrows its focus exclusively to parcel deliveries carried

out by drones in the e-commerce sector. This targeted approach ensures a concentrated investigation into the specific challenges and potentials within the e-commerce landscape, providing a nuanced understanding of the implications of integrating drones in this industry. The research methodology used in this study involves expert interviews to gain in-depth insights into the business side of utilizing drones for e-commerce deliveries. Additionally, a comprehensive survey has been conducted to evaluate customer demand and acceptance concerning drone delivery services for last-mile logistics.

Section two of this paper provides an overview of the e-commerce industry based on existing literature. It covers market trends, critical customer expectations, technological advancements in e-commerce logistics, particularly last-mile delivery, and the challenges associated with traditional last-mile delivery methods. Furthermore, the focus of the section will shift to the disruptive potential of autonomous drone technology, covering its classification, regulatory landscape, and diverse use cases. Following this exploration, the section will present the research gap. Section three will cover the research methodology, explaining the methods chosen for data collection and preparation. Section four covers the results and findings of leveraging drones for last-mile deliveries in e-commerce. It includes an analysis of the business case and customer demand on an economical, technological, and operational assessment dimension. Section five will discuss the practical implications and recommendations, drawing insightful conclusions from the results and findings. Section six will highlight limitations and avenues for future research, and section seven is dedicated to concluding this work project.

2. Literature Review

This literature review explores the dynamic evolution of e-commerce, with a specific focus on last-mile deliveries. The section further examines and classifies drone technologies and reviews a range of commercial applications for this technological innovation.

2.1. E-commerce Industry Overview

The explosive growth of the e-commerce industry has reshaped the landscape of retail, challenging businesses to adapt to the evolving demands of an increasingly digital consumer base and emerging disruptive technologies.

2.1.1. Growth Statistics and Market Trends

The e-commerce industry can be broadly defined as the method of buying and selling goods and services through online commerce channels. It can be categorized into four different types: business-to-business (B2B), business-to-consumer (B2C), consumer-to-business (C2B), and consumer-to-consumer (C2C), which are characterized by different business models. This work project focuses on the B2C market, as last-mile drone deliveries essentially impact the end customers of e-commerce companies. The B2C e-commerce industry (hereafter referred to as the e-commerce industry or the industry) has grown significantly over the past decade, reaching a total revenue of 3.32 trillion USD in 2022 (Statista 2022a). This is mainly driven by the immense rise of the internet user base and the ever-advancing global digitalization. In recent years, the industry has further experienced unprecedented growth driven by the Corona pandemic, which has forced companies and customers to adapt to online transactions. The industry's global growth surpassed initial projections, recording a 22% growth beyond the anticipated 12% from 2020 to 2021 (International-Trade-Administration 2022). The e-commerce industry is forecasted to reach 5.18 trillion USD in revenues by 2026, representing a growth rate of 56% (as of 2022 records). The top geographical markets based on sales revenue in 2022 within the e-commerce industry are China (1,236 billion USD), the US (811 billion USD), Japan (145.10 billion USD), the UK (132.70 billion USD), and Germany (100.90 billion USD) (Statista 2022b), however, emerging markets are also gaining significant relevance in the e-commerce industry (Yasmeen 2023).

2.1.2. E-commerce Logistics

Per definition, e-commerce is the electronic transaction between customers and sellers, however, one of the most important processes for selling/purchasing goods online are the underlying supply chain operations (Ramanathan, George, and Ramanathan 2014). The logistics behind e-commerce operations (also referred to as e-fulfillment) are complex and cost-intensive. Within existing research, e-commerce logistics is separated into five main areas: supply chain network design; outbound logistics (including last-mile deliveries), reverse logistics; warehousing; and IT and data management (Zennaro et al. 2022). E-fulfillment models exhibit distinctive characteristics such as their dynamic and fast-paced nature, differentiating themselves from traditional logistic models (Tarn et al. 2003). Disrupting trends such as evolving customer expectations and technological advancements force supply chain operators within e-commerce to constantly adapt. To retain a competitive edge over other participants (Wang et al. 2020) and achieve enhanced operational effectiveness (Alicke 2016), operations must consistently strive for increased speed, efficiency, and cost-effectiveness.

Customer Expectations

For e-commerce businesses, customers are the key players for success, as they drive revenue and profitability, are marketing drivers, and provide valuable insights and criticism leading to innovation and improvements (Brown 2022). Modern e-commerce companies' business models are designed to serve the customer's best interest and keep customers satisfied. A study by Homburg, Koschate, and Hoyer (2005) underlines a robust connection between customer satisfaction, particularly the perceived increase in satisfaction, and the willingness to pay for services and products, underlining the importance. One example of a customer-centric strategy is *Amazon*, which excels in prioritizing the customer and designing its business model around them (Slater 2023). The e-commerce growth has not only been increasing sales and revenues for operating businesses but has also elevated customer expectations regarding the underlying

supply chain operations, especially regarding delivery speed, flexibility, and convenience (Lim, Jin, and Srai 2017). Common customer preferences are free delivery, same-day delivery, predetermined delivery timeslots, and shipment tracking (Vakulenko et al. 2019). Sustainable operations to reduce CO2 emissions are also increasingly important to customers (Ignat and Chankov 2020). Meeting these expectations presents significant challenges for e-commerce and delivery companies as dissatisfying customers not only harms the topline but can also cause a competitive disadvantage in the industry.

Technological Advancements

E-commerce companies are forced to evolve and adapt not just due to shifting customer expectations but also because of technological advances. Rapid technological progress is a positive consequence of accelerating globalization, as it drives innovation across different industries and economies. The fourth and most recent industrial revolution, Industry 4.0, which describes the rapid technological advancements in the 21st century is revolutionizing many existing industries, including the supply chain industry (Alicke 2016). The industry has experienced substantial changes, revolutionizing not only the management of logistics but also significantly enhancing efficiency and effectiveness across the entire supply chain process. According to Khan (2023), technological advancements have helped “[...]businesses to streamline their operations, reduce costs and improve their bottom line” and will continue to do so. Many companies, such as *Amazon*, *UPS*, and *DHL* have started using innovative solutions within their supply chain operations to enhance efficiency and meet ever-growing customer expectations. Some examples highlighted by Khan (2023) are AI, machine learning (ML), and the use of big data to optimize supply and demand forecasting and inventory management. Furthermore, blockchain technologies and the IoT are leveraged for increased traceability, security, and better monitoring of goods, while autonomous vehicles like drones have the potential to improve logistics and transportation efficiency.

2.1.3. Last-Mile Logistics

One of the most critical aspects influencing the success of e-commerce companies is the efficiency of the last-mile logistics (Truxcargo 2023). Last-mile logistics refers to the final leg of the supply chain, where ordered products are delivered from a distribution center to the end consumer (Lim, Jin, and Srai 2017). It is a complex process influenced by various factors, including geography, transportation infrastructure, and consumer preferences. Efficient last-mile logistics can significantly impact overall supply chain performance and hold noteworthy importance in guaranteeing customer satisfaction (Truxcargo 2023). According to multiple studies, customers perceive a company's logistics performance, especially the last-mile distribution performance, as an important factor of their overall e-commerce satisfaction ((Agatz, Fleischmann, and van Nunen 2008), (Esper et al. 2003)). This showcases the importance of the close relationship between last-mile delivery performances and e-commerce customer satisfaction and loyalty (Yu et al. 2016). Existing solutions for distributing products to the end customer successfully include delivery trucks (electrical & combustion), crowdsourcing logistics, and delivery hubs that act as parcel lockers. Promising innovative solutions, already in existence but operating on a smaller scale, include delivery robotics and autonomous drones and vehicles, which are subjects of ongoing research and development (Ha et al. 2018).

2.1.4. Challenges Faced in Traditional Last-Mile Delivery

Currently, last-mile delivery operations represent the least efficient, most expensive, and most environmentally detrimental aspect of e-commerce deliveries (Mangiaracina et al. 2019; Gevaers, Voorde, and Vanelander 2011). Estimations reveal that last-mile delivery costs can reach up to half of the total logistic costs associated with shipping a product to the end-customer (Vanelander, Deketele, and Hove 2013). These high costs are mainly influenced by the inefficiencies within the process, such as (i) complexity of the route planning and batching of parcels for multiple stops which leaves little room for errors or delays due to described

heightened customer expectations; (ii) traffic congestions, especially in urban areas and during rush-hours, leading to delays in delivery and longer lead times, causing dissatisfaction for customers and drivers; and (iii) the management of delivery windows, which offer flexibility to customers, however presents challenges for delivery companies (Truxcargo 2023). The cost implications of last-mile logistics, including the cost of maintaining a fleet of delivery vehicles and drivers and ensuring timely and accurate deliveries, present hurdles that require innovative solutions that ultimately improve the top and bottom lines of companies operating in this space through more efficient and effective solutions for the supply chain and the customer.

2.2. Unmanned Aerial Vehicles

The global Unmanned Aerial Vehicle (UAV, hereafter also referred to as “drone”) market is experiencing explosive growth, attracting substantial investments from both government and commercial sectors. The commercial drone market, which encompasses a range of applications including filming/photography, delivery and logistics, agriculture, inspection and maintenance, surveillance, and monitoring, was valued at 8.77 billion USD in 2022 according to *Fortune Business Insights* (FortuneBusinessInsights 2023). It is projected to undergo significant growth, reaching 10.98 billion USD in 2023 and demonstrating remarkable expansion, expanding to 54.81 billion USD by 2030. Notably, the delivery and logistics sector is expected to demonstrate a higher Compound Annual Growth Rate (CAGR) over the forecast period (FortuneBusinessInsights 2023). In the delivery and logistics sector, major companies like *Google* and *Amazon* are investing heavily in drone technology, with investments totaling about 2.5 billion USD between 2013 and 2019 according to the aerospace consultancy *Teal Group* (Streitfeld 2023). The drone industry is characterized by its untapped potential, with many unexplored niches. Therefore, researchers strive to identify evolving trends in this dynamic and rapidly growing sector.

2.2.1. Classification

UAV classification is essential for comprehending their varied applications. UAVs are aircraft that are operated without a human pilot on board and function autonomously. Within the context of UAVs, the term 'autonomous' refers to the capacity for drones to operate independently using sophisticated algorithms and sensor technology, thereby allowing for precise navigation in complex environments (T. Lee, McKeever, and Courtney 2021). Initially designed for military purposes, drones are evolving from their strategic military roles to an assortment of non-military applications, profoundly transforming industries such as logistics, agriculture, healthcare, and entertainment (Kapustina et al. 2021).

Critical design factors such as weight, wingspan, range, speed, and level of autonomy differentiate drone models and serve as essential classification criteria. Fixed-wing drones are proficient in large-area mapping and agriculture, thanks to their capacity for long-range operations and efficient coverage. However, they do have their limitations, including the need for horizontal take-off and the inability to hover. Multirotor aircraft, such as quadcopters or hexacopters, are advantageous for aerial photography, search and rescue, and commercial delivery, as they can vertically take off and land (VTOL), hover, and maneuver in restricted spaces. Nonetheless, they are limited by their payload capacity and sensitivity to environmental factors like weather conditions. Single-rotor drones have various military, heavy transport, and surveillance applications due to their ability to carry heavier payloads and endure longer flights. However, they also have downsides, such as complex mechanics, higher maintenance, and increased costs. Hybrid drones, on the other hand, offer versatility for missions such as surveillance and inspections by combining the benefits of fixed-wing and multirotor types. Nonetheless, their design complexity and potential for higher costs pose certain challenges. Nano-drones, which are small in size and ideal for indoor surveillance or recreational flights are affordable but constrained by their limited payload capacity and short flight times. ((Heutger and Kückelhaus 2020), (Hassanalian and Abdelkefi 2017)). Regardless of the drone

classification, successful drone operations require a safe and secure environment for take-off and landing with sufficient space and minimal obstacles to avoid accidents (DSLIR 2023). For last-mile deliveries, multirotor drones with the ability for VTOL are utilized in most use cases. Appendix 9.2. summarizes and visualizes the discussed drone types.

2.2.2. Regulation

The regulation of UAVs is crucial to guaranteeing their safe and responsible use. Across the world, governments and aviation authorities have implemented strict regulations to govern UAV operations. These regulations typically encompass aspects such as drone registration, pilot licensing, no-fly zones (including airports and sensitive areas), maximum altitude and speed limitations, and guidelines for safe flying practices (Bassi 2019). In addition, regulations commonly cover privacy concerns, data protection, and insurance prerequisites for drone operators. As technological innovation progresses, regulatory bodies frequently revise these regulations to achieve a middle ground between innovation and public safety, facilitating the ethical incorporation of UAVs into various industries while averting potential hazards (D. Lee, Hess, and Heldeweg 2022). Currently, there seems to be a lack of agreement in developing unified regulations that extend across global borders and continents. Rules vary considerably from country to country, leading to a complicated regulatory environment to successfully launch and scale drone activities (Heutger and Kückelhaus 2020).

2.2.3. Use Cases

UAVs are increasingly utilized in commercial and public sectors for a multitude of purposes. As this literature review highlights, innovation in logistics especially last-mile delivery is vital. Research on the applications of drones most relevant to last-mile logistics can be primarily grouped into three areas: global health, perishable goods, and e-commerce & package delivery, with most of the success being observed in the first two areas.

Global Health

In global health, drones have become an effective means of transporting essential medical supplies, especially in regions with insufficient road infrastructure or during emergencies (Konert, Smereka, and Szarpak 2019). Drones can be an efficient mode of delivery for medical supplies, such as blood samples or prescription medicine, due to their small size, low weight and high value, making drones a suitable transportation method for urgent items (Moshref-Javadi and Winkenbach 2021). Drone manufacturers and operators *Matternet* and *Zipline* are among the companies that have pioneered drone delivery logistics, focused on using drones in the healthcare sector for the delivery of medical supplies. *Zipline's* operation in Rwanda has reduced delivery times from 4 hours to less than 30 minutes for blood samples and other medical products, demonstrating the potential of medical logistics through the use of drones (Ling and Draghic 2019). By September 2023, *Zipline* has safely completed more than 750 thousand commercial drone deliveries and is among the few companies that are authorized by the *Federal Aviation Administration (FAA)* to make deliveries beyond visual line of sight (BVLOS) and without human observers in the US (Zipline 2023). *Matternet*, in partnership with *UPS*, is one of the other major players that has obtained *FAA* clearance for the transportation of goods via drone BVLOS for commercial purposes, representing a significant stride towards the progression of medical logistics through the UAV technology (Fox 2023). To date, *Matternet* has completed over 20 thousand commercial flights (Matternet 2023). *Amazon Pharmacy*, a subsidiary of *Amazon*, has deployed its drone delivery service for residents in College Station, Texas, for the free delivery of prescription medications within just 60 minutes of ordering in October 2023 (Amazon 2023b). Hiebert et al. (2020) suggest in their review of the application of drones in healthcare and health-related services in North America that drones could already offer a financially viable solution in hard-to-reach areas, however, more research on the cost of such a service is suggested to be conducted. The discussed

applications indicate that commercial drone deliveries in the context of global health are successfully emerging as an innovative approach to last-mile deliveries.

Perishable Goods

Drone deliveries have also received increasing attention for the delivery of perishable goods. This is due to the demand for speedy food delivery, and long travel times in cities with heavy traffic (Moshref-Javadi and Winkenbach 2021). Ongoing innovation by companies worldwide showcases the potential of this technology: *Manna Aero*, a drone delivery company mostly focused on the delivery of food items from local vendors, completed over 100 thousand deliveries in Ireland and is in the process of expanding to Europe and the US in 2023. Their drones operate at 50 miles/hour (80 km/hour), conducting 7-8 deliveries per hour within a five-mile radius from local stores, at one-tenth the cost of a human driver (Koetsier 2023). Multinational technology company *Alphabet* conducted trials of drone deliveries through its subsidiary, *Wing*. The company used this service to transport, for example, *Chipotle's* burritos within Virginia and thereafter expanded operations to remote regions in Australia. Today, the company has completed over 350 thousand deliveries in 10 locations across 3 continents and has recently started to partner with *Walgreens*, an American pharmacy store chain, and *Walmart*, an American multinational retail corporation, to further expand its service into the retail business (Wing 2023). *Walmart's* drone delivery service is gaining momentum, with increasing demand for food and drink items. The retail giant has expanded its service to 37 store-based deployment hubs and 26 municipalities and delivered over 6000 orders via its drone service in 2022 (O'Brien 2023). The discussed use cases showcase the effective emergence of commercial drone deliveries within the context of perishable goods, especially in the food and beverage industry, showing promising potential as an innovative solution for last-mile deliveries.

Package Delivery & E-Commerce

In the field of package delivery, drones have become a technology with the potential to revolutionize expensive supply chain operations. Drones are expected to offer not only a cost-effective solution but also an environmentally friendly one for the expensive and time-intensive last-mile deliveries (Chiang et al. 2019). Postal service businesses, such as *UPS* and *DHL*, are investigating advanced multi-modal delivery techniques that combine trucks and drones to enhance productivity. *UPS* cooperates with *Workhorse*, a manufacturer of electric vehicles, by testing a configuration in which drones are loaded with packages from a truck, dispatched to deliver products, and then returned to the truck for package collection and battery replacement (Adler 2020). The project is currently in the research and development phase and, as of now, no packages have been delivered to customers by drones. Nonetheless, *Workhorse* announced it is making “significant advancements” and is working on legal and regulatory approvals with the *FAA* (White 2023). *DHL* presented its Parcelcopter 4.0, proficient in vertical take-off and horizontal flight, considerably diminishing delivery times to remote regions. However, the project was discontinued in 2021 (Daleo 2021), and according to *DHL's* website, the company estimates drones to only become a reality in 5-10 years given the limited applicability of use cases, despite drones being described as having a ‘moderately high impact on logistics’ (DHL 2023). Several other major retailers and e-commerce businesses, such as *Amazon*, *JD.com*, and *Rakuten*, are also investing in drone technology for quick and effective parcel deliveries. Chinese e-commerce company *JD.com* announced its drone delivery program targeted at rural areas in 2015 (JD.com 2017), with the ambition to operate one million drones in the sky in the future according to an interview with the company’s CEO (WSJ 2017). In 2023, the company seems to have not realized its announced plans, as no information on its drone service can be found. *Amazon* introduced *Prime Air* in 2013 intending to deliver packages to customers' front doors within half an hour of placing an order. The company’s drone prototype can travel up to

80km/h and carry a payload of up to 2.3kg, covering up to 86% of all products sold on the website (Singireddy and Daim 2018). An early study by Sudbury and Hutchinson (2016), which analyzed the costs of *Prime Air*, suggested that by implementing drone technology widespread, *Amazon* could gain a cost advantage of around one-third per package delivered against using ground delivery methods. However, *Prime Air's* delivery service seems to struggle to break through, as in its test trials, the company only managed to keep its drones flying by giving away free products according to the *New York Times*. Hurdles like weight, size, fragility, selection, weather conditions, cars in driveways, trees in backyards, and more have made last-mile drone delivery to homes a difficult project to realize (Streitfeld 2023). By the end of 2023, no actual widespread success of last-mile deliveries for their e-commerce business has been reported, however, the company is now set to start new trials with their new drone prototype which is planned to take off in late 2024 in the UK, US and Italy (Amazon 2023a). So far, the discussed applications of drone deliveries in the e-commerce sector have not demonstrated practical success, pointing to hurdles in innovating last-mile delivery services.

2.3. Research Gap & Research Scope

The existing literature showcases the potential of drone deliveries for various applications. However, when comparing the progress made by present drone delivery companies, it becomes evident that only the medical and perishable goods use cases can be considered successful, establishing themselves as an innovative solution for last-mile deliveries. These product use cases are distinctive due to their time-sensitive and urgent manner and are typically characterized by single-order deliveries. However, in the scope of e-commerce parcel deliveries, the integration of drone technology still seems to encounter difficulties when deploying drones for last-mile delivery services. Despite e-commerce and parcel delivery giants like *Amazon*, *JD.com*, and *UPS* investing millions of dollars in these operations for over a decade, no notable success can be observed, with the international parcel courier *DHL* even

completely abandoning the innovative operations. This raises questions about the feasibility of drone delivery technologies within last-mile parcel delivery operations in the e-commerce landscape. Thus, this work project seeks to answer the research question (RQ): ***“Are drone technologies a feasible solution for last-mile parcel delivery in e-commerce from a business and customer standpoint?”***. To comprehensively examine this feasibility, the work project is methodically structured around two paradigms as seen in Figure 1:

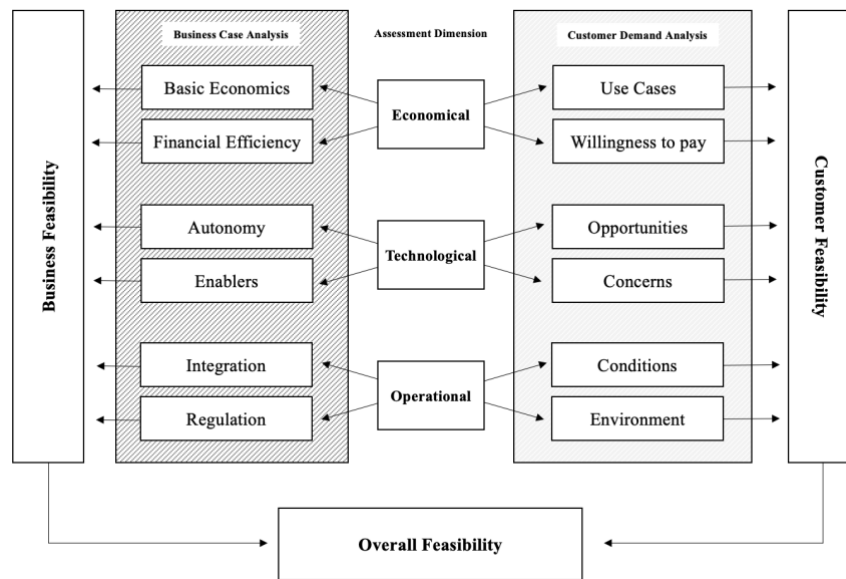


Figure 1: Research Framework

The paradigms, (1) Business Case and (2) Customer Demand, represent two main perspectives when analyzing last-mile drone deliveries in e-commerce. Businesses engaged in last-mile drone deliveries are the primary entities leading the process, directly influencing the efficiency and performance of last-mile delivery, and ultimately determining whether this technological innovation is realized on a larger scale or not. Further, given the importance customers play in driving revenues within the e-commerce sector, a part of the research is focused on the customer. Customers not only contribute to financial success but also are the final point of contact during the last-mile delivery process, experiencing this process firsthand. Within each paradigm, the research is further separated into multiple influencing factors which are categorized into three assessment dimensions: the economic, technological, and operational

dimension. All foundational influencing factors for the research are based on established business practices, consolidating micro- & macroeconomic components, as well as technological factors with significant relevance for drone technologies.

Within the economic dimension, the focus is on the basic economics and financial efficiency of businesses deploying drones as delivery vehicles. Simultaneously, general customer demand and willingness to pay for drone deliveries will be explored. Concerning technological factors, the study explores autonomy levels, as well as technological enablers, to assess the technological feasibility from the business perspective. Additionally, technological opportunities and concerns are explored from the customer's perspective and their influence on customer demand. To establish feasibility in the operational domain, the operational integration of drones and regulations of last-mile drone delivery businesses will be analyzed. Furthermore, a focus is set on operational conditions from a customer perspective, while also considering the environmental impact on customer acceptance of last-mile drone technologies for parcel deliveries. Once all these underlying factors have been discussed from a business and customer perspective, an overall assessment of feasibility can be made.

3. Research Methodology

The feasibility of drone technology for last-mile delivery in e-commerce is a multi-disciplinary research field that combines social science and applied science in business and economics.

3.1. Selection of Methods for Data Collection

When conducting research, a structured and systematic approach is essential for ensuring the reliability and validity of the study. The research onion, developed by Saunders et al. (2007), provides comprehensive decision-making guidance that leads researchers through the layers of complexity inherent in the research process. This metaphorical onion consists of several layers, each representing a critical aspect of the research design, from broad philosophical considerations to specific data collection and analysis methods. Applying the research onion

to investigate the research framework, both qualitative and quantitative data collection methods were selected, allowing for a deductive approach to be explored. The strategies chosen are (i) expert interviews, a qualitative strategy, that allows for an in-depth exploration of the subject matter through conversations with knowledgeable individuals; and (ii) a survey, a common strategy in social research, involving the collection of categorical and qualitative data through a structured questionnaire. Both strategies follow a cross-sectional design, capturing snapshot data from businesses and customers.

3.1.1. Expert Interviews

The selected interviewees are considered experts due to their position, status, and the knowledge attributed to them (Bogner, Littig, and Menz 2009). The experts interviewed have explicit knowledge of the relevant topics and are interviewed with the help of a guideline that ensures a comparable survey situation for all respondents (Bogner, Littig, and Menz 2009). The direct advantage of guideline-based expert interviews is that different perspectives on a topic can be collected. In the context of this work, different stakeholders were interviewed who are involved in drone technology development and operation, as well as experts in the e-commerce and logistics industry. When selecting the interview partners, it was ensured that the experts were from different fields within the industries to guarantee the heterogeneity of the interviews. All experts interviewed are familiar with the topic of drone technologies due to their work and position and can contribute to answering the RQ with their expertise. The experts interviewed are listed in Table 1:

#	Date	Expert	Acronym	Industry	Company	Position
A	16.10.23	Frank Steinbrenner	FS	Logistics/ Last-Mile Delivery	<i>DHL</i>	Head of Subordinate Mannheim
B	19.10.23	Michael Cunningham	MC	Drone Delivery	<i>Manna Drones</i>	Head of Commercial
C	25.10.23	Nathalie Steinmaurer	NS	E-Commerce	<i>Amazon</i>	Head of AVS FMCG
D	27.10.23	Ana Manuel Almeida Martins	AM	Drone Delivery	<i>Connect Robotics</i>	Executive Management Assistant/ Business Developer

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E	30.10.23	Lasha Sharikadze & Dr. Olaf Funke	LS & OF	E-Commerce & Technology	<i>Digital Settings</i>	CEO & COO
F	07.11.23	Ryan Walsh	RW	Drone Delivery Infrastructure	<i>Valqari</i>	CEO/ Founder

Table 1: Expert Interviewees

All interview partners were provided with the interview guide in advance of the interview so that they could prepare for the questions. The interviews were conducted via video conference and recorded with the consent of the interview partners. These recordings serve as the basis for the preparation and evaluation of the expert interviews. All interview partners agreed to be cited and named as part of this research.

3.1.2. Survey Research

A cross-sectional online survey was conducted to evaluate the impact of drone technologies on end consumers' demand and acceptance of last-mile delivery services in e-commerce. Technical abbreviations were explained upon their initial use. The information presented has a clear logical structure with causal connections between statements. The survey aimed to assess several factors influencing customer demand for last-mile delivery, including online shopping behavior, believed satisfaction uplift levels, and perceived benefits and concerns, which are assumed to affect the demand and acceptance of drone technologies for last-mile delivery in e-commerce. To accomplish a sufficient analysis of the demand, a subset of 27 questions (including 6 demographic questions) was created, structured by different factors and ratings (see Appendix 9.5. for the full set of questions). The survey mainly used Likert scale (1 through 5) measures, multiple choice, and a few open-ended questions to allow customers to share their ideas and thoughts. All questions were founded on the thorough literature review conducted before the investigation. The study's target population consisted of e-commerce customers with no restrictions on age, gender, nationality, or occupation. Given that the questionnaire was predominantly shared within the authors' network, it was provided in English and German. The research does not incorporate a control group, and the sample size of 138 participants

exceeds the predetermined minimum of 100 respondents, ensuring statistically relevant results. Ethical standards were adhered to throughout the research process, ensuring confidentiality for all participants, voluntary participation, and transparent data reporting.

3.2. Data Preparation

To assess and analyze data obtained from expert interviews and the survey, two distinct data preparation methods were employed. For qualitative interviews, it is imperative to standardize and present the interview data understandably. In qualitative interviews, the basis for the data is the verbatim transcription of the interview (Poland 1995). During the creation of the transcripts, a standard format was utilized which contained the name, position, and date of the interview, non-verbal aspects were not recorded. To systematically analyze the qualitative data obtained from the interviews, the Framework Analysis method developed by Ritchie (1994) was employed. By applying the various stages of familiarization, identifying themes, indexing, charting, summarizing, and mapping, the data is rendered comparable across various topics and within the interview.

The survey comprises mainly categorical data; therefore, a systematic approach was adopted. This approach arranged the dataset for analysis, addressing missing data through imputation or exclusion, pinpointing and handling outliers, coding, and recoding variables, creating derived variables, and transforming data to fit underlying statistical tests. Survey data was used to elaborate on descriptive statistics, showcasing customer trends as well as connections between variables. Data was analyzed to be comparable to previously explored literature as well as in line with the Technology Acceptance Model (TAM) (Davis 1989), which asserts the perceived usefulness and perceived ease of use concerning technology acceptance of customers.

4. Results and Findings

This section presents the results and findings of a comprehensive analysis of expert interviews and survey respondents to assess the feasibility of drone technology for last-mile e-commerce deliveries. The section comprises two distinct components: a business case analysis and a customer demand assessment.

4.1. Customer Demand Analysis

This section will analyze the second feasibility paradigm of drone technologies in last-mile parcel deliveries in e-commerce: customer demand. To comprehensively evaluate this a survey was conducted, questioning potential drone delivery customers. Throughout the customer analysis, the feasibility of drone technologies is measured by demand, retrieved as the customers' willingness to use the technology. Customer demand is an essential factor for companies to successfully deploy a technology and for the general adoption of a technology in society. Multiple influencing factors will be assessed to answer the sub-RQ: "*What factors significantly impact the customer demand for drone delivery technologies?*", which supports the main RQ introduced earlier.

4.1.1. Economical Dimension

To assess the economic feasibility of drone technologies in last-mile e-commerce deliveries, customer demand and perceived use cases, both independently and in comparison, to expert inputs, will be analyzed. Further, willingness to pay will be explored. In conjunction, these factors offer a comprehensive economic evaluation of the overall customer readiness for the technology.

General Demand & Use Cases

Firstly, to assess the general demand for drone technologies in last-mile delivery (Q9), findings of the descriptive analysis of all responses to the survey revealed that 113/138 (81.9%) respondents indicated a willingness to adopt this innovative approach to last-mile deliveries and only 25/138 (18.1%) participants expressed reluctance to use drone technologies for last-mile delivery. However, given a strong general willingness to adopt the technology, within the sample of 138 respondents, only 41 (29.7%) expressed a preference for an e-commerce platform based on the inclusion of drone delivery (Q10), while 69 (50%) respondents showed a disinclination and 28 (20.3%) remained uncertain. Diving deeper into analyzing the customer

base by looking into the demographic characteristics of the respondents, the survey encompassed a diverse age range of respondents. Most respondents were scattered across Generation Z (18-26 years old; 48.5%), Millennials (27-42 years old; 17.4%), and Generation X (43-58 years old; 23.9%). Despite Generation Z constituting the largest segment of hesitant participants (13/25, 52%), a more distinctive percentage distribution analysis indicated that older generations (Baby Boomers (59 – 77 years old) and Silent Generation (78 years old or older) were, comparatively to younger generations such as Generation Z, Millennials and Generation X, more resistant to drone adoption, with “unwilling to adopt drone technologies” percentages of 50% and 54.55% versus 19.4%, 0%, and 15.5%, respectively. Examining the gender distribution, 53/138 (38.4%) of respondents identified as male, while 85/138 (61.6%) identified as female. The analysis of the demand for drone technologies for last-mile delivery revealed that male respondents exhibited a higher inclination (89%) compared to their female counterparts (78%). This observed gender-based preference extended to e-commerce platform preference, where 38% of male respondents would favor delivery channels that offer drone delivery, contrasting with 25% of female respondents expressing a similar preference. Furthermore, diving into the occupational categorization, including Employed (67/138, 48.5%), Students (46/138, 33.3%), Self-Employed (23/138, 16.7%), and others (3/138, 2.2%). Deriving insights into the willingness to embrace drone technologies based on their occupation, no significant discrepancies were observed among these groups. The “others” category, predominantly comprising retired individuals, stood out with higher reluctance compared to the remaining groups. This result can be aligned with the findings based on age demographics, as retired individuals tend to be part of one of the older generations.

Assessing the general demand for drone technologies in last-mile delivery, a potentially significant factor is the online shopping frequency. Given the evidenced increasing trends in e-commerce and the online shopping demand (see literature review (2.1.1)), it can be assumed

that the increasing shopping frequency may impact drone technology adoption in last-mile e-commerce delivery. To test this, the influence of online shopping frequency (Q1) on the willingness to use drones (Q9) was investigated. The assumption underlying this research question posits that frequent online shoppers are more amenable to drone adoption, while less frequent online shoppers are not, drawing support from existing literature suggesting that customer frequency positively influences the perceived usefulness of products and solutions (Hart and Porter 2004). The null hypothesis (H0) stated that online shopping frequency and willingness to use drones are independent variables, while the alternative hypothesis (H1) proposed their dependence. A Chi-Square Test of Independence, utilizing a contingency table, was used. Accounting for low sample sizes of two answer groups, data was regrouped (“*Daily*” added to “*2-3 times a week*”; and “*Never*” added to “*Rarely*”) to fulfill the requirements of the Chi-Square Test. Applying this formula to arrive at the test statistic: $X^2 = \sum \frac{(O_i - E_i)^2}{E_i}$ the test results ($X^2 = 6.168$; $p = 0.187$) indicated a failure to reject the null hypothesis of dependency with 95% confidence.

Next to analyzing the general demand for drone technologies for last-mile deliveries, the qualitative data on the use cases that customers see for this service was examined. Respondents predominantly expressed an interest in drone delivery in the context of clothes and apparel (25%), closely followed by books, games, and toys (22.73%), food and drinks (19.16%), and healthcare products (18.83%) (Q14). A notable shift in product preferences emerged when comparing responses for traditional last-mile deliveries (Q2) to those for drone technologies. The percentage of technology and electronics products dropped from 23.15% to 11.36%, while there was an increase in the preference for food and drinks, from 13.3% to 19.15%, as well as for healthcare products, from 15.27% to 18.83%.

Furthermore, the open-ended question (Q15) which asked respondents to outline a situation they would opt for product delivery via a drone qualitative resulted in answers that are

categorizable into several themes. These themes include urgency and time sensitivity, environmental considerations, convenience and accessibility, specific product or situational needs, general speed, and efficiency, and free or cost-effective delivery preferences. On the other hand, experts operating in the drone delivery, e-commerce, or logistics industry also provided use cases from their perspective. The discussions with experts highlighted a diverse range of applications for drone delivery, each addressing specific needs and challenges. One key focus was on tailoring drone deliveries to specific customer segments, underscoring the importance of considering user groups rather than merely focusing on the shelf life of products. This customer-centric approach extends to scenarios where customers actively shape the future of delivery methods by designating locations for package delivery. Further, experts highlighted the high potential for use cases like food delivery, and medical goods that are due to their urgency characteristic an ideal use case for this technology. The overarching goal, as emphasized by the experts, is the democratization of drone delivery, making it accessible across various industries while acknowledging its potential across diverse use cases.

Willingness to Pay

Equally as important for the feasibility as the general demand for the technology is the customer's willingness to pay. The payment model adopted by existing companies, such as *Manna Drones*, includes a premium paid by customers. Revenue models depending on a premium to reach financial efficiency, underscore the significance of customers' willingness to pay. Assessing customer's willingness to pay (Q11) revealed that most respondents (90/138, 65%) are not inclined to pay a premium for the service. The remaining respondents expressed a willingness to pay for a modest premium, mostly up to 5% of the order value (25% of respondents). Examining factors influencing willingness to pay, 33/90 (36.7%) respondents, who answered negatively, indicated that faster delivery times would influence their willingness to pay, 26/90 (28.9%) cited guaranteed security features, and 34/90 (37.8%) respondents stated

that nothing could affect their unwillingness to pay. As depicted by the literature review willingness to pay is strongly influenced by customer satisfaction with a service. Customer satisfaction is also an increasingly pivotal factor in last-mile delivery, as indicated by evolving customer expectations and the concerted efforts of companies to enhance satisfaction through the integration of drone technologies. Given these insights, this research aims to test the applicability of this relationship to the context of drone technologies in last-mile parcel delivery. Recognizing the increasing importance of customer satisfaction, the study explored this connection by involving the Mann-Whitney U Test. The null hypothesis (H0) suggested no difference in willingness to pay between those who believe drones enhance last-mile delivery satisfaction (Group 1) and those who do not (Group 2), while the alternative hypothesis (H1) stated that Group 1, believing in increased satisfaction, has a higher willingness to pay. The results of the Two-Sample Mann-Whitney U test ($U = 1062.5$; $p = 0.003982$), led to the rejection of the null hypothesis with 95% confidence. This depicts a significant difference in the values between Group 1 and Group 2 populations, with Group 1's population mean being considered greater compared to Group 2's.

4.1.2. Technological Dimension

Customers' perceptions of innovative technologies are entwined with both opportunities and concerns, shaping their willingness to embrace new technologies like drones, as outlined in the TAM (Davis 1989), which asserts that the perceived usefulness of technology positively directly impacts the adoption of innovative technologies. Customer acceptance is pivotal as it directly influences their overall perception and adoption of innovative technologies, further influencing the demand and the willingness to pay.

Technological Opportunities

To analyze customers' perceptions of the opportunities and benefits of drone technology, both descriptive statistics and qualitative insights are used, to gain a deeper understanding of the

factors that influence feasibility. A multiple-choice question, asking customers to choose the benefits they see in drone delivery (Q7) resulted in 275 responses. The results depict that 90/138 (65.2%) respondents identified faster delivery times as a significant benefit, while 45/138 (32.6%) respondents, acknowledged reduced delivery costs. Additionally, 57/138 (41.3%) respondents emphasized increased delivery accuracy and 70/138 (59.7%) highlighted environmental sustainability.

As outlined by the TAM (Davis 1989), the perceived usefulness of a technology directly impacts the acceptance of customers. Leveraging identified benefits as a measure of perceived usefulness, this theory is tested by asking whether willingness to use drones depends on the number of benefits a customer perceives. To prepare the data to fit the statistical test, the data was restructured, converting the "Count of Benefits" variable into a qualitative/ordinal variable by assigning levels of benefits to each count. This adjustment allowed for a thorough analysis using a Chi-Square Test of Independence, leveraging a contingency table. The null hypothesis (H0) stated that the variables "Count of Benefits" and "Willingness to use drones" are independent, while the alternative hypothesis (H1) suggested a dependency between the two variables. The results of the Chi-Square Test ($X^2 = 36.72$; $p = 0.0000002$) indicate that the null hypothesis can be rejected with 95% confidence.

Technological Concerns

Summarizing the descriptive statistics and qualitative data on technological concerns, retrieved from the survey, it was found that among 138 respondents delivering a total of 278 responses to the multiple-choice question on concerns (Q13), a mere 8 (5.8%) respondents conveyed no concerns regarding drone technologies in last-mile e-commerce deliveries. Notably, the predominant worries encompassed technical failures (103/138, 74.6%) and safety concerns (80/138, 57.9%), while concerns related to job displacement and privacy were relatively less relevant (44/138; 31.9%, and 29/138; 21%, respectively). Additionally, the survey explored the

holdback reasons (Q9a) of respondents who indicated not to be willing to use drone technologies. Categorizing responses of the open-ended question, categories ranged from technological uncertainties, safety and security issues, environmental and noise considerations, practicality and infrastructure challenges, apprehensions about job displacement and economic impact, and public space and privacy considerations.

In addition to survey data, insights from interviews with industry experts, including perspectives from FS at *DHL*, underscored technological concerns. FS expressed skepticism about the feasibility of widespread drone deployment, particularly in large cities, citing potential dangers and privacy challenges. Noteworthy was the consensus among experts about the limitations of drone delivery in urban settings, especially in the absence of significant time pressure for deliveries. Additionally, LS and OF from *Digital Settings* mentioned privacy issues and technological concerns when drones are operating in cities with plenty of obstacles. With only eight survey respondents not having any concerns about the new technology, potential reasons behind the large number of concerns that could ultimately impact the usage decisions of customers shall be explored. Many respondents have mentioned their hesitation being grounded by their unfamiliarity with the technology. A common bias among the broad population is the “fear of the unknown”. The fear of the unknown is often evident in the context of adopting new technologies. When faced with unfamiliar technological advancements, individuals may experience anxiety or resistance due to several factors (Cugurullo and Acheampong 2023). To explore the fear of the unknown in the context of drone technologies, a statistical test was applied focussing on whether familiarity with drone technologies (Q6) influenced the number of concerns among customers (Q13). The statistical test employed was Spearman's rank correlation coefficient. The null hypothesis (H_0) stated no significant correlation between familiarity with drones and the concerns expressed by customers, while the alternative hypothesis (H_1) suggested a significant correlation. The data, initially

qualitative, was quantified by summing the concerns per respondent. Upon analysis, Spearman's correlation results indicated a non-significant small negative relationship between familiarity with drones and the number of concerns expressed by customers ($r(136) = -0.135$, $p = 0.116$).

Next to analyzing the root causes for the technological concerns encountered by the respondent, the impact of the number of concerns on the general demand for drone delivery technologies in last-mile parcel delivery was analyzed. A comprehensive data restructuring initiative was conducted to convert the quantitative variable "Count of Concerns" into a qualitative/ordinal variable by associating specific levels of concern with each count (e.g., "*Little concern*" = 1, etc.). To test the dependence of concerns and demand, a Chi-Square Test of Independence utilizing a contingency table to evaluate the formulated hypotheses was executed. The null hypothesis (H_0) suggested that the variables representing the number of concerns and the willingness to use drones are independent, while the alternative hypothesis (H_1) proposed a dependent relationship between the two variables. Based on the results of the Chi-Square Test ($X^2 = 4.206$; $p = 0.3788896$) no compelling evidence to reject the null hypothesis at 95% confidence can be found, suggesting that the two variables are independent of each other.

4.1.3. Operational Dimension

This dimension, with a focus on operational conditions and the environmental impact of drone technologies, delves into practical aspects influencing the customer adoption of drones as well as the environmental impact and its influence on customer demand.

Operational Conditions

In exploring the operational conditions necessary for the effective deployment of drone technology, current operational conditions for drone technologies in last-mile parcel deliveries are optimal for suburban environments with sufficient space, serving as an optimal landing or drop-off zone for drones. However, the survey (Q23 & 24) results indicated that only 11.6%

of respondents (16/138) possess such an ideal setting, and the majority residing in urban areas (94/138, 68.1%) and apartment complexes (75/138, 54.3%).

Through open-ended questions (Q9b and Q25) respondents expressed notable concerns regarding the integration of drones in urban settings, citing worries about obstacles, the feasibility of landing & drop off options in apartments, and the potential proliferation of drones in the sky, evoking fear and discomfort. Additional apprehensions include the risk of miscoordination, leading to deliveries on neighbors' grounds, as well as the potential for theft, raising additional security concerns. Weather conditions also emerge as a noteworthy operational consideration, with customers highlighting the reliability of traditional delivery methods in comparison to the potential challenges posed by adverse weather for drone operations.

Environmental Impact

An overarching goal of the industry is to become more environmentally friendly by implementing innovative solutions that reduce CO₂ emissions and the ecological footprint. Drone technologies are one example of these innovative solutions, aiming to reduce emissions of last-mile delivery operations. Experts and customers agreed that drone technologies could improve sustainability. Expert opinions supported the idea that drones present an environmentally friendly alternative, especially in areas where traditional delivery methods contribute to pollution and traffic congestion. Additionally, experts acknowledged the growing focus on sustainability in the industry, emphasizing the benefit of incorporating sustainability into company practices. Most customers surveyed emphasized that they consider the environmental impact of last-mile delivery methods as “*important*” or “*very important*”, 57/138 (41.3%) and 30/138 (21.73%) respondents, respectively. 37/138 (26.8%) respondents valued it as “*moderately important*”, while only 14/138 (10.1%) respondents categorized it as “*not important*” or “*not important at all*”. Observing answers regarding drone technologies as

an environmentally friendly alternative, 82/138 (59.4%) respondents believe that drones can be an environmentally friendly delivery method, 39/138 (28.3%) remained neutral, and 17/138 (12.3%) expressed doubts. Moreover, a substantial 90/138 (65.2%) respondents agreed or strongly agreed that they would choose environmentally friendlier drone technologies over a traditional last-mile delivery method, whereas only 11/138 (7.9%) disagreed, and 37/138 (26.8%) had a neutral opinion. Even though the majority of respondents (59.4%) had a positive belief about the environmental impact of drones, diving into the qualitative data reveals that some respondents are questioning the environmental friendliness of drones. Respondents expressed a willingness to adopt drone technology if more information on its benefits for both individuals and the environment were available. Some respondents attributed their skepticism to a lack of knowledge and raised concerns about how drones are powered and whether such technology is genuinely beneficial for the environment.

To analyze the impact on the demand, the research question of whether individuals who believe in the environmental impact of drones are more willing to use the technology, given they put importance on environmentally friendly delivery, was tested. The test used was a right-tailed Mann-Whitney U Test. Data preparation involved filtering out responses from those who expressed neutral or lower importance on environmental-friendly delivery methods and only proceeding with respondents who expressed importance (87/138; 63%). The Mann-Whitney U Test compared the willingness to adopt drone technologies between two groups, those who believed in environmental benefits (Group 1) and those who didn't (Group 2). The results ($U = 517$; $p = 0.000001543$) led to the rejection of the null hypothesis with 95% confidence in favor of the alternative hypothesis, suggesting that Group 1's willingness to adopt is higher than Group 2's.

4.1.4. Implications of Customer Demand Analysis

The conducted social study in combination with multiple statistical tests provides meaningful insights into drone technology adoption in the evolving landscape of last-mile e-commerce deliveries. Customers showcase a strong tendency of readiness for the technology, expressed via a general curiosity and usage willingness for the technology, and perceive the innovation as a satisfaction enhancer. Both customers and experts foresee many use cases for drone deliveries. The diverse range of responses underscores the multifaceted reasons individuals might favor drone delivery, encompassing urgent needs, environmental consciousness, and convenience. These findings contribute valuable depth to understanding the motivations guiding consumer preferences in the context of drone technologies in last-mile delivery. Some of the depicted use cases align with existing literature, emphasizing use cases in medicine, food and drinks, and urgent product deliveries due to the faster delivery times drones offer. The depicted realignment of product use cases compared to traditional delivery methods further underscores the importance of healthcare products and perishable goods in the context of drone delivery, however, these findings contradict the underlying research question of the feasibility in the e-commerce industry. Additionally, customers and experts are mostly aligned in their perceived use cases, which is an essential factor to consider when discussing the feasibility of drone technologies in last-mile drone deliveries as meeting customer expectations is a crucial part of succeeding in today's economy, as highlighted in the literature review and emphasized by experts. However, even though a general tendency of willingness to employ the technology can be recognized among customers, drone technology adoption is not significantly dependent on their online shopping frequency. Considering the robust and optimistic future trend of the e-commerce industry leading to an overall increase in shopping frequency, it is improbable that the technology adoption will be directly impacted by this growth. This finding ignores the natural life cycle of technology adoption and the associated growth. Further, customers do not

show a strong willingness to pay for the drone delivery service, and the general willingness to pay is low, posing a potential challenge to companies' revenue models.

Aligning drone technology feasibility to the different factors analyzed, it can be recognized that the willingness to use drone technologies is significantly dependent on customers' perceived increase in service satisfaction, the perceived benefits of the technology as well as the environmental impact. All these significant factors can be controlled and reinforced by strong customer communication and expectation management about the technology, its benefits for the customer and the last-mile delivery service. Despite customers acknowledging potential benefits, concerns about technological and operational factors persist. Many express doubts about the operational model of drones, safety, and reliability, emphasizing the need to address concerns in last-mile e-commerce deliveries. However, the willingness to use is found to be independent of perceived concerns, suggesting that customers prioritize perceived benefits over concerns in their adoption decisions. Regardless, the potential risks and concerns of drones cannot be ignored. Even though the test results show no significant dependency between the number of concerns perceived and the willingness to use drone technologies, companies should still ensure to address concerns to decrease the customer's "fear of the unknown" and increase familiarity with the technology. Strong customer communication and education about the potential benefits, as well as the potential risks, can mitigate the recognized unfamiliarity, ultimately increasing customers' readiness further. Based on the conducted analyses, it can be summarized that from a customer perspective drone technologies in last-mile e-commerce deliveries are considered feasible, with further potential to grow out readiness in the future.

5. Discussion

The discussion section is the focal point of the academic exploration, revealing connections between business viewpoints and customer perspectives. Assessing the overall viability of drone technology for last-mile e-commerce and parcel deliveries requires the integration of findings from the business case and the customer demand analyses to answer the overall underlying RQ: “Are drone technologies a feasible solution for last-mile parcel delivery in e-commerce from a business and customer standpoint?”.

Figure 2 compares the retrieved implications on business readiness (Part 4.1.4.) (y-axis) and customer readiness (Part 4.2.4.) (x-axis). Based on the implications derived from the results and findings, it is concluded that implementing drones for last-mile e-commerce parcel delivery is not a feasible solution at this time.

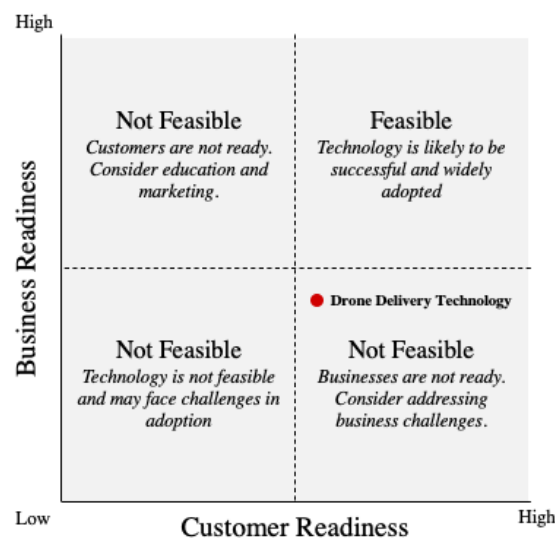


Figure 2: Technology Feasibility Graph

Discussing both perspectives simultaneously reveals dependencies and interactions between the influencing factors. Customers' willingness to pay for drone delivery services is directly influencing the revenue model and financial efficiency of businesses operating in last-mile parcel deliveries operating drones as delivery vehicles. As willingness to pay is generally low among surveyed customers, it poses significant challenges for businesses' financial efficiency,

and they cannot rely on customers' payment at the current state. The present reluctance to pay coupled with the substantial investments required to engage in last-mile drone deliveries and the inherent limitations concerning payload and battery life present significant obstacles to the revenue model of businesses, making it currently an inefficient space to operate in. Additionally, operational constraints do not permit heavy or long-route deliveries, leading to increased costs per delivery due to a lack of batching opportunities and economies of scale. Another challenge for drone operations is final meter deliveries and landing operations, as the customer demand analysis found that most surveyed customers' living situations are not ideal for drone deliveries, especially for the parcel drop-off phase. This misalignment of the ideal settings of the final meter requirements poses challenges, as urban landscapes entail obstacles, and apartment living introduces complexities in landing and delivery logistics. Additionally, the outlined use cases from the business and customer perspectives are largely in agreement that the most effective use cases encompass products with a time-sensitive nature and an urgent need. This coherence is in line with the established successful use cases, such as medical and perishable goods. Nonetheless, it does raise concerns about the viability of e-commerce products, as the majority of e-commerce orders lack the attribute of an urgent need and are generally not time sensitive. This again speaks against the feasibility and raises questions if it is worth the financial risk and high upfront cost if only a fraction of the selection is onboarded to the service. Although drone technology for last-mile parcel deliveries in e-commerce currently appears unfeasible due to the associated high financial risks, regulatory, and operational hurdles, this does not preclude the potential for this technology in the future. The interconnected supply chain networks, technological advancements, significant investments involved in the e-commerce parcel industry, and strong adoption willingness among customers indicate that businesses could eventually adopt this technology on a wider scale.

6. Limitations and Future Research

The assessment of the feasibility of last-mile drone delivery in e-commerce was based on predetermined factors identified through extensive research. It is important to recognize that additional factors may not have been included in this assessment, due to the scope and application of the work project.

The expert interview process faced a few limitations. Although the experts interviewed were drawn from a variety of sectors within the last-mile e-commerce drone delivery industry, ensuring heterogeneity of insights, the pool of experts remains limited due to constraints related to their availability, accessibility, and willingness to participate, potentially introducing bias. In addition, the subjective nature of expert opinions and their susceptibility to personal experience or bias may have influenced responses. The existence of non-disclosure agreements (NDAs) further limited the depth of insight into key factors determining the feasibility of deploying drones for last-mile deliveries. Additional limitations were identified in the survey methodology. It is worth noting that the respondents were not informed about the potential advantages of drone delivery services for last-mile delivery, nor were they informed about the current cost and pricing models of last-mile delivery methods. These factors may have impacted the context of their responses. Furthermore, the survey was predominantly disseminated within the authors' networks, thus restricting its representation of the entire population of potential customers.

To address these limitations and further contribute to the assessment of last-mile drone delivery in e-commerce, multiple future research avenues are suggested. These include a detailed analysis of the selection process for e-commerce products suitable for drone delivery, based on the establishment of eligibility criteria like urgency or weight. Additionally, the possibility of integrating drones into existing supply chains, including delivery vans and hubs, is another valuable area for investigation. Additionally, future research could focus on the exploration of

implementation factors from a local perspective, as the adoption of drone technologies is influenced by both global and local factors, and the successful implementation relies heavily on local considerations such as geography, regulations, and logistic networks in proximity which were not considered thoroughly in the underlying study. Further, future studies could look at the design considerations for drones, assessing the weight and range required to effectively overcome operational challenges. In addition, a quantitative break-even analysis could be included to thoroughly assess the profitability point at which the technology becomes financially feasible. This would provide valuable insights into the sustainability and viability of the examined financial model or strategy. These areas of future research will contribute to a more holistic understanding of the feasibility and implementation of last-mile drone delivery in e-commerce.

7. Conclusion

In conclusion, the assessment of drone technology for last-mile e-commerce and parcel delivery reveals a complex landscape at the intersection of business feasibility and customer readiness. While the innovative approach to last-mile delivery is technologically advanced, it faces significant financial inefficiencies and regulatory hurdles from a business perspective. Despite customers expressing positive curiosity and willingness to embrace drone deliveries, concerns about safety, technology, and operational unfamiliarity persist. The current landscape suggests that high upfront costs, coupled with operational and regulatory barriers, make drone technologies infeasible for a significant portion of the e-commerce market. However, the conclusion drawn from this assessment does not discount the potential of drone technology in the future. The robust interconnected supply chain networks, industry expertise, and significant investment within the e-commerce parcel sector suggest a possible trajectory for the adoption of drone technology once financial risks are mitigated and operational challenges are addressed.

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9. Appendix

9.1. List of Abbreviations

AI – Artificial Intelligence

B2B – Business to Business

B2C – Business to Consumer

BVLOS – Beyond Visual Line of Sight

CAGR – Compound Annual Growth Rate

C2B – Consumer to Business

C2C – Consumer to Consumer

FAA – Federal Aviation Administration

IoT – Internet of Things

ML – Machine Learning

NDA – Non-disclosure Agreement

RQ – Research Question

TAM – Technology Acceptance Model

UAV – Unmanned Aerial Vehicle

VTOL – Vertical Take-off and Landing

9.2. Classifications of UAVs

	Use Case	Advantage	Disadvantage	Visual
Fixed-Wing drones	- Large area mapping and surveying - Agriculture for crop monitoring - Wildlife monitoring	- Long range - Efficient coverage of large areas.	- Horizontal take-off (more space required), - Limited ability to hover or fly slowly	 Source: Defensebridge (2022)
Multirotor drones (e.g., Quadcopters, Hexacopters, Octocopters)	- Aerial photography and videography - Search and rescue operations - Inspection of infrastructure - Commercial delivery	- Vertical takeoff and landing - Hovering capability - Maneuverability in confined spaces - Light weight	- Limited payload capacity - Short range - Susceptible to external environmental conditions	 Source: Amazon (2022)
Single-rotor drones	- Military applications - Heavy payload transport - Aerial surveillance	- Can carry heavier payloads - Greater endurance compared to multirotors	- Complex mechanics and maintenance - Higher cost	 Source: UnmannedSystemsTechnology (2023)
Hybrid drones	- Surveillance and reconnaissance - Mapping and surveying - Inspections of infrastructure	- Combine the benefits of fixed-wing (efficiency) and multirotor (vertical takeoff/landing, hovering) drones - Versatility for different types of missions	- Increased complexity in design and operation - Potentially higher cost compared to specialized drones	 Source: ResearchGate (2019)
Nano-drones	- Indoor surveillance - Monitoring in confined spaces - Recreational flying in small areas	- Compact size for maneuvering in tight spaces - Often more affordable	- Limited payload capacity - Shorter flight times.	 Source: IIMioDrone (2022)

Table Appendix 1: UAV Classification

9.3. Customer Analysis Findings

Section	Research Question	Questions	Data Types	H0	H1	Test	p-value	Result
Economical Dimension	Are online shopping frequency and willingness to use drones dependent on each other?	Q1 x Q9	Ordinal/ Binary	Online shopping frequency and willingness to use drones are independent.	The two variables are dependent.	Chi- Square Test of Independence	0.187	Fail to reject H0.
	Are respondent who believe in the satisfaction enhancement of drones more willing to pay for the service?	Q8 x Q11	Ordinal	There is no difference in willingness to pay between the two groups.	Group 1 has a higher willingness to pay.	Two Sample Mann Whitney U Test (right tailed)	0.0003982	Reject H0.
Technological Dimension	Are willingness to use drones dependent on the number of benefits a customer perceives?	Q7 x Q9	Ordinal/ Binary	Willingness to use drones and number of benefits are independent.	The two variables are dependent.	Chi- Square Test of Independence	0.0000002	Reject H0.
	Does technology familiarity influence the amount of concerns raised?	Q6 x Q13	Ordinal/Quantitative	There is no significant correlation between familiarity with drones and the concerns expressed by customers.	There is a significant correlation between the familiarity with drones and the concerns expressed by customers.	Spearman's rank correlation coefficient	0.116	Fail to reject H0.
	Are willingness to use drones dependent on the number of concerns a customer perceives?	Q13 x Q9	Ordinal/ Binary	Willingness to use drones and number of concerns are independent.	The two variables are dependent.	Chi- Square Test of Independence	0.3788896	Fail to reject H0.
Operational Dimension	Are people who believe in the environmental impact of drones more willing to use the technology given they put importance on environmentally friendly delivery?	Q17xQ9 (Condition Q16)	Ordinal/ Binary	There is no difference in willingness to use drone technologies between the two groups.	Group 1 has a higher willingness to use.	Two Sample Mann Whitney U Test (right tailed)	0.000001543	Reject H0.

Table Appendix 3: Customer Demand Analysis – Results

9.4. Survey Questions

Survey for assessing the impact of drone technologies on e-commerce last-mile deliveries

* Required Questions

E-commerce and Last-Mile Parcel Delivery Experience:

1. How frequently do you engage in online shopping? *

Never

Rarely (a few times a year)

Once a month

2-3 times a month

Once a week

2-3 times a week

Daily

2. What products do you order online? (Select all that apply) *

Clothes & Apparel

Books, Games, Toys etc.

Technology & Electronics

Healthcare products

Food & Drinks /Other

Last-Mile Delivery

Definition: Last-mile delivery is the final step in getting products from a storage place to your doorstep. It's like the last part of a journey for goods, making sure they're well-packed and sent straight to you after arriving at a warehouse.

3. On average, how satisfied are you with the current last-mile parcel delivery services provided by e-commerce companies? *

Very satisfied

Somewhat satisfied

Neither satisfied nor dissatisfied

Somewhat dissatisfied

Very dissatisfied

4. What are the main challenges you face with traditional last-mile parcel delivery services? (Select all that apply) *

Delays

Inaccurate delivery

Limited delivery time options

Package theft

Other

5. In your opinion, what aspects of the last-mile delivery process contribute most to customer satisfaction? (Rank from most to least important) *

Speed of delivery

Accuracy of delivery time slot

Communication about delivery status

Cost of delivery

Flexibility of delivery options (Drop off at neighbours house, pick-up locations, etc.)

Delivery condition of package

Autonomous Drone Technologies

Autonomous drone technologies are small flying robots that can deliver packages to your doorstep all by themselves. They use special sensors and GPS to find their way and drop off your packages with the goal of making deliveries faster and more efficient.

6. How familiar are you with drone delivery technologies? *

Very familiar

Somewhat familiar

Neutral

Rather unfamiliar

Not familiar at all

7. What potential benefits do you foresee in the use of drones for last-mile delivery? (Select all that apply) *

Faster delivery times

Reduced delivery costs

Increased delivery accuracy
Environmental sustainability
None
Other

8. To what extent do you believe drone technologies can enhance the quality of last-mile parcel delivery? *

Extremely
Very much
Moderately
Slightly
Not at all

9. Would you be willing to make use of drone technologies for your e-commerce package delivery? *

Yes
No

If no:

9a. Explain why, what would hold you back to use a drone? *

Open

10. Would the option of drone delivery influence your decision to shop with a particular e-commerce platform over another? *

Yes
No
It depends

If it depends:

10a. Specify what your decision depends on: *

Open

11. Would you be willing to pay a premium for getting your product delivered by a drone? *

Yes, up to 5% of the order value
Yes, between 5% - 10% of the order value

Yes, more than 10% of the order value

No

12. What factors would affect your willingness to pay more for drone delivery, if any? *

Faster delivery time

Guaranteed delivery window

Enhanced security features

None

Other

13. What concerns or reservations do you have regarding the use of drones for last-mile delivery? (Select all that apply) *

Privacy issues

Safety concerns

Technical failures

Job displacement

No concerns

Other

14. What products would you most likely get delivered via drones, if available in your region? (Select all that apply) *

Clothes & Apparel

Books, Games, Toys etc.

Technology & Electronics

Healthcare products

Food & Drinks

Other

15. In what situation would you order a product via a delivery drone? (Shortly describe a situation)

Open

Environmental Impact

16. How much importance do you place on the environmental impact of delivery methods when making online purchase decisions? *

Very important

Important

Moderate

Not important

Not important at all

17. Do you believe that drone delivery could have a positive environmental impact compared to traditional delivery methods? *

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

18. Would the environmental benefits of drone delivery influence your decision to choose it over other delivery options? *

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

Demographic Information

19. What is your age? *

Under 18

18-26

27-42

43-58

59-77

78 and above

20. What gender do you identify with? *

Man

Woman

Non-binary

Prefer not to say

21. What's your nationality? *

German

Portuguese

Italian

Spanish

Other

22. What's your occupation? *

Student

Employed

Unemployed

Self-employed

Other

23. Do you live in an urban, suburban, or rural area? *

Urban

Suburban

Rural

24. Specify your housing situation: *

House with garden

House without garden

Apartment Complex

Other

25. Please share any additional thoughts or comments you have regarding the use of drone technologies in last-mile parcel delivery within the context of e-commerce.

Open

9.5. Data Types – Survey Questions

Question	Variables	Variable Type	Variable Subtype
1	Online Shopping frequency	Categorical	Ordinal
2	Products	Categorical	Nominal
3	Current Satisfaction	Categorical	Ordinal
4	Current Challenges	Categorical	Nominal
5	Satisfaction Factors	Categorical	Nominal
6	Drone Familiarity	Categorical	Ordinal
7	Drone Benefits	Categorical	Nominal
8	Satisfaction Enhancement	Categorical	Ordinal
9	Willingness of Drone Usage	Categorical	Binary
9a	Holdback Reasons	Qualitative	Open End
10	Channel Switch	Categorical	Binary
10a	Decision Factors	Qualitative	Open End
11	Willingness to pay	Categorical	Ordinal
12	Willingness to pay factors	Categorical	Nominal
13	Drone Concerns	Categorical	Nominal
14	Drone Products	Categorical	Nominal
15	Use Case	Qualitative	Open End
16	Environmental Importance	Categorical	Ordinal
17	Drone Environmental Impact	Categorical	Ordinal
18	Drone Preference (Env)	Categorical	Ordinal
19	Age	Categorical	Ordinal
20	Gender	Categorical	Nominal
21	Nationality	Categorical	Nominal
22	Occupation	Categorical	Nominal
23	Living Area	Categorical	Nominal
24	Housing Situation	Categorical	Nominal
25	Additional thoughts/comments	Qualitative	Open End

Table Appendix 4: Data Types

9.6. Descriptive Statistics Graphs

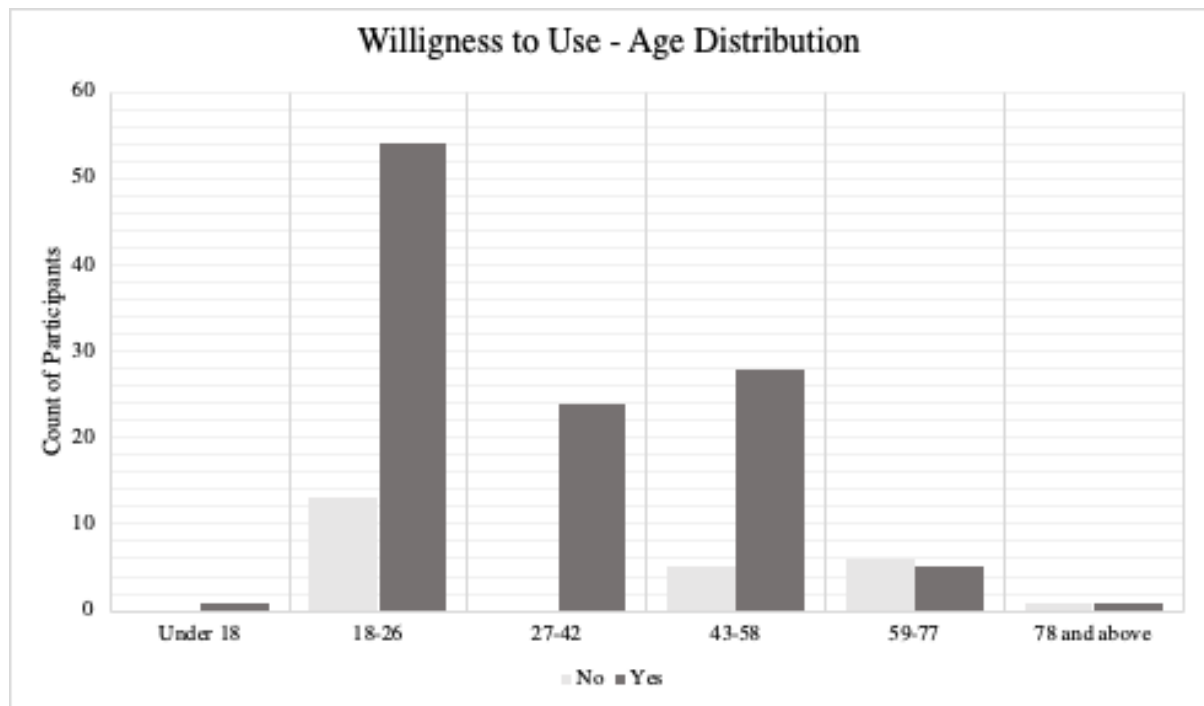


Figure Appendix 1: Willingness to Use - Age Distribution

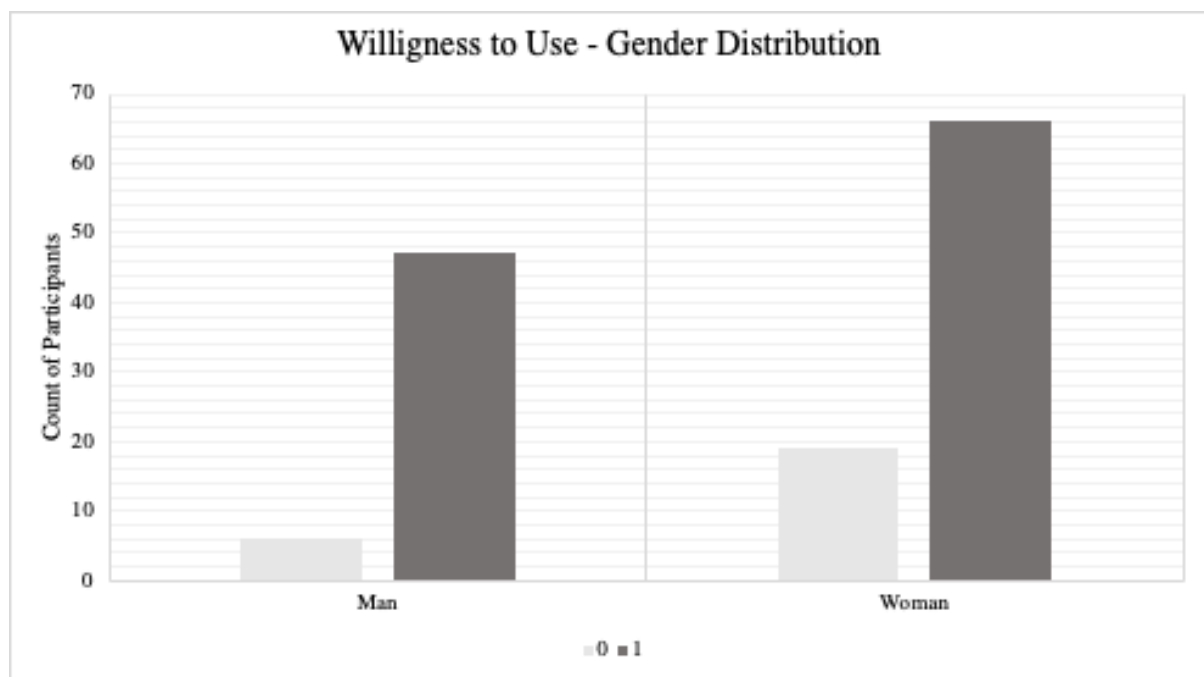


Figure Appendix 2: Willingness to Use - Gender Distribution

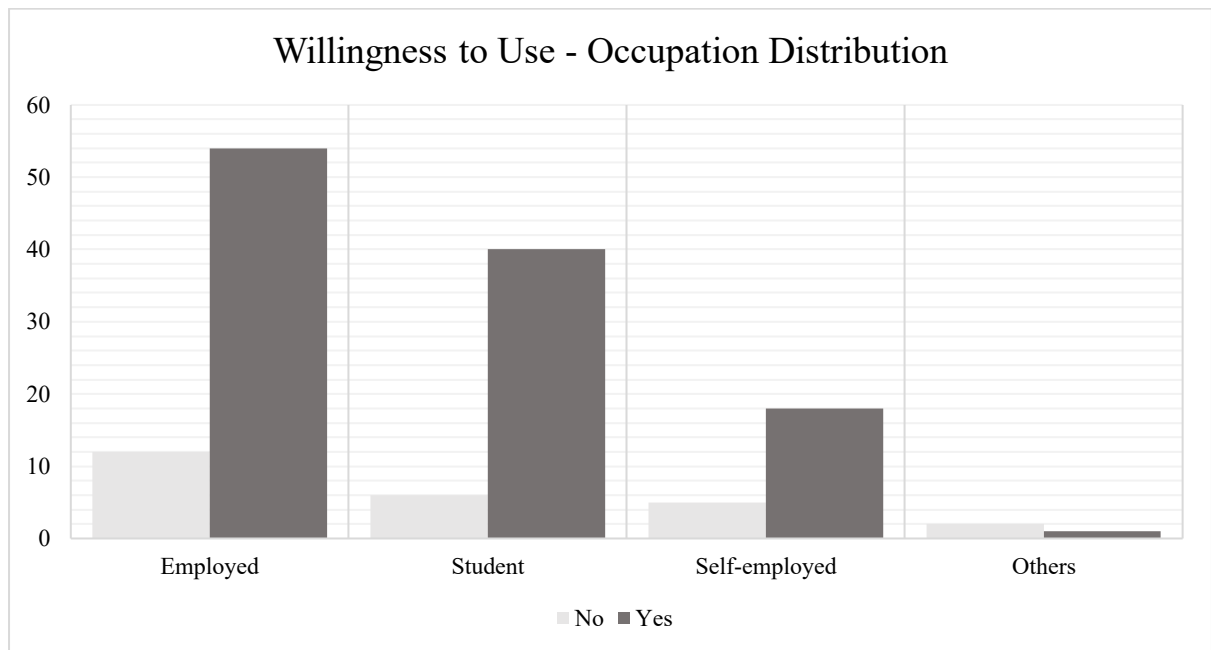


Figure Appendix 3: Willingness to Use - Occupation Distribution

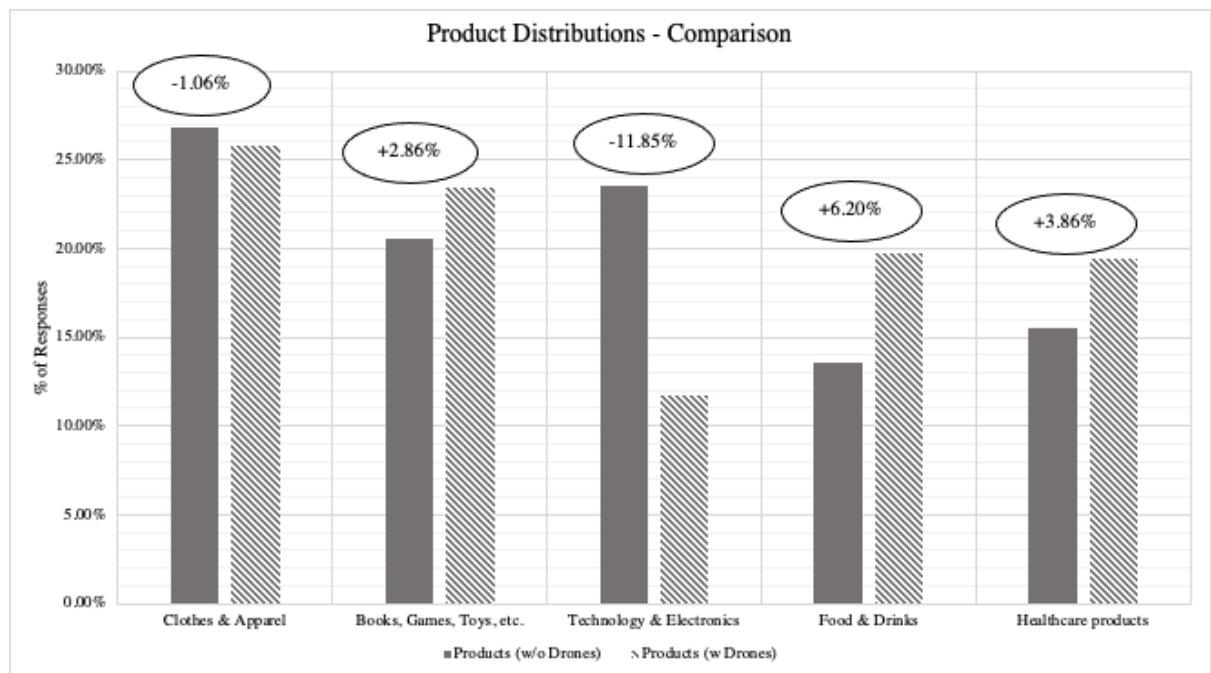


Figure Appendix 4: Product Comparison

9.7. Interview Transcripts

Free online services were used to transcribe the interviews, but it is important to note that the quality of the transcript may be affected by the use of these tools. Depending on the video conference tool, the meeting was transcribed in full or as a summarized condensed version.

9.7.1. DHL: Frank Steinbrenner

1 Transcript (full-length interview)

2 Interview with Frank Steinbrenner (Head of Subordinate DHL, Mannheim)

3 **16.10.2023**

4 *Start of interview*

5 *Check of ethical considerations and greetings*

6 **Interviewer:**

7 We have prepared a few questions, but you can start first and then we'll see what you're
8 covering. But feel free to talk first.

9

10 **FS:**

11 I'm just going to go in. I'll put it this way, at Deutsche Post DHL, you want to be innovative
12 when trying things, but until today, the result has certainly come, I'll say, the topic of cost-
13 mass-business. So, if I think for you, in the German market, that's an interesting market,
14 because we are a growing market. So, we have a market share of 45% Number 2 is now
15 Amazon It's quite exciting, Amazon is our biggest customer with the Chinese together So
16 Amazon and the Chinese, and Amazon is our biggest competitor, now even more than GLS,
17 DPD, Hermes. You have to imagine that we alone from DHL supply 5 million parcels daily.
18 And then comes the thought, I say it like this, in the urban area we supply daily, and in the
19 urban area, that's great for us, a classic parcel supplier has a parcel carriage of 200 parcels,
20 during a day, then maybe has 100 stops for the 200 packages. Because stop means he

21 sometimes gets several packages, be it with a private customer or with a business customer.
22 And that is really the idea of this cost situation. These are the classic economies of scale that
23 we have, because we simply export massively in mass business. And that's why, if you look at
24 the costs, you think, yes, you could be, you see it in the beginnings, I'm sure the first
25 consideration, as it was with the island of Juist, mountain regions. For example, we have a
26 postman on the train station every day. Things like that, or islands, that's the first step, the far
27 away, because that's more expensive for us. Because the mail carriers on the flat land don't earn
28 as much money as in the city. That's why all the considerations that may come in the next 10,
29 20 years, I think, will go more in that direction. Not only, you have to think about whether you
30 only take packages or whether you also have important documents. That would definitely be
31 an approach. Important documents, that you actually transport them on islands. So in addition
32 to the cost argument, where you have economies of scale, which I can hardly imagine how you
33 can of course also check things like that in your master's thesis. Of course, you have to regulate
34 the air traffic. That would also be a way to go in there and check. If we act as Amazon or DHL
35 now, you have to imagine it in an exaggerated way, we have 5 million parcels a day, a market
36 share of 45 percent, I'm not a part of 50% of the 12 million packages daily. It's exaggerated.
37 Do you want to see 12 million drones every day in the sky? And that's why I'm sure for the
38 entry, I think there will be something. I'll come back later with a thought that may also have a
39 certain charm. With my entry, it won't be 12 million. And we will never, if we are at once in
40 one recipient, it's more grotesque. Even if you imagine a drone, which maybe can take 20
41 packages, I don't know. So check out the air traffic, what's going on there. We're getting more
42 and more of this ISG topic, sustainability. You may have noticed that with us, we have already
43 in my report, so from us, I would say, 900 vehicles, we already have half with eco-fuel. So the
44 topic of sustainability may also have a charm, which develops a dynamic because sustainability
45 is, as a company you have to bring it. And I also notice that with us, I'm not sure I'm so much

46 to say bring a unique America by once the cool To fix me on the outside. I think I if a carbon
47 saver is the other company the other side this is to reach out I'm going to be honest with you.
48 Do you know the packing stations?

49

50 **Interviewer:**

51 Yes.

52

53 **FS:**

54 That's a patent of ours, it's just a little bit of politics. Amazon has the packing stations too, they
55 are the only ones next to us. And we tolerated that. Actually, we could go against them without
56 a doubt, because the patent is still in effect. But we tolerated that because Amazon is also an
57 important customer of ours. So we now have about 13,000 packaging stations. And what is
58 definitely... I say, you have to think about it, if that would be something. So I think that's quite
59 charming. Then the drone would only be in the possession of the German Post DHL. So with
60 the packing stations you can give packages or parcels. Some don't know that and let you do it.
61 So, this thing is booming without end, because there are so many young people like you or
62 people who go to work, they just think it's cool. We have some stations, huge packing stations,
63 because people just say, cool, I can give out packages and I can pick up packages. And that
64 would be a use, where you could think about it. It would be theoretically feasible to say that
65 would be a package that is given up in the pack station. You could theoretically see if it doesn't
66 work. For example, it's not just such a fan. If not, some system would be conceivable. Now I'm
67 trying to be a visionary, but I'm not sure I'm doing it. If a drone reads the address, that somehow
68 blocks up from the packing station, drone, and the drone flies to another packing station. So
69 this packing station, that would be the beginning, that you say from customer to customer, from
70 packing station to packing station. These are usually the customers who are a bit smarter, who

71 go along with these first changes. That was what I thought. So if you get more into the topic
72 and say, man, the drones are getting cheaper, the air traffic will be regulated at some point. I
73 think the first step will really be the classic mountains, remote areas, where you have to look
74 at the other hand, now I'm sending a drone to a customer. How does the drone fly back? Do
75 they fly back automatically. So you have to think about how that works. And as I said, the pack
76 station, that might even have a real charm about it. Especially as we think of drones as an
77 extension to our network, and not replacing it. So if we had thought about it in advance, what
78 could possibly happen in the next time? That might be something, because then the drones
79 would be completely with us. And I wouldn't have to deal with private customers. And let's
80 say, at least 13,000 pack stations. And if there is a lot of traffic between the pack stations, that
81 would really be from one pack station to the next. Could perhaps be conceivable for you as an
82 idea?

83
84 **Interviewer:**

85 Yes, no, it's definitely an interesting approach. We tried to think about it a bit visionary, but
86 we haven't thought about that yet. So thank you very much for that, it's definitely a good idea.

87
88 I'm just looking at what you've covered so far, especially the questions we had. because you
89 also talked about this test phase in the e-mail that you wrote to Annelie. It would be very
90 interesting if you could tell us if you know what factors were there that led to the closure of
91 this test phase or that it was not carried on?

92
93 **FS:**

94 So it's going a little bit in the direction. You want to be innovative, but it was..., I would
95 speculate on that. So that would be something. Now I'll say something, because, as I said, I

96 have now pulled out this info, for example, I called my press speaker. And then he gave me the
97 things. So I'll note it down. We could talk a little bit, maybe I'll get something from us. But I,
98 as I said, you have to imagine it that way. We are a huge store with us with 180,000 employees
99 and 140 employees. I am now one of 40 employees. I'm not the one who buys e-cars. I use the
100 e-cars where the central one has the strategy. Hey, I want to do something with e-cars now.

101

102 **Interviewer:**

103 I have another question. You said at the beginning that the idea was to make delivery to islands.

104

105 **FS:**

106 Yes, exactly.

107

108 **Interviewer:**

109 I don't know if you heard about it, but is it also a vision now actually day-to-day package now
110 how you imagine to deliver it to the gardens of the customers ?

111

112 **FS:**

113 So I think that we will slowly begin with individual customers. So maybe for you too, we
114 already have customer relations to the recipient customer, not to a deposit contract. That means,
115 a customer tells me at Deutsche Post, that our supplier documents with signature, he has handed
116 over the package safely. At Amazon, it is sometimes photographed. But we still do it like this,
117 that we make so-called deposit contracts, that a customer says, listen, I'm often not home, but
118 I want you to give it to me, put it in the garage. And there is a contract and it is documented in
119 our hand scanner. I can deliver it there. So if we go further and I say we have innovative
120 customers who may come to us and are active and customers say. Hey, I have a possibility here

121 on the balcony that's my landing site, I want to have my package there, and it is important to
122 offer such a service. It is also difficult to let customers decide the drop-off point. Especially
123 because the environment changes, one day the car is there, the other it isn't. So if it is a
124 driveway or balcony, it is very difficult for the drones. That's conceivable. I always say I'm
125 always hanging on the mass of 5 million in the growth market. So you have to imagine it like
126 this, we have to think about it, we are in such a supply base where maybe 6,000 packages are
127 being supplied to me this morning. That is exactly the question now, where do we decide then?
128 The customer's agent would have to decide, now I'm sending it via drone. Yes, it is like that,
129 who controls innovations? Is it the entrepreneur or is it the customer? If a dynamic would
130 develop there, so the guys who are already taking pictures with their drones or whatever, and I
131 say, hey, why can't you do that to me? In my catering business, you bring service and I have to
132 cater for two years. So as I said, we already have an innovative attitude.

133

134 **Interviewer:**

135 Yes, definitely. If you're talking a little bit about customers did you notice anything during the
136 test phase, how customers have received it from you? How it arrived in general? How did you
137 guys approach this?

138

139 **FS:**

140 Well, in my opinion, the thing with Juist was a kind of apothecary. It's always complicated, the
141 handling, the cost situation. They are a bit far behind. You can see the development. I don't
142 want to make you worry. We didn't do anything with it last year. It was something from China,
143 which is far away, where they tried something. It's always a question of cost and innovation. I
144 think with Troisdorf we are on the right track.

145 In the end, we were maybe a little more risk-averse in the next ten years. We say we want
146 innovation, but after a certain time I have to expect innovation. And if we don't make money
147 with it, just because we say, nice to have a few press articles, then we don't do it. And that's
148 how I appreciate our board of directors and our bosses up there, who also do it so well. We do
149 what we earn money with and after a certain time we have to earn money with it. I think that's
150 the biggest bottleneck. Although I can hardly assess the regulation of the planes. But I think
151 that's the biggest bottleneck, that you want to make money in a tough competition.

152

153 **Interviewer:**

154 Yes, it makes total sense. That's the biggest problem we found out so far. That currently no one
155 can do it, but the big players put massive money in it. And then probably the first to be. That's
156 why it's interesting that DHL is currently in a standstill in Germany. But we also had the
157 assumption that it is a marketing thing for many.

158

159 **FS:**

160 It just has to be proven to you. I have the idea, I have read it for over 30 years. It's like this, for
161 example, we are, like we talk about others, for example. At Amazon we say, the clever ones,
162 they were a long time ago, just before the day, what they do all green, so classic greenwashing
163 or Hermes. and we say, now you have to admit a car. How many vehicles are really in your e-
164 cars and how many not? There is of course also a fight and there is always the question of what
165 you actually do and what you do only. And that's just every car is a G-strategy. And I say even
166 the, now you have to be careful, I say even the company Hermes, who treat their people in
167 some painful conditions. Even they leave and have to sell somehow. You have to swim with
168 them in this thing. And maybe they are too solid in some areas that you say, we don't want to

169 do anything big there. But that's a bit of speculation again. But I think it's good that he gets as
170 close as possible to Troisdorf. Because they are the heads that have the most in our direction.

171 **Interviewer:**

172 We've talked about a lot of things now. You were able to answer a lot of our questions like
173 that. So really nice, thank you. That really helped to get some industry insight.

174 *End of Interview*

9.7.2. Manna Drones: Michael Cunningham

1 **Transcript (condensed)**

2 **Michael Cunningham (Head of Commercial, Manna Drones)**

3 **19.10.2023**

4 *Start of interview*

5 *Check of ethical considerations and greetings*

6 **Interviewer:**

7 Perfect, lets kick it of then. Could you explain the underlying rationale that made Manna

8 Drones to strategically concentrate its drone delivery efforts specifically on perishable goods?

9

10 **MC:**

11 Sure thing. We noticed a big issue with hot food deliveries, it was arriving cold. And, you

12 know, the whole rush-hour traffic situation from 5 to 8 pm was making it worse, especially in

13 the suburbs. So, we decided to go for quick 3-minute deliveries, no matter the time.

14

15 **Interviewer:**

16 Makes sense. Is Manna Drones thinking about jumping into regular parcel delivery and getting

17 into the broader e-commerce game? And how do the challenges for delivering regular stuff

18 compare to perishable goods?

19

20 **MC:**

21 Absolutely, we're thinking about it. Non-perishable goods are on our radar because they're way

22 easier to handle, especially when things calm down during off-peak hours. It's all about

23 avoiding the congestion we face with perishable deliveries.

24

25 **Interviewer:**

26 Interesting, How's the public feeling about autonomous drone deliveries, especially with
27 Manna Drones leading the change?

28

29 **MC:**

30 Oh, it's been great! Our surveys show over 90% of folks are totally down to use our services.
31 We've hit up a 40% market share, and our Net Promoter Score is a solid 84. People are loving
32 it.

33

34 **Interviewer:**

35 Impressive stats. We have another question for the domain of last-mile drone delivery, what
36 are the pivotal operational considerations that Manna Drones prioritizes to ensure an optimal
37 level of efficiency and seamlessness? And what is the current degree of human involvement?

38

39 **MC:**

40 It's a multi-faceted operational structure. Currently, we require human loaders to facilitate the
41 loading process of the drones. One loader is adept at handling approximately four drones
42 simultaneously. At the same time, other important roles like as mission control, dispatch, and
43 customer service, operate in a centralized fashion, reflecting a strategic division of labor within
44 our operational framework. But it is also worth noting that we always still need humans to
45 oversee the entire operation, especially for the case of unexpected events that might require
46 human intervention.

47

48 **Interviewer:**

49

50 Got it. Could you break down Manna Drones' business model all about? Spekaing of key
51 revenue streams, strategies ensuring profitability on a per-use basis, and overarching
52 operational methodologies?

53

54 **MC:**

55 A cornerstone of our business model lies in the optimization of aircraft utilization. Currently,
56 our primary revenue streams comprise a commission derived from partner restaurants, a
57 delivery fee imposed on the end customer, and a markup applied to our proprietary products
58 stored at the base, including items such as coffee, drinks, and ice cream. We envision
59 diversification in the future, introducing additional revenue streams such as a subscription
60 model and advertising initiatives.

61

62 **Interviewer:**

63 What have been, or persist as, the primary challenges confronting Manna Drones in the
64 application of drone delivery technology for its services?

65

66 **MC:**

67 Predominantly, regulatory challenges have proven to be a substantial impediment, particularly
68 in countries such as the UK and the USA. Additionally, a notable challenge on the horizon
69 pertains to securing the necessary funds to facilitate our envisioned scale-up endeavors.

70

71 **Interviewer:**

72 When contemplating expansion into new markets, what specific local factors does Manna
73 Drones take into consideration, and how do these factors significantly influence the strategic
74 decision-making process?

75

76 **MC:**

77 Excellent point. When expanding, our primary focal point is the regulatory landscape of the
78 prospective market. Additionally, factors such as market size, housing density, climate
79 considerations (with a current prioritization against extremely cold or hot regions), and the
80 prevalence of food delivery trends all weigh into our strategic considerations. It's a meticulous
81 evaluation, ensuring that each market's unique nuances are thoroughly considered in our
82 expansion strategy.

9.7.3. Amazon: Nathalie Steinmaurer

1 **Transcript (full-length interview)**

2 **Interview with Nathalie Steinmaurer (Head of AVS FMCG – Amazon)**

3 **25.10.2023**

4 *Start of interview*

5 *Check of ethical considerations and greetings*

6 **Interviewer:**

7 Yes. Because quick background on kind of what we specialize in or what our kind of research
8 question is or what we're looking at. So our overall topic is technology innovation with our
9 professor and we look at innovation in B2C logistics per se. And within that we mostly focus
10 on last-mile delivery or what at least is important for us now because you know most expensive
11 time consuming part. And look at the biggest customer impact. Exactly, exactly. And then we
12 kind of looked at what's happening there, how can you innovate, how can you increase
13 efficiency, and within that part we focus on drone technologies.

14

15 **NS:**

16 Okay.

17

18 **Interviewer:**

19 Exactly. So then we kind of looked at what's happening, what has been done in the past years,
20 months. A lot actually has happened, but we don't, we're not just focusing on Amazon, we're
21 looking at the whole industry.

22

23 **NS:**

24 Yeah, yeah, everywhere, I understand. And I think a lot of companies, and I think different
25 parts of the world might be more ready for it than others, right?

26

27 **Interviewer:**

28 And that's kind of where I was hitting, because, for example, healthcare, they're actually quite
29 ready for it, and there is companies like Zipline, I don't know if you've heard of them, mostly
30 operating in Africa, and they're distributing medical goods whatsoever all across basically
31 where they're needed so they're not just operating in Africa because the use case there is given
32 you know the pharmaceutical products are low-wage they're very expensive so they're really
33 justify you know having a drone flying out there so that makes sense. So let's say...

34

35 **NS:**

36 And infrastructure are also very complicated. So the speed of delivery, which is a big topic.

37

38 **Interviewer:**

39 And very important there as well.

40

41 **NS:**

42 And the dedication is always timely. I think there is an economics question. I think the big
43 challenge if you look and if you compare, not even drone delivery, but what they call the quick
44 covers, right? So all of those old and gorilla and those guys, right? Who are kind of really
45 focused on that last-mile, fast delivery, smaller choice, not. The economics don't always add
46 up. Exactly. Right? I think it's the biggest challenge there. I think we are from a business
47 standpoint, fully ready to scale, right? We scale as a living, right? This is what we do. But I
48 still think there is an economics about, I don't know, do customers really need all that with that

49 kind of speed? And are they willing to pay for the cost, right? Because obviously it's a one-
50 man drone, right? Like you do a parcel thing where parcel A goes to this place. I don't know if
51 it's effectively possible, but that's the only way you would reduce the cost. So I it's very
52 challenging.

53

54 **Interviewer:**

55 Yeah. That's also kind of our status quo, let's say, for what has been researched and so on
56 already. That the use case is a bit questionable overall in e-commerce. I don't need my book
57 within 30 minutes. One day delivery is great. And if I really need it urgently, most people live
58 in cities anyway, you can also go out to your local... If it's that urgent, why pay extra?

59

60 **NS:**

61 Yeah, you're leaving the middle of Siberia where you're going to freeze yourself off going out
62 to buy.

63

64 **Interviewer:**

65 Exactly. Exactly, and that use case is also out, at least for e-commerce, because it's again even
66 less economically feasible, viable whatsoever to fly that far out, because then you need whole
67 different type of drones than the drones that fly like 20 kilometers. So it's really short in
68 distance, specific types of products, specific types of customers as well.

69

70 **NS:**

71 That is a big thing, the economic viability.

72

73 **Interviewer:**

74 Kind of question we try to figure out now is A, what factors, or are we looking at different
75 factors that kind of just have to be given in order for that to make sense? Also, at one point
76 economically, sure, back in the days people said with e-commerce you can't make money never
77 I mean look at Amazon now

78

79 **NS:**

80 You know so at one point sure I think I don't believe it's a hoax the whole thing I just think
81 right now. It's it doesn't make sense as people wanted to make sense yet Also, I think that's why
82 kilos of rice over drones, not really. But as you said earlier in the case of medicine and the
83 content of what to deliver, right, I think there is a potential.

84

85 **Interviewer:**

86 And that's also interesting that you said that you're in healthcare because I was going to ask
87 kind of what selection you would think would make sense or what the customers want to see
88 being able to deliver by drone. And do you think like, especially people that shop, you know,
89 any pharmaceutical products, whatsoever, I don't know what the top sellers in healthcare are.
90 Would, is the willingness to pay there from customers in your opinion, or what do you say?

91

92 **NS:**

93 So I believe it depends. So obviously, even though we do healthcare, we only do real healthcare
94 in the UK, right? Because this legislation in, in mainland Europe is really complicated. So you
95 cannot do half of the medication. In the UK we sell quite a lot of proper medicine, in the rest
96 of Europe it's not happening. In the US it's a big topic as well, because we've opened kind of
97 the, I don't know how it's called, Amazon Pharmacy, I imagine, I forgot the name.

98 So for those type of things that have a time sensitive element, I could imagine that that would
99 work. So in the health and personal care, a lot of it is nutrition products. They are like shelf life
100 products. I don't think that would make so much sense or CBD oil is a big topic, those type of
101 things. I don't imagine there is such a need, like you run out, right? It's not like in the past where
102 I ran out of cigarettes so quickly, I don't think people run out in the same way. And also I think
103 what is the time saving element that customer would be willing to pay for that extra, right? I
104 could imagine for some customer group that might make sense, I would imagine parents of a
105 newborn that needs something quite urgently for the baby or something, you know, like you
106 run out of paracetamol for the baby, the baby has a fever without having to get out of the house,
107 you could do that. Or elderly people who are physically not able to get to the shop or customer
108 that would be disabled, for example, or with chronic illness, like, you know, I think there are
109 maybe some customer group as opposed to product per se. You know, I would maybe take
110 more the angle of what customer needs is fixing as opposed to products. From a product
111 standpoint, I think there's a big element of the weight, yeah, because I imagine anything that's
112 bulky would be out, even though the first thing that came to my mind was nappy, right? To run
113 out of nappy.

114

115 **Interviewer:**

116 If that's an emergency for sure I can imagine.

117

118 **NS:**

119 You know, like even though how much people really run out of nappy, I don't know. I
120 personally never did. But for those type of things.

121 And I think also there might be different attitudes towards this, we are seeing more and more
122 the kind of consciousness of customer rights. You've seen we've launched a lot of programs to

123 reduce packaging, for example, right? So we now have that project where products are
124 delivering their original packaging without being wrapped with Amazon products, like
125 Amazon Cardboard or anything, we stop all plastic. And so I think there is maybe an element
126 there as well of the barrier will be that at the moment the world is a bit on fire. And so people
127 are going to say, do we really need drones to come and pollute in a way, right? So that I see as
128 a very, very big topic on top of customer mind at the moment.

129

130 **Interviewer:**

131 But do you think it would make a difference then to kind of market the whole drone technology
132 delivery also as a more sustainable choice, because it is more sustainable than delivering via
133 truck in general.

134

135 **NS:**

136 Yeah. I think anything today that helps customers realize that there is a benefit from an
137 ecological or sustainability standpoint always works. You will always have the customer that
138 are like, oh, of course, we don't need that. We need to go back and grow our own fruits and veg
139 in the garden, right? Like, there are all customers on the spectrum, and yes, I believe to be able
140 to demonstrate, even though there is also a lot of work being done on moving to electrical
141 vehicle, this type of things. Yeah, so I think that that will do. I think the other thing is, what
142 proposition do you have for customer? Is it something, an additional, so you can have it
143 delivered with Prime, super quickly, not so Prime, and then sort of slower, and then like, you
144 were fast, you have the drone delivery. Is it something like you would imagine, like a subscribe
145 and save program, where a certain number of select customer, pay a premium to have access
146 to have that service on a selection of products that are available for them. It's all that economic
147 model of saying, do you make that part of the prime offer for us, for example? Is it something

148 that customers would want as part of the, I have one need and as a one-off, I'm going to do the
149 drone delivery. How do you educate customer about what it means? So I live in a high rise, I
150 have no balcony. Where on earth is this going to be delivered, right? Because it's always the
151 challenge of, oh, my driver didn't leave the parcel where I said it should be delivered. You've
152 left it in the wrong balcony. So I think there is a big element of customer education as well,
153 and customer feasibility. Are all customer able to receive these? How do you assess who are
154 the customer? Because for us, like if I would think, and obviously I'm thinking from an Amazon
155 standpoint, right? But if I would be Amazon, can I deliver every customer with drone? Maybe
156 not, but how do you, you know, do you need a questionnaire for, and determine a certain
157 number of factors that the customer needs to have. So me, I have a garden, you know, so it's
158 not a problem. The drone can access and leave it in front of my door. But if I live in a high rise,
159 I don't know, in a region of high highs or something like this, it's a little complicated, right? So
160 is there a questionnaire you need your customer to fill in to be able to evaluate who could be a
161 candidate? And then how do you manage the expectation, right? If people want it and you can't
162 do it, it creates a lot of frustration for customer.

163

164 **Interviewer:**

165 That is actually also, in general, super interesting because there's a massive, that's the thing,
166 you know, it's a global solution, but scaling it locally is super difficult, especially because I
167 mean, in general, you can say that the countries within Europe are similar in that sense, the
168 topography and stuff, but you know, in comparison to the States, for example, the suburbs, they
169 have space. So totally different. But even though I would say also the attitude in Europe might
170 be different. I can't imagine that really working out in Germany, for example.

171

172 **NS:**

173 The data privacy, the need to have a camera to figure out where they land. This is going to be
174 a revolution. Where I think in other countries might be a bit less. It depends also how safe the
175 place is, but it's as safe as dropping a parcel when you have a, you know, and how the customer
176 proves that they've received, right? Because sometimes the driver is clicking and saying, yeah,
177 it's been delivered, but how do you do that with a drone?

178

179 **Interviewer:**

180 And generally, I don't know if you have an opinion on that or know anything about that, but
181 what is kind of your impression on the future trends. Again, it doesn't need to be specifically
182 Prime Air now, but would be also interesting to kind of see it from an Amazon perspective to
183 see what the future trend with that technology is. How would Amazon leverage that? Would it
184 make sense? How big will this be scaled whatsoever? Because currently, massive investments
185 going on for 11 years, I think. 10 years, 11 years, yeah. And no results really. I mean, they tested
186 it and stuff like that. I think last month there were 100, or in May, 100 deliveries in total, so
187 nothing. No scale. In that type of time. But I would imagine that if Amazon does the scaling, I
188 think they might identify a set of market where it makes sense, right?

189

190 **NS:**

191 So there's a test being conducted, but we've just announced we're opening South Africa. Yeah,
192 so Amazon is opening in South Africa in 2024. My main door is there, opening Amazon there.
193 And, you know, I think what is interesting is understanding, right? Is there a specific
194 marketplaces where that would make sense because it makes sense from a customer standpoint.
195 You know, like it's the same if you look at digital payment, China, Africa, a lot of parts, they
196 do everything through mobile phone where some parts in Europe are not, yeah? And so I
197 imagine there is a question of where to test, what to test it with, and I think having different

198 hypotheses of things you test. I would say we as Amazon never care about how long an
199 investment is going to pay off if we build it well. Yeah, we've always done that, you know,
200 Amazon Germany just celebrated 25 years. You know, if people would have said 25 years ago
201 that we would be where we are, I don't think it would have worked. So I think there is really a
202 question of what kind of a customer proposition is there and what needs does it answer and
203 how does the technology then enable. Technology is always an enabler to do something that is
204 good for customer. If the customer either don't want it, don't see it, then I think it's different.
205 But if you start and you work backward for customer, I think there will be a need. But maybe
206 not in all the country the same way, not across all the products the same way. There are
207 parameters that would need to be evaluated, right? The thing, how heavy can a drone be in the
208 future, if I make an order with five or six products, is it a multi-product possibility? Because
209 that means you need to have the warehouse set up in the way, because today your parcel might
210 be delivered from four or five, you know, you make one order, it might be delivered from
211 different warehouses. If you do the drone, it would mean one pick-up point. This also ties into
212 the integration of the existing supply chain network we have here at Amazon, its huge, really
213 huge. This is a huge advantage for our operation with drones, we can scale at much much
214 bigger capacity than other companies, making this a factor to be on the lookout for.

215

216 **Interviewer:**

217 That the whole logistical integration into the existing systems is also a massive, massive part.
218 And personally, we don't focus on it but you showcase like how is that going to be possible
219 with a new technology like that.

220

221 **NS:**

222 But I think the question is really location right? I know Portugal for example is super early
223 adopter of new technology and they've always been for whatever reason right like some of
224 those things. So I would also focus on what are the parameters that would facilitate this scaling,
225 right? So there is obviously the regulatory framework about are you allowed to have cracks
226 lying around in the city, you know? How do you do with countries where kind of electric line
227 are still out, yeah? Because some parts of Italy, some parts of France, the electricity cable are
228 not working. So it's an absolute maze. So I would look at that, right? What are the regulatory
229 framework when it's even possible? Is there anything today that define the condition in which
230 products have to be delivered? Yeah, obviously if it's medication, it means there might be a
231 temperature component. There might be some of that. I would also look at customer willingness
232 to try new things and funny enough, they're not all the same. I'm not surprised that the Irish are
233 trying that, right? Because Ireland, in my experience, I worked in Northern Ireland for a while
234 for projects and they were very open, very, very open to try new things. So I think there's an
235 element of, can you do it? Do the customer want it? And is it effectively doable, right?
236 Because again, as you say, if you deliver within Munich city center, I mean, Amazon Fresh
237 doesn't even deliver to me in Switzerland, right? And I'm like 20 minutes from the city center.
238 So, you know, what's the radius that you can serve, because then that also impacts your ability,
239 I think, to make it economically viable.

240

241 **Interviewer:**

242 And do you think, because for example, the company that I told you about in Dublin, for
243 example, that delivers these perishable goods, they have a very strong position on that e-
244 commerce, especially they always focus on Amazon, that that is not happening, that it does not
245 make sense. Sure, maybe it's their marketing, they want to showcase themselves in a better
246 light, but do you think that, especially in e-commerce, only a company like Amazon, you know,

247 with the funds in the background, is it possible to tackle such a big challenge rather than, you
248 know, having the given use case? Or do you think also like smaller startups?

249

250 **NS:**

251 The challenge always goes back to selection. Right? If you are advertising yourself, how big
252 of a selection can you even offer? And it's true that obviously, you know us, right? Selection
253 for us is about everything. So if you say, okay, I'm gonna take 10% of the selection of healthcare
254 products, let's say, if the customer are not, and again, you can refine and say, okay, we're gonna
255 evaluate what products, I think smaller firm will have, because they will not be competitive on
256 price. We see that even with Amazon Fresh, yeah? When you go talking to a Coca-Cola, even
257 when you're Amazon, they laugh, right? Because Coca-Cola, they prefer to work with the Rewe
258 or Lidl, you know? Because the volumes are there. I think that's the biggest challenge, I think,
259 a partnership with a company that could do the technology, but Amazon generally don't.
260 Amazon generally do in-house, but I could imagine, right, if I would be a technology company
261 that would be providing such a service, having a partnership with a Reve, a Neleca, whoever,
262 right, and some of the big guys who have the volume and the price and the products, right? So
263 you don't have to build warehouse from scratch. You don't have, because this is the problem,
264 right? It's all the scale at which you can do it. Yes, of course, you can do one warehouse and
265 you have like, I don't know, 50 drones and you do a bit here or there. But if you want to do
266 something very like scalable, all the scalable part needs to be there. And you need to be able to
267 sustain, I think a long time before, because it's not gonna be adopted.

268 Oh yeah, now I do all my shopping with a drone. Yeah, I don't imagine it's gonna be. And the
269 customer education will require a large amount of time. And I think you need to have a position
270 of trust. You know, I'm a random company A, and I'm coming in and I'm going to tell you how

271 to do drone holder. Yeah, some customer will be willing to try, but I imagine quite a few will
272 be like, oh my god, is that a scam?

273

274 **Interviewer:**

275 That is very true. That is also, I guess, why Amazon can do it the way they are doing it, in a
276 way of being the drone technology provider and the goods provider. Because, for example,
277 Wing is a drone company from Alphabet. They're for example just partnering with companies
278 like Walmart or DoorDash or whatsoever.

279

280 **NS:**

281 And they're just doing the technical drone delivery aspect. And then you know, it's like a
282 Gorillaz or whatsoever, but it's a drone and Gorillaz in that sense is a wing. So I mean, my
283 opinion, my biased subjective opinion, only really Amazon could pull that off now because,
284 you know, at this stage. Yeah, I think it depends on the country, Ramin. I think it depends on
285 the country.

286 I mean, I'm an Amazonian. I'm an Amazonian, I can do anything. This is what I've been fed
287 for the last three and a half years, right? But I think it requires a lot of different components,
288 right? So it's not just about developing that technology. Because if you think about it, there is
289 a lot of application you can have elsewhere, right? I'm a hospital, I need to have blood
290 transported, I have a shortening, like there's a lot of other things. But in the context of e-
291 commerce, obviously, the later entrant, and you can see, right, if you look at something like
292 Knusper, for example, who is doing really well in Germany, right, is that, you know, those type
293 of a big niche, they do the product from the farm and they do the standard kind of everyday
294 shopping essential, then you can add that value, that value add, right? The reality is for Amazon
295 at the same time, we're all about speed and everything we do is focusing on the speed of

296 delivery. Will it be any faster than ordering from yesterday and getting it today. Yeah, what
297 comes, what proportion of the selection effectively has a speed benefit?

298

299 You know, and it all comes back to that, even though you could say in the past, people were
300 very happy, I mean, I placed an order, at Decathlon the other day, it took almost two weeks to
301 arrive. I was appalled, I was like, I love the product, so that's why I put a shop there. But they
302 closed the shop near us, so we have to order online. But you know, those type of things, yes,
303 in the past, that was normal. Right? Today, it's not acceptable anymore. Today, it's like, I was
304 really pissed. So I think there is that element what proportion of that will become a bit more
305 mainstream. Realistically, it will not be mainstream with everybody. Especially if you consider
306 at the moment the cost of living crisis, right? The increasing cost like in the UK even more
307 than in the rest of Europe. Is that a must or is that a, I don't know, you know, like you buy a
308 new fancy car and you're like, yeah, I'm showing off, right? I'm having a drone delivery. And
309 for me, this remains the biggest barrier to this. And that's why when I look at those guys, those
310 gorillas, I've been approached a lot in the last year or so to go work with those guys. And I'm
311 like, I don't believe in the model. I absolutely don't believe that it's, you know, and the other
312 thing that I would say though, is if you think about specific, so I'm thinking about Zoopla, you
313 know, the pet company, right? So some pet owner are crazy, yeah? They would go to, you
314 know?

315 And so if you have a customer group that had, and they love their animals, and I don't know,
316 they have cats, and they have, then you could imagine that people would be willing to pay a
317 premium, right? They buy clothes for their dogs, right? So at some point, it's already crazy. So
318 if you have some customer group that has specific needs like this, you could say hey actually
319 yes you know I could imagine for product like my daughter comes home and she has life I don't
320 know how you say in English you know like the little things that you know I mean I don't know

321 I think it's like obviously I need to buy a thing so me I have the thing at home because I'm
322 prepared but you receive a message from school, your kids come home, they're scratching, of
323 course you want the thing in an hour. But those things I think are more exception versus the
324 norm. And the reality is how do people shop? Even me, I don't shop my groceries on Amazon.
325 I shouldn't be saying that, but I don't shop on Amazon because I don't find the value proposition
326 very easy. Me, I prefer to do my one weekly shop. I do everything that I need and everything
327 comes together at one time. If you have to have a drone delivery, you want 10 products, does
328 it mean what, 10 drone delivery? does it mean what, 10 drone delivery? To five pounds or
329 something per delivery. And you know, groceries can get heavy, so I don't think groceries is
330 the good use of case. I think the healthcare part, I think, makes a lot of sense, right? Someone
331 is, let's say we're back in COVID time, right? If you would have another pandemic, how do
332 you deliver medication to people without having to have someone taking the risk, you know,
333 in the case of something quite contagious. Those type of use cases, yes, definitely. But
334 otherwise, I think there is still more to be done on the economics model. I think the technology
335 is there. What is refined enough to be able to make it work, I still think there is a customer
336 proposition question. Yeah, it's gonna be super interesting to see how that is going to evolve or
337 how is it evolving and how is it developing. I'm very curious to see. And you never know,
338 right? My husband wrote a thesis in his university time about pods in airports to be able to
339 sleep and to work, right? I remember what maybe 10 years ago we went into whatever airport
340 and he's like, oh wow, they have pods now. Right? And I think some of those things, I think
341 that's the thing when the technology is there, I think it works. You know? But... Interesting.
342 Maybe in 10 years, I'll be walking around and be like, oh wow, they do have these drones.
343 They do have drones.

344

345 **Interviewer:**

346 Thank you for your insights.

347

348 **NS:**

349 For me it always, look at the flywheel, right? If you want to look at the parameter, look at the
350 flywheel and look at every single component of the flywheel and you will see where is it
351 blocking, yeah? Because you need enough selection for customer to be able to find, you need
352 to have enough volume to bring the cost of doing this down. And if the fly, and we know that
353 even when the flywheel fly it doesn't always fly, yeah? Because the cost doesn't always reduce
354 proportionally, right? I still think the cost of delivery compared to a tradition, because that's
355 the competition. Traditional delivery versus what's the benefit for what cost. If it costs three
356 times more, will the customer be willing to pay? I think in, yeah, to try out for fun.

357

358 *End of Interview*

9.7.4. Connect Robotics: Ana Manuel Almeida Martins

1 **Transcript (condensed)**

2 **Interview with Ana Manuel Almeida Martins (Executive Management Assistant /**
3 **Business Developer)**

4 **27.10.2023**

5 *Start of interview*

6 *Check of ethical considerations and greetings*

7 **Interviewer:**

8 Alright, let get started. Could you elaborate on the factors that led Connect Robotics to foccuus
9 specifically on the delivery of medical goods within the expansive realm of drone technology?

10

11 **AM:**

12 Certainly. The motivation behind our strategic focus on medical goods delivery emerged from
13 the notable traction observed in the market and the distinctive niche it represents. This niche is
14 characterized by an imperative need for expeditious, contactless responses, particularly in areas
15 with challenging access, be it the rural expanses or urban and suburban locales grappling with
16 high density, population, and the perennial issue of traffic, all of which inevitably culminate in
17 deleterious delays, thereby impacting not only time but also financial resources and, most
18 significantly, human lives.

19

20 **Interviewer:**

21 Interesting. When looking into the future, does Connect Robotics harbor strategic visions of
22 integrating drone deliveries for general parcels, thereby potentially venturing into the
23 expansive domain of e-commerce delivery services?

24

25 **AM:**

26 Yes, our overarching goal is to democratize the utilization of drone delivery, rendering it
27 accessible to a number of businesses. While our current focal point remains on the health
28 market, it's pivotal to underscore that our modus operandi is not exclusively tethered to this
29 sector. Rather, our fundamental purpose lies in meeting the exigent demands for safe, swift,
30 and autonomous deliveries, not confined solely to the health sector but encompassing a broader
31 spectrum of destinations, both urban and those arduously hard to reach.

32

33 **Interviewer:**

34 What distinctions or unique challenges does Connect Robotics grapple with when
35 contemplating the deployment of drone deliveries for general parcels as opposed to the more
36 specialized field of medical goods?

37

38 **AM:**

39 The core technology, at its essence, remains consistent across these diverse applications. It is,
40 therefore, more apt to conceptualize the challenges in terms of the inherent value proposition.
41 We possess the nimbleness to seamlessly adapt our software to harmonize with a number of
42 hardware options available in the market, meticulously aligning with the idiosyncratic needs
43 of our esteemed clients. The challenges, therefore, are contingent upon the nuanced
44 specifications of each business, the difficulties of the landing scenarios (precision paramount,
45 albeit distinct when grounding or employing the innovative drop-in-a-basket technique), and,
46 significantly, the extant regulations governing each sector. For example, urban environments
47 have different regulatory requirements we hav to follow in comparison to rural areas. In the
48 context of Portugal, for instance, the transport of medicines necessitates explicit authorization
49 from Infarmed, an authorization that we, in fact, have successfully secured. Furthermore,

dealing with goods requiring special licenses is a challenge we stand adequately prepared to navigate.

Interviewer:

Lets talk about the public perception, how has the reception been towards the concept of autonomous drone deliveries, particularly in the context of Connect Robotics' pioneering initiatives in the medical supply sector?

AM:

The reception from the public sphere has been very positive. We have not merely encountered, but diligently addressed, a number of challenges, thereby substantiating a demonstrable enhancement in efficiency, both in terms of cost-effectiveness and temporal expediency.

Interviewer:

Okay thats good. If we are now zooming in on the specifics of last-mile drone delivery, could you explain the key operational factors that Connect Robotics meticulously prioritizes to ensure not only efficiency but also the seamless orchestration of operations in the delivery of goods?

AM:

At the forefront of our operational ethos lies an unwavering commitment to safety. This manifests in a rigorous testing and approval process, where we leave no stone unturned to ensure the integrity of our operations. Coupled with this commitment is our dedication to harnessing the crème de la crème of technology and deploying a cadre of specialized professionals who function as the linchpin in guaranteeing operational efficiency. Moreover, a

pivotal facet of our operational strategy revolves around the active involvement of end-users in comprehending and proficiently utilizing the technology at their disposal.

Interviewer:

In the grand scheme of Connect Robotics' operations, could you provide nuanced insights into the current level of human involvement and concerted effort necessitated for the seamless operation of drones within your organizational framework?

AM:

While our operations are inherently characterized by a pronounced degree of autonomy, it's imperative to acknowledge the substantial human involvement that transpires during the nascent stages of our operations. This involvement is particularly salient in the meticulous construction of our solutions, the bespoke customization of projects for each client spanning diverse operational spheres, and the intricate navigations pertaining to licensing intricacies, safety measures, the formulation of a cogent business strategy, and a panoply of other pivotal considerations. Rest assured, we maintain an unwavering commitment to having a dedicated team, one hundred percent vested in addressing the unique needs of each operation, with the client assuming a direct and consequential role in shaping the trajectory of our operational paradigm. Ultimately, the goal is to achieve complete autonomy, but that is certainly dependent on the regulation in place and technological compliance with these regulations.

Interviewer:

In a nutshell, could you succinctly outline the fundamental elements encapsulated within Connect Robotics' overarching business model? This could encompass key revenue streams,

delineation of plans aimed at ensuring profitability on a per-use basis, and the strategic operational approaches specifically within the purview of the medical goods delivery sector.

AM:

In essence, our business model is intricately woven around a turnkey subscription model, a model that lends itself to flexibility, accommodating the nuanced needs of our esteemed clientele. The lucidity of our plans stands as a testament to our commitment to reach both clients and funds, thereby fortifying our organizational bedrock for growth. Our operational strategies remain steadfastly aligned with the exponential growth witnessed within the health sector, charting a trajectory that ensures synchronous evolution.

Interviewer:

Looking into challenges, what have been, or continue to be, the primary impediments that Connect Robotics grapples with in the application of drone delivery technology specifically for medical goods services?

AM:

Undoubtedly, the regulations within the EU.

Interviewer:

Navigating towards expansion, when contemplating entry into novel markets, what specific local factors does Connect Robotics judiciously take into consideration, and how do these factors intricately influence the meticulous strategic decision-making process of the organization?

123 **AM:**

124 When embarking on the exciting trajectory of market expansion, we exercise judicious
125 consideration of a myriad of factors indigenous to the locale in question. Foremost amongst
126 these considerations is the presence of an open regulatory environment, a receptiveness to
127 embrace and implement our avant-garde services, the omnipresent ethos of safety, and,
128 unequivocally, the fiscal considerations that underpin the deployment of a service that seeks
129 not only to meet industry standards but to exceed them. It is this confluence of factors that
130 forms the fulcrum of our strategic decision-making process, encapsulating an open-minded
131 regulatory ambiance, an amenable attitude towards our service implementation, the bedrock of
132 safety, and, naturally, a judicious assessment of the associated costs that pave the way for us
133 to unfurl the banner of quality that distinctly sets us apart.

9.7.5. Digital Settings: Lasha Sharikadze & Dr. Olaf Funke

1 Transcript (full-length interview)

2 Interview with Lasha Sharikadze (CEO) and Dr. Olaf Funke (COO) from Digital Setting

3 30.10.2023

4 *Start of interview*

5 *Check of ethical considerations and greetings*

6 Interviewer:

7 I will shortly introduce to you what we are doing or what we are working on is that, so we try
8 to explore in our master thesis the use of drone technology within the e-commerce last-mile
9 deliveries. And if there is a potential for that technology to kind of enhance e-commerce last-
10 mile deliveries, or if not, what are the factors that are not contributing to it, or if what are the
11 factors that could contribute for this to revolutionize this industry. So this is just a short
12 background and basically how we want to study this is we're going to talk to different experts,
13 including you, and also going to do a customer survey to see if there's some customer
14 acceptance, if customers are willing to pay for the service, if they're willing to accept the service
15 as an alternative. So yeah, that's basically just a short summary of what we are working on
16 within our thesis. And that's also just as a background for the questions that we are asking. As
17 I already said in the email, if you don't know the answers to some of them, it's totally fine.
18 We're just very interested to hear from your perspective and also your thoughts on this whole
19 topic. So maybe it's, to start off, maybe first explain what you guys are working on and what
20 your roles are so we are on the same page.

21

22 LS:

23 Perfect so maybe I will start. Okay I'm representing the digital settings this is a technology and
24 innovative company mostly working on different solutions like IoT direction, Internet of

Things, also e-commerce and also too many different types of applications for clients. We are let's say founded at first in Georgia too. So we created as a digital settings, we created different solutions for Meama like vending machines, coffee capsule vending machines. This was a really innovation for the whole market because already win worldwide award twice and it was one of the best solutions for offices with different size like small and big offices to distribute coffee capsules amongst the employees. payment methods and it works totally with cloud system. It has also an administrative panel. And so we created the whole vending management solution, the classical VMS system from zero with inside resources. one main IoT direction which we are doing for now. The second thing is the e-commerce direction. We already created e-commerce from scratch. We are working for now the application and also we have the core system which unites, I will explain for now, which unites all the sales channels for this Meama company. So Meama is not only coffee capsule provider for the market, it's also a technology company. It unites every sales channel, every customer in one place, every sales transaction from vending machines, from e-commerce, from application. Also it's connected with a physical shop and the business owner can control everything from one dashboard, let's say, every transaction, every user and business owner has holistic control of his business. We also for now are working to implement BI solutions like business intelligence to predict the next steps for the business, marketing, optimization, and everything. Another direction which our team has a big experience is like hospitality business. Kailas system for hotels and applications for users and plus CMS. So we have one-stop solution for hotel owner to digitize their business more wide perspectives than he can do himself. And yeah, this is shortly what we are involving in too many small and medium-sized projects also. And yeah, I will be happy to share my knowledge and experience, 10 plus years almost, in e-commerce and startup industry.

50 **Interviewer:**

51 That's very interesting.

52

53 **OF:**

54 Lascha, you told all about digital settings. I joined digital settings to make operations and to
55 help out in different business areas. And we want to partner up with the hospitality business as
56 well and in the coffee business at the moment. And after, during Lascha explained, I had a few
57 ideas and questions. I think drones, I think Lascha showed yesterday what we explored. Lascha
58 and me was at the weekend, I showed him the countryside of Germany. I think Theresa, you
59 will know the Eifel area. She's from Cologne, so she knows this area here. And she knows the
60 little villages which have no shop anymore, nothing. Maybe this could be a really innovative
61 thing where we can go straight forward to deliver in these little villages directly at home. This
62 can be something. Because you know it, the old people in these areas. It can be a market. And
63 not only in Germany, I think I see Belgium, I see the same in Luxembourg, I see the same in
64 France and Austria is similar.

65

66 **Interviewer:**

67 So what you're saying basically also goes into our first question about drones. What do you
68 think is the use case for drones in customer e-commerce deliveries? And you're saying Olaf, is
69 those villages, which definitely is a use case, which we also found already.

70

71 **OF:**

72 I think big cities are crowded and it's not undangerous, it's forbidden, you have to control the
73 air. And I think in big, clouded cities it's not really needed. For example, if you see Cologne,
74 the city of Munich, you go in the night out, you find a gas station, you find a kiosk, you get

anything you want around the clock in principle. But on the countryside it's completely different and it's easier to send a drone out because of the air, because of the Luftraum, I think, the air control.

LS:

Yeah, I will add some comments also here. Not only countryside, I think, I mean the villages outside of the city, also the not city centers, the city suburbs are interesting, the homes with their own yard, I mean enough space for drones. It's also considering and interesting because in a drone delivery, with a drone delivery you can offer to the potential users with totally touchless service. Let's say that it needs only put some mark where can drone put down the parcel and that's it. It doesn't need any let's say sign up or mark that you got something the drone can itself do everything automatically, sees a specific area where it should put the parcel, takes a picture or screenshot to prove that it really provides a product to the customer and that's it. innovative and seamless experience for the clients. Only one thing is only the privacy and regulation and the legal issues that different drones should fly over the neighborhood with different yards. And maybe if I'm a neighbor and I'm not using the drone delivery system, I have some issues or doubts what these drones are crossing my yard and what is happening there. Maybe it should be an issue, but everything is changeable I think because I'm looking this in a positive manner. For now, from my view of perspective, I am a non-EU member, not yet, but from my view of perspective, the European Union has big issues that the laws too many GDPR compliances and these things. So it's, let's say, it gives a break to the innovation. I mean, if regulations won't be so strict and so high, then every innovation easily tested on the markets and easily adjustable. Yeah, this is my opinion regarding drone delivery.

Interviewer:

100 Very interesting. When we talk about the use case, do you think that drone deliveries are
101 feasible for any kind of e-commerce product or would you say it's rather limited to some
102 products that you need it I think.

103

104 **LS:**

105 If you have time to get it, I think no one will take it wrong. Fine, the post brings it, that's fine.
106 I think it's for maybe, I think for food can be a really good thing to send out a pizza or whatever.
107 For medicine I see it as immediate. I think this is totally important. What I thought from the
108 countryside as well because if all people want to have medicine and if someone needs
109 something really urgent and you have the possibility to send it via drone for example. He has
110 no catheter capsules anymore and he needs it and it's cost him so much time to get it, then it's,
111 you can, you can, I think that it makes sense, but not in any case. And the regulator will kill us
112 because they want to control our... Yeah, also we can use drone delivery in a medical use. I
113 mean when there is an emergency situation situation, someone can provide even blood with
114 drone. Why not? Yeah, when we're talking about emergency situation. But regarding products,
115 I think even subscription-based products are beneficial for drones and drone users for example
116 food for pets which you can get regularly even weekly newspapers for example or coffee
117 capsules and tea capsules why not and yeah things even wine or cigars or anything which users
118 are consumed regularly. It should be provided via drones. It depends where. I think it depends
119 a little bit where the location is. In the city center I wouldn't do it because the regulator would
120 never allow it. At the moment we have the law that you cannot use a drone because if it comes
121 down, if it breaks, you have an issue, you kill the people, Therefore, the regulator is really
122 strong with this.

123

124 **Interviewer:**

125 Yeah, exactly. So these use cases are generally good for drones. Kind of question on that also
126 because you have that background in e-commerce. And let's stick to the example with, for
127 example, coffee cups. A very big question for this whole drone topic still is the economic
128 viability. How that's also probably still one of the biggest issues for the companies, why it
129 maybe hasn't taken off to that level that was maybe predicted a couple of years back yet. So
130 how would you think, is for example, let's say coffee cups, is the profitability per use case
131 given? How is that financially feasible? Because if you imagine the drone has to fly, let's say,
132 20 kilometers just to drop off a few coffee cups to a user, right now at least that's difficult and
133 it's not financially feasible. So how do you think companies can tackle that?

134

135 **LS:**

136 Okay, I will start and try to answer. If we take only one example, one exact example, and
137 compare it with what is a traditional method of delivery, we can also doubt which one is
138 cheaper or expensive. And I will try to explain. If we want to see the big picture, we need to
139 put every aspect of participants, let's say. For example, what alternatives we have for now? The
140 fast delivery, which includes the scooter, electric scooter or traditional engine scooter or car
141 This person we need to hire, we need to give them an application, we need to give them
142 insurance, salary, every aspect. And also there is plus safety things, also too many aspects are
143 participating. that if you take one big machine and then imagine like 10 points where should
144 this machine go step by step and deliver, maybe it should be price wise. But if we imagine like
145 only one pizza should deliver from point A to point B and it delivered by a guy who sits in a
146 motorcycle versus drone delivery, it would be way cheaper than the person who needs to be
147 delivered. Also, there should be in the later, near future, there should be no reason why
148 someone should work as a courier, as a delivery guy. And it means what? It calculates in salary
149 wage, yeah? It needs more salary for this delivery guy. And if we reach the automatization of

150 drone delivery, then it should be way cheaper than hire someone, train someone, give them
151 salary, give them insurance, transportation, personal health. Yeah, this is a tool. complex
152 manner. Drone delivery should be cheaper than the traditional delivery, I think.

153

154 **OF:**

155 I agree fully to Lasha, but one thing has to happen. The drones have to have the possibility to
156 transport more than they can do at the moment with the weight and the distance because the
157 battery technology. This is a little issue. If you can harm 10 points, I think I fully agree, it's
158 cheaper. You cannot compete with a delivery person. But at the moment we have only the
159 possibility for, I don't know, one or two points a can. So, I think this is a little issue. Which
160 makes it more expensive.

161

162 We need to consider these two things that in parallel, the traditional transportation getting
163 expensive and expensive and alternative way of delivery is promising to extend inequality like
164 the long distance, the cheaper technology, more weight. Yeah, this is two parallels.

165

166 One big thing, there's a big thing because if I see in the city center the guys with the electric
167 vehicles, they are driving around. This is at the moment not a problem, but I think for the
168 environment, if you have in the countryside or wherever, in the suburbs, you have for sure
169 people with cars which are driving around and then you have the CO2 issues, environmental
170 issues, I think drones can save a lot of this. Because they are electrical, you can choose the
171 energy with which you charge them, and so on. I think this is a real dream, a dream that will
172 be pegged as well, for the world.

173

174 **Interviewer:**

175 Yeah, for sure. And you already covered a lot of points there. Maybe one other interesting point
176 would be, especially when you say you work in the field of IoT, how do you see potential
177 collaboration of emerging technologies like IoT or AI collaborating with drone deliveries to
178 make the whole process more cost-efficient and generally efficient?

179

180 **LS:**

181 Yeah, exactly. So, even in today's world, we see that AI is taking over in many directions. So,
182 these quantum computers, maybe you already know it and see it, can do the calculations like
183 thousands more faster, like wiser than the man, than the GPT-4, for example. Yeah, so, it will
184 think what? That this quantum computing plus AI should give us the direct prompts how to
185 automatize price-wise, not only price-wise, in other economical issues and factors, and give us
186 better solutions for drone delivery automatization. For example, in a bit later the data, I believe
187 that they can analyze not only how to deliver smartly the parcels, also the spots. Where should
188 we have the centers of drone delivery? I mean, with the suburb areas, with the user-customer
189 spending possibilities, with the potential customers and it will give us a prompt map where we
190 should put the centers of drone delivery centers, the charging centers, service centers and
191 everything. And yeah, quantum computers can handle things in a more complex way than
192 humans are seeing in act for now because we have the limits to think in many diverse directions.
193 AI and quantum computing can handle it and plus we cannot analyze in many like mathematical
194 algorithms or something. So, yeah, this is what I'm thinking.

195

196 I think in the case of IoT, I think the... I was in a project by Cisco. And they had the reverse
197 switches and routers for telcos worldwide. And there was a project which has taken all data
198 from the switches from the routers and has seen if there is an upcoming problem because of
199 the log files you see, you can see if you measure the temperature or whatever, that the router

200 will die in a few minutes or a few days or whatever. And what they did was to inform the
201 service people. They told him, hey, check it, go there and replace it before it breaks, so that we
202 have no issue with the SLAs. In future, it can be so that a drone will deliver the device because
203 it's thousands of types of devices. And this is still a problem to get it from the dock, where it's
204 this device which breaks in two days. They know this, they can predict this. And I think this
205 can be a piece for a drone to deliver it or to see, okay, we have a problem there. Bring it up
206 front there that the service person is there. It's still existing because I have seen this as a
207 problem. They have known it was really an issue. In India, I was there and then they had the
208 issue that they have seen that by the problem that five switches were dying. But they couldn't
209 deliver it because of the traffic. It was impossible to deliver it in time, so it broke. And they
210 have no one that could watch the break, they could watch the fail, but it was still in the taxi on
211 the road. For hours. And one comment regarding IoT. This 5G technology is overtaking in a
212 short period of time, I believe. Plus, the Starlink-like technology and itself Starlink and cloud
213 computing, it means if we plus everything together and to put everything together, It means
214 that users can have a more faster internet, more fast connection and coverage. Plus, we should
215 have more precise maps, more precise pins. near future regarding some starting technology
216 regarding 5G and plus this cloud engineering. But for me it's all a business case of a business
217 case. I think so far it is useful or price wise from the margin good to use it or cheaper. People
218 will, the industry will use it, will spot it. At the moment it's not effective enough, I would say.
219 Only for a few islands in North Germany. And to give them medicine.

220

221 **Interviewer:**

222 Yeah, for sure.

223 I actually have another question because to all the points you mentioned before that and also
224 would kind of briefly touch upon it in the beginning, the whole regulation topic, especially in

225 the EU, so far, you know, with AI, IoT, quantum computing, all of that, data privacy point or
226 legal issues whatsoever. These are obviously the main challenges for the application of drones
227 right now. When and how do you think companies will, or not even companies, will ever tackle
228 that in order for drone operations to scale? Because currently it seems like this is not happening
229 in the next one or two or even few years. Do you have any prediction if that's going to evolve
230 somehow?

231

232 **LS:**

233 I can tell you more. In Georgia, in my country, there is one company, they are coming from
234 Israel, Israel-based company, they already starting the drone delivery because in Georgia it's
235 more easy to start particularly anything because the law regulation. There is also the regulations
236 for drones, but yeah, it is starting. Even three years ago when Myanmar coffee getting popular
237 in Georgia, we wanted to do it with ourselves because there was no one who can give us offer
238 that we have a drone delivered because it It should be beneficial in two ways. At first, we are
239 positioning ourselves as an innovative company that we have the service that no one has. It
240 would be first. And second, Georgia, to be listed as the capital of the city, And second, Georgia,
241 to be listed as the capital of the city, has quite big traffic jams in the early morning and the late
242 evening. It would be a great advantage for delivering something. And yeah, we thought to do
243 it, but we did not solve because we are working in too many directions in parallel. So, the
244 human-sized taxi drones are already operating in the US and in Dubai as I talked. We are also
245 interested in this topic. We are looking for the solutions just for to buy the one drone for the
246 commercial reasons to show that we forward thinkers, let's say. And in Estonia, Latvia, also
247 some Eastern European countries, maybe also in Georgia, there are some robot delivery
248 companies. So, I think it's not already tomorrow we are talking about two days think I think
249 the same and I think if I see the military sector drones are really popular they are really useful

250 and helpful to save people and it doesn't mean that they kill someone like the US doing very
251 often. I think I mean to protect, to clear, to clarify therefore drones are really useful and they
252 are state-of-the-art at the moment. It's not a future technology that uses even this hobby drones.
253 I think the technology will go straight forward but I mentioned at the beginning we need to
254 have drones which are a little bit more more performant. I totally agree in a manner of like war
255 industry let's say because drones are totally changed everything as I see in how countries or
256 how escalated sides to have war on each other. I can remember Armenia-Azerbaijani war. It
257 was five years ago and Azerbaijan has total advantage and total control of the war because they
258 have drones from Turkey and they are dominating and they get total win to the Armenia
259 because they do not have drone technology. I can say the same within Russia-Ukrainian war
260 because it doesn't for now, it seems it doesn't have a matter US made or Russian made because
261 one smart drone can destroy it and that's it. Even I can say it's the same in Israeli Gaza conflict.
262 Also, the two sides can be, let's say, have the same power if both sides have drones. because
263 this is smarter, this is cheaper, and this has really big power to destroy enemies, any war
264 machine. So, lots of game changers in any sector.

265

266 *End of Interview*

9.7.6. Valqari: Ryan Walsh

1 **Transcript (condensed)**

2 **Interview with Ryan Walsh (CEO and Founder of Valqari)**

3 **07.11.2023**

4 *Start of interview*

5 *Check of ethical considerations and greetings*

6

7 **Interviewer:**

8 Let's start by diving into Valqari's strategy. What motivated the company to develop its
9 patented Drone Delivery Station instead of pursuing solutions that directly address the "last
10 inch" of the last-mile logistics problem, similar to the direct-to-consumer approach of
11 initiatives like Prime Air?

12

13 **RW:**

14 Absolutely, happy to provide more context. When we initiated our patent filings, the existence
15 of solutions like Prime Air from Amazon wasn't on our radar. Our initial goal was to explore
16 innovative solutions for the last-mile utilizing drones. However, recognizing the historical
17 prevalence of patents related to remote vehicles dating back to 1898, and acknowledging the
18 scale and resources of industry giants such as Amazon and Google, we pivoted our strategy.
19 We realized that direct competition in the realm of remote vehicles might not be sustainable at
20 scale. Consequently, our focus shifted to finding a patentable solution that served as a pivotal
21 support function for drone delivery, rather than concentrating on the drone itself. This quest
22 led us to the development of landing stations. Anticipating the inevitable evolution of drone
23 delivery to parallel traditional delivery services, driven by customers' demands for
24 convenience, we honed in on solutions that mirrored existing customer habits. Our patented

25 innovations cover mailboxes, lockers, and window stations, aligning with contemporary
26 customer preferences.

27

28 **Interviewer:**

29 An insightful journey indeed. Transitioning to challenges, what unique considerations or
30 hurdles arise when contemplating drone deliveries for general parcels via air?

31

32 **RW:**

33 This is a complex landscape, and I appreciate the opportunity to elaborate further. Combining
34 the intricacies of the heavily regulated aviation market, which demands zero tolerance for
35 errors, with the colossal institutions dominating last-mile delivery—such as USPS, FedEx,
36 UPS, and Amazon—alongside considerations like HOAs, municipal zoning, and other
37 regulatory factors, results in a landscape that is inherently multifaceted. The convergence of
38 these elements creates a web of challenges that need careful navigation and consideration.

39

40 **Interviewer:**

41 Certainly a multifaceted and challenging landscape. How has the general public responded to
42 the concept of drone deliveries and the pick-up/drop-off stations that Valqari provides?

43

44 **RW:**

45 It's been a pleasantly surprising response, and I'm happy to share more details. Contrary to
46 cautious expectations, the public response has exceeded our initial anticipations. During our
47 installations, we haven't encountered a single upset resident. On the contrary, people have not
48 only been receptive but genuinely excited about the prospect of drone deliveries and the

associated pick-up/drop-off stations. The overall sentiment has been one of enthusiasm and eagerness.

Interviewer:

Exciting to see such positive reactions. In the last-mile drone delivery sphere, what operational factors does Valqari prioritize to ensure efficiency and seamless operations in delivering goods?

RW:

Delving into operational nuances is always interesting. While I can't reveal specific trade secrets, what I can emphasize is the inherent uniqueness of every deployment. Each location, customer, and use case presents a distinct set of variables, making flexibility and modularity paramount for ensuring seamless operations. Our approach revolves around adaptability to cater to the specificities of each deployment scenario.

Interviewer:

On the human involvement front, what's the current level of human involvement and effort required for operating drones within Valqari's operations?

RW:

The operational aspect is a critical dimension. At present, our software operates with virtually zero human involvement. Theoretically, it can be configured to run entirely autonomously. The high level of autonomous operation is ensured by offering static delivery points, making the learning and adaptability for the drone much easier. While our system includes safety measures that necessitate a human pilot's approval for the mission and takeoff, aligning with FAA and

regulatory requirements, we routinely run our system entirely autonomously in controlled testing environments.

Interviewer:

Can you elaborate on the fundamental elements of Valqari's business model? This includes key revenue streams, plans for profitability on a per-use basis, and overarching operational strategies in the drone delivery sector.

RW:

While I would love to provide comprehensive details, I must respect confidentiality considerations. However, on a publicly disclosed level, our revenue model involves selling and leasing full systems or landing stations, licensing our technology and intellectual property, and in some instances, providing end-to-end services for specific customers. The broader operational strategies align with ensuring the sustainability and scalability of our drone delivery solutions.

Interviewer:

I understand. Reflecting on challenges, what have been the primary hurdles that Valqari has faced or continues to face in the application of drone delivery technology, given the diverse range of services it provides?

RW:

A critical consideration, and I'm glad you brought it up. Regulatory challenges, particularly those hindering Beyond Visual Line of Sight operations, are a significant hurdle, essentially

restricting 99.5% of the market for the next 15 months. Once these regulatory barriers are lifted, the landscape appears more navigable, with challenges that seem surmountable in the long run.

Interviewer:

Regulatory landscapes can indeed shape the trajectory of drone delivery initiatives. Looking towards expansion, when considering new markets and sectors, what specific local factors does Valqari weigh, and how do these factors influence the strategic decision-making process of the company?

RW:

An excellent question, and one that involves nuanced considerations. Unfortunately, I can't delve into the specifics due to confidentiality and proprietary considerations. However, it suffices to say that local regulatory landscapes, market size, housing density, climate conditions, and prevalent trends in the delivery domain are integral factors that guide our strategic decisions. Each market presents its unique challenges and opportunities, influencing our approach to expansion.

Interviewer:

Ok, considering the future, does Valqari have strategic plans to diversify its drone delivery services, possibly through partnerships with the broader e-commerce delivery industry?

RW:

Indeed, and I appreciate the opportunity to share insights into our strategic vision. In short, yes, we do have strategic plans for diversification. However, the landscape is intricate, and forging alliances too early with end-user partners requires careful consideration. It's a situationally

123 dependent process. Nevertheless, a savvy strategy of strategic partnerships across multiple
124 verticals seems to be an integral part of Valqari's future.

125

126 **Interviewer:**

127 On the regulatory front, can you elaborate on the role of FAA regulations and other regulatory
128 challenges that Valqari encounters in its drone delivery operations? How does Valqari's
129 approach to regulatory compliance differ from that of its competitors?

130

131 **RW:**

132 A critical aspect of our operations, and I'm happy to provide more insights. While Valqari isn't
133 a drone company per se, we find ourselves intertwined with our customers, partners, and end-
134 users who do fall under these regulations. As a result, we pay close attention to FAA regulations
135 and other regulatory landscapes, considering them as core drivers for our user base. Our
136 approach differs in that we aim to be a neutral operator within the market, akin to a mailbox
137 today. We strive to enable and support our user base without seeking the spotlight, adopting a
138 role devoid of bias, agenda, or ego. Many competitors tend to place themselves in the limelight,
139 but Valqari's role is to be a neutral and supportive player in the market.

140

141 *End of Interview*

