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# Drone for social good : Navigating Zipline's ethical challenges

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**Abstract**

Zipline is a global leader in using drones to deliver medical supplies to underserved regions, improving access to essential healthcare. While its model shows great promise, operating across different countries, especially in emerging economies, raises important ethical and practical challenges. This study addresses these challenges to explore how drone-enabled healthcare delivery can be made both fair and sustainable. Using a qualitative methodology based on a case study approach, this study illustrates how Zipline can refine its strategy to broaden healthcare access while balancing ethical imperatives with practical constraints. The findings provide insights for organizations seeking to use technology for social good.

***Subject Classification:*** *90B06, 91B06.*

***Keywords:*** *Drone industry, Zipline, Emerging countries, Ethics, Corporate social responsibility.*

## 1. Introduction

Over the past decade, drones have moved well beyond their original military and recreational purposes to become important tools for solving real-world challenges. In many emerging countries, where road networks are unreliable and access to healthcare is limited, drones have been

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adopted as a practical solution to bridge critical gaps in logistics. One of the most prominent examples is Zipline, a U.S.-based company that launched operations in Rwanda in 2016. Since then, Zipline has become the world's largest medical drone delivery network, transporting blood, vaccines, and other essential supplies to remote communities. This paper addresses the central question: What ethical challenges is Zipline facing while operating in an emerging country like Rwanda?

This study is important for both scholarly and practical reasons. First, it contributes to the growing literature on drone-enabled logistics by examining the ethical, institutional, and operational challenges of deploying advanced technologies in emerging market contexts. While existing research has largely emphasized the technical efficiency and cost advantages of drones, fewer studies have explored the broader social, ethical, and governance implications of drone operations in low-resource environments. Zipline's business model provides a compelling case of "embedded CSR," where social impact is closely tied to the firm's core operations. Examining both the positive outcomes and the ethical tensions allows for better assessment of whether and how technology firms can simultaneously pursue social value creation and commercial viability in emerging markets. Second, this research offers insights into the challenges of operating in underdeveloped institutions, including weak regulatory frameworks, limited data protection regimes, and evolving aviation governance. These conditions are common across many emerging economies but remain underexplored in the context of drone and digital health technologies.

Finally, the study has important practical implications for policymakers, technology firms, and international organizations. For policymakers, it underscores the need to design regulatory and ethical frameworks that can keep pace with rapidly evolving technologies. For firms, it provides lessons on balancing innovation with accountability, trust-building, and long-term sustainability. For development practitioners, the findings offer guidance on evaluating technology-for-good initiatives beyond short-term efficiency gains, emphasizing equity, governance, and local capacity building. Together, these contributions make the study relevant to debates on responsible innovation, global health equity, and sustainable development in emerging markets.

## 2. Literature Review

### 2.1 *Overview of Corporate Social Responsibility (CSR) and Sustainability*

The role of companies has changed significantly over the past century, as they are increasingly expected to justify their presence by serving various stakeholders and, at the same time, to behave responsibly beyond legal and profitability requirements. A term given to such important phenomena in the business sector is CSR.

CSR seems like a grand concept that has a deceptively "clear" concept of doing good beyond making profits generally. However, there are arguments that the meaning and driving forces of CSR actually vary significantly according to interpretations of wider business-society relationships [1]. While institutional and individual investors look for responsible programs as a factor in their investment decision, some consumers demand that businesses practice human rights and show stewardship toward the natural environment [2].

In addition, undertaking and reporting of social initiatives has given employers a greater opportunity to recruit a talented workforce who show greater loyalty [3], [4]. Therefore, while stakeholders' demand and expectations are driving forces behind CSR adoption, profitability as well as sustainability reasons also motivate managers at different levels across different industries [5]. From the 1990s to the present day, companies' approach to CSR has become much more strategic and all-encompassing in nature. In this regard, [6] contend that CSR is no longer considered simply as a sort of moral 'responsibility' of corporate managers for greater social good or executives' discretionary expenditure that could hamper a corporation's profitability, but as a strategic resource to be used to improve the bottom-line performance of the corporation. Rather consistently, the trend above also holds true for companies operating in the drone industry.

### 2.2 *The Drone Industry*

The drone industry is poised for significant growth in the coming decade, primarily driven by increased demand across various sectors [7]. Drones, defined as small, unmanned aerial vehicles (UAVs), operate either via remote control or autonomously through onboard computer systems [7]. Originally developed for military applications as safer and more cost-effective alternatives to manned aircraft, drones are now widely used in both consumer and commercial markets. Their affordability has improved substantially due to the use of smartphone components and the resulting economies of scale in electronics manufacturing [8].

Drones function as mobile, distributed sensors and are increasingly viewed as platforms for software development, enabling the creation of applications for flight planning, mapping, insurance, and pilot marketplaces. These functionalities are transforming industries, paving the way for drones to become integral to commercial operations. Although drones are often associated with military use or hobbyist entertainment, commercial applications represent the most promising area for future growth. Regulatory advancements, including commercial-use permissions from the U.S. Federal Aviation Administration, have enabled the substitution of traditional operational methods with drone technology. This has resulted in reduced costs, improved data analytics, and new business model opportunities [8].

### 2.2.1 Military and Commercial Applications

Drones have military origins dating back to the 18th century. The first recorded use of unmanned aerial weapons occurred in 1849 when the Austrian army deployed them in warfare [7]. The modern concept of UAVs took shape during World War I and evolved significantly thereafter, particularly with radio-controlled aircraft used for surveillance and attack [7]. In 2022, the global commercial drone market was valued at approximately $19.89 billion, with a projected compound annual growth rate (CAGR) of 13.9% through 2030 [9]. The increasing integration of drones across industries such as logistics, construction, agriculture, and media is driving this expansion.

### 2.2.2 3D Mapping and Delivery

Drones provide efficient, high-resolution imaging for 3D mapping, benefiting sectors such as agriculture, mining, and construction. Farmers gain precise insights into crop health, while construction firms use drone-generated contour maps to monitor site changes and improve planning. Drones are highly effective for inspections, particularly in hazardous or hard-to-reach locations. Their use spans telecommunications tower checks, insurance claims assessments, and aerial infrastructure evaluations [8].

Package delivery via drones is among the most innovative applications in logistics. Amazon's "Prime Air" initiative envisions sub-30-minute deliveries using GPS-guided drones capable of flying at 50 MPH and carrying packages up to five pounds [8]. Walmart has expanded its drone delivery footprint through partnerships with Wing and Zipline, operating in seven U.S. states with over 20,000 deliveries completed [10], [11], [12].

Zipline, a Silicon Valley-based startup, delivers essential medical supplies, including blood and vaccines, to remote areas in Africa, where poor infrastructure makes air delivery far more efficient than road transport [8]. Given rising labor costs, drone delivery is increasingly attractive in developed countries.

### 2.2.3 Data Transmission and Video Collection

Drones can amplify internet signals and connect remote or underserved regions. They offer a lower-cost, faster-deploying alternative to terrestrial networks, particularly useful during large-scale events or in areas lacking land-based infrastructure. Drone-based video capture supports security, disaster response, and film production. Drones allow for rapid deployment and high-quality aerial footage at a fraction of the cost of helicopters, while minimizing human risk in critical situations [8].

### 2.2.4 Drones in the Healthcare Industry

Drones are playing a transformative role in reshaping the healthcare landscape by enabling faster, more efficient, and cost-effective delivery of medical services and supplies. With the growing demand for accessibility, especially in remote or underserved areas, drones are emerging as crucial tools in enhancing healthcare infrastructure and outcomes.

One of the most prominent applications of drones in healthcare is the transportation of medical supplies, including blood units, vaccines, medications, and diagnostic samples. By bypassing traditional transportation constraints such as traffic congestion or poor road infrastructure, drones significantly reduce delivery times, particularly in rural or disaster-affected areas [13]. In emergency settings such as natural disasters, where roads may be blocked or healthcare infrastructure compromised, drones offer a lifeline by delivering critical care packages and equipment. They have been employed to distribute automated external defibrillators (AEDs), emergency medications, and first-aid kits directly to patients or first responders in real-time [14]. Their ability to reach areas inaccessible to ambulances or helicopters allows them to serve as first-response tools during life-threatening situations.

Drones gained widespread attention during the COVID-19 pandemic for their role in reducing human contact while maintaining essential healthcare services. They were used for delivering personal protective equipment (PPE), disinfecting public spaces, and even broadcasting public health announcements in quarantined zones [15].

Recent developments have explored the integration of drones with telemedicine, allowing remote areas to access basic medical devices and consultation kits. In some pilot programs, drones are being used to deliver stethoscopes, blood pressure monitors, and communication devices to patients, allowing healthcare providers to offer remote diagnoses and consultations [16]. This innovation has the potential to bridge the rural healthcare divide, especially in developing countries or geographically isolated regions, by supporting real-time medical consultations with the aid of drone-facilitated tools.

### 2.3 *Company Background*

Since its founding in 2014, Zipline International Inc. has emerged as a pioneer in the use of autonomous drones for logistics. The company aims to establish an equitable and widely accessible delivery system by designing, manufacturing, and operating a comprehensive drone network. Zipline's services span multiple countries and reach businesses, government agencies, and individual consumers across four continents. By continuously expanding its global operations, Zipline is reshaping the possibilities of autonomous delivery technology [17], [18]

Zipline began its journey in March 2014 in Half Moon Bay, California, with a vision to transform logistics through innovative technology. Although the company was founded then, it was not until 2016 that Zipline launched its first commercial operations in Rwanda, signaling its early commitment to addressing critical delivery challenges in regions where they were needed most [19].

The company's foundation was shaped by a founding team with complementary skills and diverse experiences. Keller Rinaudo Cliffton, now CEO, brought entrepreneurial experience from co-founding Romotive, a company focused on smartphone-controlled robots, as well as a background in software engineering, robotics, and even professional rock climbing. Keenan Wyrobek, Chief Technology Officer, was already recognized in robotics circles for co-creating the open-source Robot Operating System (ROS) and contributing to medical robotics innovation. Ryan Oksenhorn, another Romotive co-founder, focused on cloud software, geospatial data, and drone navigation systems, while Will Hetzler brought expertise in aviation, transportation consulting, and economics. Together, this team combined technology, business, healthcare, and aviation knowledge, an essential mix that guided Zipline's early growth and operations [20].

The founders' pivot from Romotive to Zipline was motivated by a desire to make a more tangible societal impact. Their focus was on improving the delivery of medical supplies in regions with limited infrastructure. First-hand accounts of preventable deaths in Tanzania due to delays in accessing essential medical resources highlighted the urgency of the challenge. Zipline concentrated initially on delivering blood, a perishable, life-saving resource that requires rapid transport. Addressing this critical humanitarian need allowed the company to gain early momentum and establish vital partnerships, particularly with health officials in Rwanda [19].

### 2.3.1 Key Historical Milestones

Zipline's growth story is defined by a series of notable milestones that illustrate its rapid innovation in autonomous drone delivery. In 2016, the company launched operations in Rwanda through a partnership with the Rwandan government [21], establishing a distribution center near Muhanga. Initially serving a single hospital and focusing on blood deliveries to remote facilities, this collaboration allowed Zipline to refine both its technology and business model in a real-world, high-stakes environment.

By 2018, the company expanded its presence with a second distribution center near Kayonza, enabling deliveries to smaller clinics and extending its range to vaccines and essential medicines. That year also saw the debut of Zipline's second-generation drone, which earned recognition on Time magazine's "Best Inventions of 2018" list, highlighting the company's growing reputation for technological innovation.

Between 2019 and 2020, Zipline entered Ghana, opening four distribution centers to serve approximately 2,500 health facilities, with all centers operational by mid-2020. During this period, the company secured $190 million in funding, increasing its valuation to $1.2 billion, signaling strong investor confidence. From 2020 to 2023, Zipline pursued expansion in the United States and new technological developments. In November 2020, it was selected by the Federal Aviation Administration (FAA) for a type certification program for delivery drones, a critical step toward broader U.S. operations. That year, Zipline also partnered with Walmart to pilot home delivery services, marking its first move beyond healthcare. In March 2023, the company launched Platform 2 (P2), a drone system designed for direct-to-home deliveries in urban and suburban areas, with early users including Sweetgreen (an American fast casual restaurant

chain that serves salads), Michigan Medicine (the University of Michigan's academic medical center), and the Government of Rwanda. Later in 2023, FAA clearance for operations beyond visual line of sight (BVLOS) opened the door to expanded U.S. delivery services [22].

The momentum continued into 2024 and 2025. In April 2024, Zipline completed its one-millionth commercial autonomous delivery, reflecting the scale and maturity of its operations. U.S. partnerships expanded to include the food and beverage industry, such as Panera Bread and Jet's Pizza, as well as healthcare services such as Memorial Hermann Health System, while international operations grew in Nigeria, Japan, Côte d'Ivoire, and Kenya. Additional U.S. collaborations with GNC, Pagliacci Pizza, and Associated Couriers strengthened its reach in retail, food, and healthcare logistics. By August 2024, Zipline drones had flown over 80 million autonomous miles and completed 1.1 million commercial deliveries, a trajectory that continued into 2025 when the company surpassed 100 million miles flown and 1.4 million deliveries, firmly establishing Zipline as a global leader in autonomous logistics [18], [23].

### 2.3.2 Evolution of Services

Launched in 2016, Zipline's first service in Rwanda focused on delivering critical medical supplies, including whole blood, platelets, frozen plasma, and cryoprecipitate, to hospitals and clinics facing limited access to these resources. This service addressed urgent medical needs, such as postpartum hemorrhaging, where timely blood delivery is essential [18], [22].

Over the years, Zipline has grown from a healthcare-focused drone service in Rwanda to a versatile logistics provider across multiple sectors. In Rwanda and Ghana, it expanded to deliver vaccines, essential medicines, and other health commodities, investing in ultra-low temperature freezers to maintain cold-chain integrity, an effort that proved crucial during Ghana's COVID-19 vaccination campaign. The company also supported HIV-related deliveries in Kenya and broadened into agricultural and child nutrition logistics in Rwanda [18], [22].

Zipline's services now reach healthcare, restaurants, grocery and convenience, agriculture, and public health. From delivering prescriptions, lab samples, and vaccines to supplying farmers and providing rapid food and grocery deliveries, Zipline demonstrates how drone technology is transforming logistics, connecting remote villages, suburban

neighborhoods, and global supply chains with speed, precision, and reliability [18], [22].

### 2.3.3 Zipline's Contribution to CSR and Sustainability

Zipline has become a leading force in the rapidly evolving drone delivery and logistics industry, distinguishing itself through its early focus on high-impact healthcare applications in developing countries [24]. This foundation has supported its strategic expansion into competitive commercial markets, giving the company a notable advantage despite growing industry competition. The company's business model leverages autonomous drones to address the critical "last-mile" challenge, delivering essential goods to remote and underserved regions where traditional logistics face limitations. Beginning with medical supply deliveries, Zipline has progressively diversified into commercial services, demonstrating adaptability and a commitment to innovation within the logistics sector.

Beyond operational success, Zipline has advanced corporate social responsibility and sustainability by improving public health, promoting environmental sustainability, supporting economic development, and fostering equity [22]. These initiatives highlight the company's capacity to address global challenges while maintaining a commercially viable business model [24]. This section critically examines Zipline's contributions to CSR and sustainability, drawing on both empirical evidence and scholarly perspectives.

#### 2.3.3.1 Improving Healthcare Access

One of Zipline's most notable contributions lies in improving access to healthcare in underserved regions. By leveraging autonomous drone technology, the company has facilitated the rapid delivery of critical medical supplies such as blood, vaccines, and medications to remote areas. For example, in Rwanda and Ghana, delivery times have been reduced from hours to minutes, a crucial factor in life-saving emergencies [25]. These efforts align with global health equity goals by addressing geographical barriers to healthcare delivery [26].

During the COVID-19 pandemic, Zipline expanded its impact by transporting vaccines and personal protective equipment to rural areas, ensuring equitable access to essential healthcare resources. This initiative highlights the company's ability to adapt its logistics infrastructure to meet urgent public health needs [25]. However, while these achievements

are significant, the long-term sustainability of Zipline's healthcare delivery model warrants further investigation, particularly in terms of cost-effectiveness and scalability.

Zipline's impact on healthcare access has been particularly significant. In Rwanda and Ghana, the company's faster blood delivery services have contributed to a notable reduction in maternal mortality rates. Furthermore, in Ghana, Zipline's drone delivery network has led to decreased vaccine stockouts and an increase in overall vaccination coverage, addressing critical public health challenges. By enabling the rapid delivery of essential medicines and diagnostic specimens to remote areas, Zipline has improved healthcare accessibility for populations that were previously difficult to reach. The faster delivery times achieved by Zipline compared to traditional ground transportation methods are crucial in emergency situations where time is of the essence.

Beyond healthcare, Zipline's operations have also had a positive impact on supply chain efficiency and sustainability. The on-demand delivery model has contributed to a reduction in wasted blood products and other medical supplies, as only the needed quantities are delivered, minimizing spoilage. The use of drones offers a more efficient logistics solution, particularly in regions with challenging terrain where traditional transportation can be slow and unreliable. Furthermore, Zipline's commitment to using fully electric, battery-powered drones with zero emissions makes its delivery service an environmentally friendly alternative to traditional vehicles, aligning with global sustainability goals.

#### 2.3.3.2 Environmental Sustainability

Zipline has demonstrated a strong commitment to environmental sustainability through its use of electric-powered drones, which significantly reduce carbon emissions compared to traditional delivery methods. A sustainability analysis conducted by Zipline revealed impressive reductions in delivery emissions: a 99% decrease compared to vans, 98% compared to cars, and 94% compared to electric vehicles [27]. By replacing conventional transport systems with electric drones, Zipline contributes to the global effort to mitigate climate change and transition to low-carbon logistics solutions.

While these reductions are commendable, it is important to critically assess the broader environmental impact of drone manufacturing, operation, and disposal. Studies suggest that the environmental benefits

of electric vehicles, including drones, can be offset by the energy-intensive processes involved in battery production and recycling [28]. Thus, Zipline's sustainability claims should be contextualized within a life-cycle assessment framework to ensure a comprehensive evaluation of its environmental footprint.

#### 2.3.3.3 Economic and Technological Development

Zipline's operations have had a positive economic impact in the countries it serves. By creating jobs for drone operators, logistics personnel, and support staff, the company contributes to local economic development. Additionally, its introduction of advanced logistics and delivery systems fosters technological innovation and knowledge transfer in partner countries. These contributions align with the United Nations Sustainable Development Goal (SDG) 8, which promotes inclusive and sustainable economic growth. However, the extent of technology transfer and capacity building remains an open question. Critics argue that foreign firms operating in developing countries often prioritize their own interests over long-term local development [29].

#### 2.3.3.4 Equity and Inclusion

A core component of Zipline's mission is reducing disparities in healthcare access. By reaching remote regions often excluded from conventional healthcare supply chains, Zipline helps bridge inequities in service delivery. This aligns with principles of social justice and the ethical imperative to ensure that vulnerable populations are not left behind in global health initiatives [30]. The company's efforts in Rwanda and Ghana serve as compelling examples of how technology can be leveraged to promote equity.

### 2.4 *Emerging Markets*

#### 2.4.1 History & Evolution

The term emerging market is often used in discussions of the global economy, but there is not one single definition everyone agrees on. At its core, an emerging market is a developing country that is in the middle of a major transition. These economies are growing quickly, becoming more connected to global trade, and starting to look more like modern, industrialized countries. They usually show some of the traits of developed economies, but not all. In short, emerging markets are economies in

transition, moving from lower-income, less industrialized systems toward more advanced ones with higher living standards [31].

Emerging markets often grow much faster than developed economies. This is partly because they are starting from a lower base, which makes it easier to show quick progress, a phenomenon often called the catch-up effect. Many of these countries also focus on exports, using global trade to fuel their growth. As their economies expand, average income levels rise, although they still remain lower than in developed countries.

Another important feature of emerging markets is industrialization. These economies gradually build key financial and economic systems, such as a national currency, stock exchanges, and functioning banks. They also tend to push for reforms that open up markets, attract investment, and encourage growth. These reforms might include investing in education, improving infrastructure like roads and ports, or passing laws to protect property rights. Together, these steps help emerging markets move closer to becoming more stable, globally connected economies [32].

### 2.4.2 Common Challenges

Emerging economies are among the most dynamic actors in the global marketplace, accounting for a growing share of global GDP, investment, and innovation. Yet, they also grapple with institutional voids, gaps in formal systems for enforcing laws, governing transactions, and managing public resources [33]. These voids give rise to a distinct set of challenges for businesses and policymakers alike.

Rwanda is a compelling example of an emerging economy due to its rapid economic growth and forward-looking development agenda. Rwanda's economy expanded by more than 8.5% in 2024, and projections indicate that this momentum will continue through 2025–2027 [34]. However, like many emerging economies, Rwanda faces persistent institutional challenges that can undermine this progress if not addressed. As [35] notes, despite remarkable achievements, emerging markets often lack mature legal frameworks, efficient regulatory environments, and reliable enforcement mechanisms. Understanding the structural characteristics of these economies is essential for designing resilient international strategies and achieving sustainable development outcomes. This paper explores four interconnected challenges commonly faced in emerging countries: weak intellectual property rights, lack of transparency, corruption, and government interference.

### 2.4.3 Weak Intellectual Property Rights (IPR)

Emerging countries frequently struggle with the weak enforcement of IPR laws, even when such laws exist in formal statutes. These deficiencies reflect broader institutional gaps and limited administrative capacity. As [33] emphasizes, the protection of intellectual property in emerging markets is often inconsistent and subject to bureaucratic inefficiencies. This environment discourages foreign direct investment (FDI) in high-tech sectors and limits local innovation ecosystems. Without credible IP enforcement, firms are less likely to engage in technology transfer or R&D-intensive ventures [36]. As [37] observe, firms facing such voids must often adapt their strategies to protect knowledge assets through alternative mechanisms, such as speed to market, partnerships, or localization.

### 2.4.4 Transparency

Transparency plays a central role in economic governance, yet many emerging countries lack the institutional maturity to ensure openness in public decision-making. Unclear regulatory frameworks, poor access to information, and opaque procurement processes contribute to policy uncertainty. [38] Identifies transparency as a cornerstone of institutional trust. [33] Stresses that this institutional ambiguity affects foreign firms' ability to assess risks and plan long-term investments. [39] Further argue that global firms entering such markets must remain agile, adapting their organizational structures and internal governance to cope with rapidly shifting and often opaque external environments. Studies show that improved ESG and non-financial disclosure can lower firms' cost of capital and investors' perceived risk [40].

### 2.4.5 Corruption

Corruption remains a widespread problem across emerging markets, undermining governance, legal systems, and economic equity. It distorts resource allocation, weakens public service delivery, and increases transaction costs. [35] Describes corruption as a core institutional challenge that shapes firm behavior in these contexts. Recent research indicates that transparency measures such as audited financial reports do not necessarily eliminate corruption in many emerging economies, especially where institutional oversight is limited [41]. [42] Emphasize that institutional quality, including levels of transparency and corruption, directly influences

the success of export-oriented strategies and international performance outcomes.

#### 2.4.6 Government Interference

In emerging markets, firms often encounter arbitrary rule changes, inconsistent enforcement, and favoritism based on political ties. While strategic state support can promote industrial development, overreach and politicization can hinder efficiency and suppress market dynamism. According to [33], state interference can extend to limiting civil liberties and restricting non-governmental organizations (NGOs) or the press. Recent research has demonstrated that government interference via regulatory constraints, protectionist measures, and political pressures remains a significant challenge for firms in emerging economies. These interferences increase costs, reduce strategic flexibility, and force firms to engage more heavily in corporate political activities to maintain competitiveness [43].

## 3. Methodology

### 3.1 *Research Design*

This study adopts a qualitative case study methodology to examine the ethical and institutional challenges faced by Zipline in its deployment of drone-based healthcare logistics in emerging markets. Qualitative research has increasingly been recognized for its potential to advance understanding of contexts and phenomena characteristic of emerging markets. In the field of International Business, such contexts are especially valuable for adding fresh perspectives to the literature and extending theory beyond traditional Western-centric frameworks [44]. The case study approach is particularly well-suited for investigating complex, context-dependent phenomena where the boundaries between the central organization and its environment are not clearly defined [45]. Given the novelty of large-scale medical drone delivery and the ethical questions it raises, an in-depth case study enables a rich and holistic understanding that would be difficult to capture through quantitative methods alone.

### 3.2 *Case Selection and Data Sources*

Zipline was selected as the focal case due to its pioneering role in medical drone delivery and its extensive operations in emerging economies, particularly Rwanda and Ghana. The company represents a

critical and information-rich case, as it operates at the intersection of advanced technology, public healthcare systems, and state institutions. The study relies on multiple secondary data sources to ensure triangulation and enhance the credibility of the findings [46]. These sources include company reports and official communications from Zipline, policy documents and reports from international organizations, government publications, reputable news outlets, industry analyses, and prior academic studies related to drones, healthcare logistics, corporate social responsibility, and emerging markets. Using multiple sources allows the study to cross-validate key claims and reduce the risk of single-source bias. Publicly available data are particularly appropriate given the exploratory and interpretive nature of the research and the limited access to proprietary or confidential firm-level information.

### 3.3 *Analytical Approach*

Data were analyzed using a thematic analysis approach. Relevant documents were systematically reviewed to identify recurring patterns and themes related to ethical concerns, institutional challenges, and sustainability practices. These themes were then interpreted through the lenses of corporate social responsibility, institutional theory, and international business literature on emerging markets. The analysis followed an iterative process, moving back and forth between theory and empirical observations to refine interpretations and ensure conceptual consistency. This abductive approach allows existing theoretical frameworks to inform the analysis while remaining open to new insights emerging from the case [47].

### 3.4 *Validity and Reliability*

To enhance construct validity, the study draws on well-established theoretical concepts and uses multiple data sources to corroborate findings [48]. Internal validity is supported through pattern matching between empirical observations and theoretical expectations from CSR and institutional theory. While the single-case design limits statistical generalizability, the goal of this study is analytical generalization, whereby insights from the Zipline case can inform broader discussions about responsible technology deployment in emerging markets.

## 4. Results and Discussion

### 4.1 *Zipline's Ethical Challenges*

Drones have opened the door to exciting innovations across industries, especially in healthcare and logistics. But along with their potential, they bring a number of ethical concerns that deserve serious attention. Zipline, a company known for using drones to deliver medical supplies, highlights many of these issues through its work in places like Rwanda and Ghana.

#### 4.1.1 Privacy and Data Concerns

As drone technology becomes more integrated into global healthcare and logistics systems, privacy has emerged as a major concern. Drones equipped with high-resolution cameras are capable of capturing images and data from residential areas, sometimes without consent. This raises important questions about data governance, including who controls the data, how it is stored, and whether individuals are being monitored without their awareness [49]. Zipline's expanding operations in Rwanda and Ghana bring additional ethical concerns, particularly regarding data colonialism and the use of emerging technologies in contexts where data protection frameworks may be limited. As both a technology company and a humanitarian organization, Zipline operates in a complex position that requires careful ethical consideration.

The company's data practices are central to this conversation. According to Zipline's website, every interaction with one of its drones is recorded and analyzed to improve supply chain efficiency and operational performance [22]. CEO Keller Rinaudo described Zipline as a data-driven company, highlighting the scale of information produced by its logistics network and drone systems [50]. In addition to operational data, Zipline has established digital databases that contain sensitive health information, such as blood demand and usage, which are shared with the Rwandan government [51].

While such data collection may enhance service delivery, it also presents ethical challenges related to consent, oversight, and the potential for misuse. The absence of comprehensive data privacy regulations in many of these countries raises concerns about the long-term use of this information and the power imbalance between multinational corporations and local communities. The model reflects a familiar pattern of resource extraction, with data replacing physical commodities as the primary asset.

Zipline's approach is also indicative of a broader tendency by technology companies to introduce new systems in countries with limited

regulatory frameworks. This practice has drawn criticism from scholars and advocates, who argue that it allows companies to refine technologies in environments where legal protections are minimal. In Zipline's case, its operational success in Rwanda and Ghana has contributed to subsequent expansion into markets such as the United States and Europe [52]. Some critics view this strategy as a form of innovation asymmetry, where the benefits of experimentation accrue to entities outside the countries where the technologies are first deployed.

#### 4.1.2 Equity, Access, and Dependence

While Zipline has helped improve healthcare in rural parts of Africa, not everyone can equally benefit from drone services. In many parts of the world, access to drone-based delivery technology is still limited to wealthier or more urban areas. This could unintentionally leave poorer or more remote communities behind, widening existing gaps in healthcare access [22]. There is also the risk of countries becoming too dependent on foreign companies for essential services. While Zipline's technology is valuable, some experts worry that relying on outside help may prevent countries from developing their own tech infrastructure or supporting local innovation [25]. As drones become more common for deliveries, there is a growing concern about job loss. Automated systems like Zipline's could replace human delivery drivers, which could hit low-income workers the hardest [22].

#### 4.1.3 Governance, Transparency, and Public Trust

Another concern involves how governments work with companies like Zipline. In Rwanda, for example, some critics have questioned whether the government is being fully open about the costs of these partnerships. There is a worry that money spent on drone deliveries might be better used to build hospitals or train more medical staff [25]. Some people also argue that these high-tech partnerships can serve as a form of distraction from deeper systemic issues. A government might promote the use of medical drones to boost its image internationally while ignoring more serious problems at home, like limits on freedom of speech or human rights violations [25].

Further concerns have been raised regarding transparency in Zipline's partnerships. In Ghana, a $12.6 million medical drone contract between the government and Zipline came under scrutiny. The Michigan Aerospace Manufacturing Association Humanitarian Emergency Logistics Program

(MAMA-HELP) alleged that the government adopted a drone delivery initiative based on a proposal they originally submitted, without obtaining their formal agreement. MAMA-HELP had previously proposed a broader healthcare plan, including infrastructure and emergency services, and later initiated legal proceedings citing procedural concerns and a lack of clarity in the project's implementation [53].

#### 4.1.4 Sustainability and Safety

Even though many drones are electric and produce fewer emissions than gas-powered vehicles, they still come with environmental costs. The production and disposal of batteries, for example, is not always clean or sustainable. Additionally, more drone deliveries could lead to increased packaging waste [49]. Finally, safety is a practical concern. Drones can malfunction, crash, or interfere with other aircraft, especially as they become more common in everyday life. Making sure they are operated safely and responsibly is key to avoiding accidents [49].

Together, these issues reflect deeper questions about fairness, accountability, and digital sovereignty. While Zipline's technology has improved healthcare access in underserved regions, its operational model may contribute to imbalanced power dynamics between high-income and low-income countries. Without strong legal frameworks, community involvement, and transparent governance, the long-term risks of such partnerships may outweigh their initial benefits. In short, while drones like Zipline's have the potential to generate substantial social benefit, especially in geographically remote or underserved areas, they also raise important ethical questions that should not be ignored. Balancing innovation with fairness, transparency, and sustainability will be important as this technology continues to grow.

## 5. Conclusion and Implications

Emerging economies are often shaped by institutional weaknesses such as weak intellectual property enforcement, limited transparency, corruption, and varying degrees of government intervention. These conditions create uncertain and complex operating environments for firms. At the same time, emerging markets offer substantial opportunities, including large consumer bases, unmet social needs, and strong potential for innovation. Zipline's experience highlights this dual reality, demonstrating both the challenges of operating in fragile institutional

contexts and the potential for meaningful impact when technology is carefully aligned with local conditions.

For international firms, success in emerging markets requires an in-depth understanding of institutional constraints and a willingness to adapt strategies accordingly. This includes building partnerships with local actors, investing in compliance and risk management [54], and engaging constructively with governments to support institutional development. Policymakers, in turn, play a crucial role by strengthening the rule of law, improving transparency, and fostering accountability to enable sustainable and inclusive growth.

The drone delivery market is becoming increasingly competitive, with major players such as Amazon and Alphabet's Wing entering the space. To maintain its competitive advantage, Zipline must continue to innovate while ensuring high levels of operational reliability and safety as it scales. Maintaining consistent service quality across diverse geographies, operating in challenging weather conditions, and safeguarding deliveries are critical as the company expands its network.

Looking ahead, Zipline's growth strategy emphasizes geographic expansion, continued development of its Platform 2 technology, and deeper penetration into commercial applications, particularly in densely populated areas. Expanding partnerships with healthcare providers, retailers, and other businesses will be essential for scaling operations, while diversification into sectors such as agriculture and e-commerce offers additional opportunities. The use of data analytics and artificial intelligence can further enhance efficiency and service delivery, alongside continued investment in drone design, battery technology, and autonomous systems.

Regulatory engagement remains a key success factor. Aviation regulations in many emerging markets are evolving, requiring early and sustained collaboration with governments and civil aviation authorities. Zipline's experience in Rwanda demonstrates the value of co-designing safety and operational frameworks to reduce regulatory uncertainty. Equally important is building community trust. Drones may be perceived as intrusive or unsafe, making community acceptance as critical as regulatory approval. Awareness campaigns, community consultations, transparent communication of social benefits, and the employment of local staff can strengthen legitimacy. Infrastructure limitations, ethical concerns related to data governance, and the risk of over-reliance on government partnerships further underscore the need for resilient system design, transparency in data practices, and diversified stakeholder

relationships. Ensuring equitable access through transparent pricing and investing in local capacity building are also essential for long-term sustainability.

Overall, the findings suggest that success in emerging markets depends not only on technological innovation but also on trust-building, ethical governance, regulatory cooperation, and inclusivity. Zipline's experience shows that when these elements are carefully managed, emerging markets can become powerful platforms for responsible innovation and global impact.

Several limitations of this study should be acknowledged. First, the analysis focuses on a single firm, Zipline, which limits the generalizability of the findings to the broader drone industry. While Zipline provides a rich and informative case for examining ethical challenges in emerging markets, future research would benefit from comparative studies involving multiple firms to assess whether these challenges are firm-specific or more widely shared across the sector.

Second, the geographical scope of the study is restricted to the emerging economies in which Zipline currently operates. Expanding the analysis to include additional emerging markets would enable cross-country comparisons and offer deeper insights into how institutional, regulatory, and cultural differences shape drone operations.

Finally, the study relies primarily on secondary data sources, which limits access to internal decision-making processes and stakeholder perspectives. Although these sources provide valuable insights, future research incorporating primary data, such as interviews with company executives or local stakeholders, would allow for a more nuanced and robust analysis of firm strategies, challenges, and impacts.

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