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Project Advisor

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THE INNOVATION OF DRONES IN THE SUPPLY CHAIN PROCESS

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AN EXAMINATION OF THE INNOVATION OF DRONES IN THE SUPPLY CHAIN
PROCESS

Kadda Bertrand

Under the Supervision of Professor Mary R. Bartling

Statement of the Problem

The contemporary consumer is driven by convenience as a significant factor in their consumption of goods and services from a retailer as opposed to an organization's brand identity/image. The core of meeting such customer expectation is in the supply chain process of an organization, precisely the last mile of delivery. Once a customer has placed an order, how long does it take for the good to reach the owner, safe, and secure? To solve the puzzle, drone technology, or unmanned aerial vehicles (UAVs) have been developed and implemented.

This study seeks to examine the usage and significance of the drone technology in the supply chain process as well as the challenges faced to its full adoption and implementation. The technology has been used in diverse sectors such as military, trade, agriculture, humanitarian response, journalism, and other commercial uses. However, challenges such as safety and security concerns, privacy, the maturity of the technology, and current insufficient regulations have been raised by skeptics of the drone technology and will be exposed in this study.

Methodology

Diverse data used in the project will be obtained through both the primary and secondary data collection techniques. In the secondary data collection methods, information from published materials such as journals, newspapers, magazines, and technology publications will be utilized to give many insights of the scholarly information regarding drone technology (Bell, et al., 2018).

Sources from the secondary data will contain the advancement of technology in the corporate world and statistical information about the benefits of using drone technology. Such figures would include exact percentages and averages which can be quantified. Also, secondary data will contain information on the challenges that organizations have faced in the past and some apprehensions exhibited by the general public resulting from the usage of drone technology. Government publications and regulations will also be used as secondary sources.

Observation and interviews sources will be conducted to collect the primary data on the drone effects and challenges (Bell, et al., 2018). Interviews will be guided to technology companies such as Boeing and Amazon which are trying to revolve the large programming scale. Interviews will be held to customers who have been served by drones, to the firms using them through their executives or managers, and to the citizens who have been affected by them such as in the Gatwick Airport UK case. Primary data gives a qualitative approach to the project to get a deeper meaning and suggestions of the affected use of drones. Participants will also be used in the primary data collection technique. As a participant of a drone recipient from a delivery company, it would be imperative to note how the technology beats the traditional mechanisms. How well drones meet consumer convenience over brand loyalty will be tested.

Outcome Anticipated

The project anticipates several outcomes from investigations of technological advancement and drone innovation. The project serves an educational material for the public, the corporate and government agencies on the importance of drone technology and the challenges that it faces thus coming up with mitigation processes. The project expects that once the organizations can learn the challenges facing the market, they will be able to equip themselves with compliance and regulatory requirements to facilitate the growth of innovations. The project expects a situation where some

businesses will be skeptical about following and investing in the innovation of drone technology. Anticipatorily, the research prospects to catalyze further reactions.

It is however imperative to note that a significant anticipate outcome will be on the importance of drone technology in satisfying the convenience of the public and civic education. The public safety, security, and privacy concerns are anticipated to be addressed thus promoting public support towards the initiatives of Unmanned Aerial Vehicles in the supply chain (BBC News Service, 2018).

Abbreviations

AMISOM - The African Union Mission in Somalia

AUVSI- Unmanned Vehicles Systems International

CEO- Chief Executive Officer

CSR- Corporate Social Responsibilities

IWM- Imperial War Museum

NATS- National Air Traffic Services

OCHA- Office for Coordination of Humanitarian Affairs

PKP- Polskie Koleje Państwowe

PwC- PricewaterhouseCoopers

UAVs- Unmanned Aerial Vehicles

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I. Introduction

According to Mike D. (2018), the contemporary consumer is mostly moved by the efficiency and effectiveness of an organization in offering services rather than their brand image or corporate identity. Mike claims that the buyer is ordinarily interested in how fast a company responds to issues raised by the consumer or the extent to which that company works to their convenience. In a nutshell, the consumer`s confidence, loyalty, taste and preference of an organizational good to a large extent is influenced by the way a business can deliver on purchaser needs and expectations. The use of drone technology or unmanned Aerial Vehicles (UAVs) is at

the heart of such technological invention within the supply chain management. Akshay, Arman, and Omkar (2018), allege that drone technology is paramount in cutting costs, saving time and increasing convenience that the consumer is looking for within the supply chain management. It is thus critical to note that the supply chain contributes significantly to consumer confidence.

The use of drones or Unmanned Aerial Vehicles in supply chain management is significant in the world economy since it raises revenue and organizational growth. According to a publication from the White House, the technology will likely generate approximately 100,000 new jobs and an income of \$82 billion in economic growth by 2025 (Doyle, 2018). Accordingly, a research was conducted by the PricewaterhouseCoopers (PwC) and indicates that the technology in the supply chain process attracts an average of \$127 billion globally and \$13 billion coming from the transportation sector. Evans N. (2018), advances that the research directed by Goldman Sachs suggests that the global estimates for the drone technology from 2016 to 2020 would be \$100 billion.

Drones or the Unmanned Aerial Vehicles has been used extensively by most organizations in their supply chain processes to cut costs, increase efficiency and effectiveness to meet consumer convenience. In February 2018, the National Air Traffic Services (NATS), the leader in the air traffic provisions in the UK, announced their intention of a partnership with the Altitude Angels to develop a comprehensive system of air traffic. According to the reports published by Mike D. (2018), NATS is seeking to have drones manage safe and effective flights. This step in having drones to operate the aircraft flights in itself is a testament that the use of drone technology increased. It is imperative to note that the Chief Executive Officer (CEO) of Amazon.com Jeff Bezos, a strong proponent of drone technology, shocked the world in 2013 by declaring that his organization will be investing heavily in drone deliveries of their goods and services. This

statement suggests that within thirty minutes of placing an order, a customer would be able to have their products with them.

It is therefore essential to note that there are several significant contributions that drone technology adds to the supply chain management. The technology has been utilized during natural disasters for humanitarian aids to supply food, water, blankets, and other social amenities. Drones have also been used to enhance safety and security through aerial surveillance. In another optical, drone technology faced many challenges, ranging from complex environmental regulations to some complicated technology such as battery power storage, safety, security and privacy of the general public among other concerns. As such, this study seeks to present the innovation of drones in the supply chain process, highlighting some of the significant contributions the technology has on the supply chain, as well as the challenges this technological advancement is facing.

II. Literature Review

In the recent past, a lot of efforts have been made to popularize and regularize the use of drones in the supply chain which reduces the cost of production and increases efficiency and effectiveness. As will be discussed below, most buyers today are concerned with the effectiveness and efficiency of a business in service delivery convenient to them as opposed to the company's brand image (Mike, 2018). It is at this point that drone technology or the Unmanned Aerial Vehicles becomes convenient. The literature review has also established several challenges facing the drone technology thus making its accessibility into the market perplex.

Akshay, Arman, and Omkar (2018) concluded that drone technology has been imperative in the military supply chain management for decades and have been implemented to deliver war attacks, defense systems, and monitoring. The Austrian Army developed an unmanned air balloon

filled with explosives and attacked Venice in 1849. Accordingly, they state that the US military converted the Standard E-1 airplanes to drones with Larynx being one of them. During the cold war, such drones were implemented to collect radioactive data.

In the same optical, the Imperial War Museum (2018) cited that in recent times, drone technology has majorly been used by the military for surveillance purposes. They advanced that the technology has been utilized by the US border patrol agents at the Southern border between the United States and Mexico to monitor illegal immigrants trying to enter the US without following the legal process. In Somalia, the US government through President Obama also partnered with the African Union Mission in Somalia (AMISOM) and offered military drones to monitor the movements of Al Shabaab and organized an ambush. Drones have also been used by the military to carry out the monitoring of climate change, conducting search operations, following a natural disaster, leading the filming, photography, and delivery of equipment. The drones have mainly been implemented in regions where the troops are not able to safely enter. Additionally, the organization advances that drones have been used to carry out targeted attacks to militants in the Middle East in regions as Iraq by the US forces. As such, the supply chain has benefited tremendously in line with the drone technological advancements in the military field.

Other scholars have indeed advanced that drone technology has been efficiently implemented to boost the supply chain management in the delivery of goods, monitoring, and other service provisions. Accordingly, Wall R. (2018) states that the significance of drone technology has been imperative even to the flight industry. He notes that the leading provider of air traffic services in the United Kingdom, NATS (National Air Traffic Services), announced its intention to partner with Altitude Angels which would be assigned with designing and developing an effective drone method to manage the air traffic control system. NATS is mandated to oversee a safer aircraft

flights within the UK airspace and seek to develop drone technology by 2020 for management services (Banker, 2016). Thus, for the very first time, drones would be used to fly way beyond the sight of the operator.

Drone technology is reflecting the future of distribution since it offers faster delivery to consumers thus meeting their convenience needs. Akshay, Arman, and Omkar (2018) advance that drones ease in reducing the cost of production with automated drones used, also reducing the human labor costs associated with similar deliveries. Additionally, the scholars advance that the use of drones helps increase access to areas difficult to reach. In supply chain management, there are areas where delivering commodities are very difficult. However, when the technology of unmanned aerial vehicle is used, such places can be accessed easily. Additionally, raw materials can be obtained from similar areas.

In his publication with Business Insider, Jeff (2018) states that Amazon is leading in the supply chain with the innovation of drone technology. The organization through its CEO in 2013 announced the usage of drones to deliver goods by 2018. Accordingly, the organization has already managed to obtain patent rights, and the drones will be able to communicate with each other through mesh network for information sharing on whether and different routes. Jeff's article also advances how the Dhahi Ports Company utilizes unmanned aerial vehicles to safeguard ships and also strengthen security for sensitive cargo and high-value merchandises. Similarly, Polish Freight Carriers PKP Group conducted some trial on the safety of drones to help in the protection of goods and services on the rail network. Therefore, drone technology can cut cost by eliminating human error and labor charges hence improving efficiency and effectiveness.

Alternatively, drones have been instrumental in humanitarian aid to help victims of natural disasters. According to the United Nations Office for Coordination of Humanitarian Affairs

(2014), there is increased usage of the civilian unmanned aerial vehicles to curb disasters. The drones are used to deliver food, blankets, water, and other rescue equipment to the affected population. Additionally, the drones are used to monitor the weather and climatic conditions to help vulnerable groups to prepare for impending danger states Patrick (n.d). In the Philippines, drones were used after the Typhoon Haiyan of 2013. Following the Hurricane Sandy of Haiti in 2012, drones were implemented to rescue and help the affected communities. Most recently, the use of drones was witnessed following massive earthquakes in China and the flooding in the Balkans. During a humanitarian crisis, cities have been able to use drones to get images of the affected people and conduct aerial surveillance. Such actions have been imperative in helping prevent or contain the impact of damage to the people.

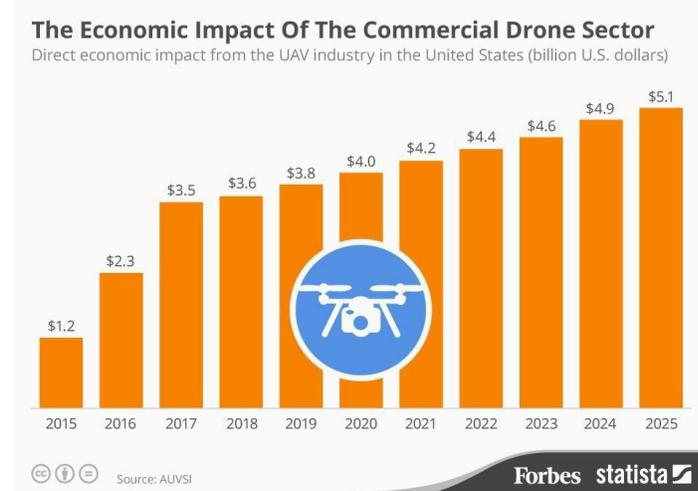
Literature has also revealed that despite the useful reports regarding the significance of drone technology in the supply chain, there are still many challenges that the industry is facing. For instance, it has been published that consumers have little confidence with the drone technology. Doyle M. (2018) advances that there is an increased number of concerns regarding the safety, security, privacy, and maturity of the technology to be capable of flying in the airspace. For instance, the public interest is focus on how technological sophistication can affect the safety of the people? The concern arises that batteries can run low and the drones can fail with heavy luggage thus harming the public.

Additionally, regulations concerning drone technology have not been heightened to allow for fluent operations. It is challenging for manufacturers to produce and operate such devices. The Aviation Authority in the US authorizes drones to fly 400feet high. It is imperative to note that such concerns have been worsened by a drone attack on the President of Venezuela Nicolas Maduro, while inspecting a guard of honor. Several public safety and security were raised

following the incident. Recently, in the UK, drones were purposefully used to destabilize flights at Gatwick Airport, Europe's busiest airport (Wall, 2018). According to the BBC News Service (2018), the police department at Sussex stated that the attack was a deliberate human act to disrupt flights at the airport. Such incidences have also negatively impacted the pursuit of actualizing drone usage in the supply chain process.

III. Discussions

According to the report by the Association for Unmanned Vehicles Systems International (AUVSI), the introduction of drones to the US economy can create about 70,000 jobs moving towards 2020, with an impact of 13.6 billion dollars injected in the economy (Jenkins and Vasigh, 2013). The report also indicates that such benefits will increase through the year 2025 where it is projected that the impact would be 82 billion dollars to the economy and over 100, 000 jobs created. According to the PwC (PricewaterhouseCoopers), the global market for businesses impacted by drone technology stands at 127 billion US dollars, with 45.2 billion dollars invested in infrastructure, \$32.4 billion in agriculture, \$10.5 billion in security, \$4.3 billion in mining, and \$13 billion in the transport sector. While the economy is gaining from the technological invention of drones, businesses are also gaining tremendously through cost-cutting where expensive human labor is replaced by technology as well.

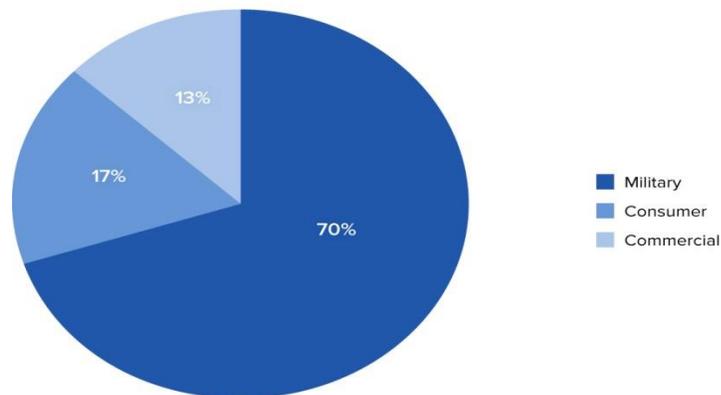
Figure 1: Contribution of drones to the USA economy

Source: Niall McCarthy, *Forbes* contributor 2015.

For businesses, the use of drone technology or the unmanned aerial vehicles is seeking to improve efficiency, effectiveness, and consumer convenience, cut costs, enhancing safety and security (Mike, 2018). Several companies adopted drone technology in their initial phases of supply chain management for obtaining their raw materials. The last mile of the supply chain involves the delivery of the product to the end user. Distribution is seen by most organizations to be expensive, and consumers test a firm's convenience depending on the safe and timely delivery of their orders. However, the emergence of drones has the potential to improve faster delivery of goods and services thus reduction in cost and time.

Figure 2: Drones chat by sector consumption

Chart 1: Drone Market by Sector

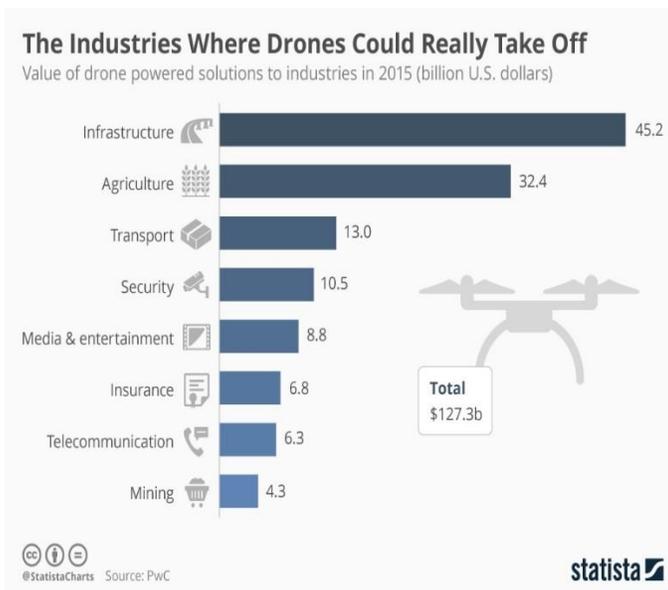


Source: Goldman Sachs

toptal

Source: Castellano (n.d)

There are several uses of drones in the supply chain in different fields. According to Adam U. (2018), the military uses drones in many ways such as security, surveillance, and attacks. Similarly, drones are apply to mine, land surveying, and prospecting. In agriculture, Adam claimed that drones could be implemented for the inspection of plant health, spraying pesticides, mapping crop yields, and for photo log growth of plants. Additionally, they can be used for soil testing to optimize the content of water and usage of fertilizer hence improving crop harvests. Drones are utilized in the last mile supply chain to make deliveries to the buyers and also to obtain raw materials for manufacturing and processing of goods. Ann G. (2018) cited that the media can rise the use of drones in news coverage and aerial photography, a sector that was left for news outlets which could afford helicopters for aerial viewings such as in rallies, protests, and games situations.

Figure 3: Sector where drones could be used most

Source: Niall McCarthy from the Statistics Portal, 2016

Unmanned aerial vehicles have been used extensively in agriculture to meet market demands and changing sectorial. Drones have been implemented in agriculture to meet production needs. According to Rank (2018), the UAV is used for spraying crops, irrigation, planting, observation, and health assessment. At the same time, the technology has helped with planting which was a preserve of the workforce. As such, it has reduced the cost of labor and time taken to plant some entire farmland. The overall health of plants can be assessed and several mechanisms implemented to battle impending diseases or outbreak. To this extent, therefore, drones have been critical in the agricultural supply chain management. It reduces the cost of production, enhances safety and security of both crops and animals thus reducing the cost of production, transportation and time consumption.

Sandvik and Soesilo (2016), claimed that drones have been essential in humanitarian aid in recent years with the delivery of cargo to disaster areas, terrain mapping, assessment of structural damages, delivering medical equipment and impact valuation. It is essential to note that drone or

UAVs already contribute to disaster responses all over the world. In 2013 after Typhoon Haiyan of Philippines, and Haiti following the aftermath of Hurricane Sandy in 2012, drone technology was used in the rescue mission, mapping the affected regions and delivering medical equipment (Ananya, 2017). In the Balkans, recent flooding that occurred and the subsequent earthquakes in China saw a more contemporary approach to the use of drone technology in humanitarian responses states Ananya. According to Soesilo (2015), drones have been critical when it was used to examine the damages assessment in Vanuatu when the World Bank was hit by the Cyclone Pam. Additionally, the technology was utilized in Ecuador following the earthquakes of 2015 contends Soesilo. In humanitarian assistance, supply chain management is assisted since they can cut transportation cost and provide accurate information regarding danger areas. In places such as Haiti, the drones have been used by the locals to examine hazardous areas and to vacate before the disaster strikes.

Some scholars have advanced various uses of drones and UAVs by the military and other security agencies to be for reconnaissance, targeted attacks, and surveillance. Following the terrorist attacks on the US on 9/11, the usage of drones has augmented in America (Angela, 2018). It is implemented for surveillance of areas where troops cannot access safely, also used as weapons to reach militant groups. According to Novak M. (2018), the US Customs and Border Protection used more drone surveillance to cover the borders and evaluate their security situation. In the recent debates of President Trump to build a border wall, the usage of drone technology has been supported. Trump`s critics supposed that UAVs would be more effective than a wall. At the same time, Harkins (2018) claimed that smugglers and drug traffickers had utilized drones to survey vulnerable spots along the US and Mexico border thus passing drugs and illegal immigrants. As such, the place of drone technology is valuable in supply chain management.

IV. **Challenges Facing the Drone Technology**

According to Doyle M. (2018), approximately 1.6 million drones will be operational in the US skies by 2021, dependent upon the regulators' quick action to allow the advancement of the technology. However, such regulators are still working on security and safety measures for both people and drones. Skeptics are also levying a lot of criticism on the technology which would have to be controlled ultimately. There are diverse challenges which include safety risks, security and privacy, interference with military, private, and commercial aircraft are obstacles to the implementation of drone technology.

Another serious challenge facing the drone or unmanned aerial vehicles is the inadequate regulations on the airspace. According to Bob T. (2018), the Federal Aviation Authority has not yet set rules governing the airspace on how both aircraft and drones will operate. So far, the Federal Aviation Administration has restricted that drones can only fly below 400 feet, stay at least five miles away from airports, and avoid movement near people and crowded places, with such restrictions not being legally signed in to allow (Prince, 2015). Such limitation makes it difficult to advance the technology within the supply chain.

Skeptics to the drone technology have raised concerns regarding the ability of third parties in gaining access to the drones through hacking. In such events, drones delivery items can be stolen thus creating panic to both buyer and seller. The invasion of people`s privacy has been an essential concern. Drones taking pictures, surveillance might obtain information from people`s homes or compounds which are not relevant to their operations. Collision liability and the potentiality of higher rates of insurance contribute to the slow implementation of the technology to supply chain.

Certain technological limitation attributed to drones must be addressed as the limited battery life. Such a technical challenge limits the range and scope of operations. It is also limited to carrying light or small packages due to low battery life. However, in such a line, the Boeing Company made some technological advancement. Boeing most recently developed an unmanned aerial vehicle with the ability to carry cargo up to 500 pounds (Doyle, 2018). The company is advancing the technology to carry loads on a large scale to lead autonomous cargo flights.

According to Glaser A. (2017), in 2014, a man was arrested after he flew a drone very close to a hospital window where a patient was resting. He claimed that a similar incident occurred where two men got arrested for 13 years following the smuggling of some contraband to a maximum security prison in Maryland. Glaser added that a person was arrested for flying a drone closed to his property and claimed that it was a privacy invasion and trespassing. The victim was sued for damage of property. Similar happened in Seattle where a man got sentenced 30 years jail time after his UAV collided with a building and injured two people in the Pride Parade of 2015. According to Prince D. (2015), a 75-year-old man was arrested in the US for prostitution after a drone captured the footage through a window of his car and delivered it to the police. The man's privacy was not considered in this case. These examples impart a variety of limits in the legislation and regulations of drones' procedures.

Another challenge facing drone technology appears as most of the operations through unmanned aerial vehicles are mainly done in rural areas. It is not clear if the drones will be able to maneuver such places without collision, or interference with the human population (Doyle, 2018). The weather is another concern and the related critics require answers from the developers. The question raised is the ability of the drones to effectively operate and keep the packages safely under challenging weather conditions.

V. Summary

The study has been vital in establishing the issues of unmanned aerial vehicles around the world, and their significance to various economies. According to the research herein, drones are crucial to economic growth and help organizations to cut their costs. The drones have been implemented mostly in the last mile of the supply chain where delivery has been critical. Organizations have been capable of replacing redundant human labor with drone technology. Labor costs have been reduced, and efficiency improved thus meeting consumer convenience. Scholars also claimed that drones have been used in diverse sectors such as military, agriculture, journalism, transportation, humanitarian work, constructions department, and telecommunication. In a many ways, drones have been enforced to enhance the coverage and efficiency of results due to accuracy. It has been established that several important global brands such as Amazon are already reflecting on the implementation of drones in their supply chain last mile processes.

However, few challengers emerged as barriers to the full adoption and implementation of the technology. First, few policies exist for controlling the manufacture and movement of drones in the aerospace. The regulators have been slow in establishing the general guidance for the adequate implementation of drone in the airspace alongside aircraft. The skeptics of the innovation have substantially raised questions about safety, security, and privacy. Failure in the technology such as small battery lifespan or technical errors as missed signals have threatened the successful adoption and implementation of the technology on a large scale and global proportion.

Accordingly, such application has been left to vast rural areas.

VI. Conclusion

It is apparent that despite the several benefits injected by drone technology in the supply chain, still many challenges impact its advancement and full adoption. Indeed, drone technology has been critical in saving costs and time to the supply chain processes. Human labor costs have been replaced by technology. Human errors and limitations such as time consumption and basic errors have also been reduced. The last mile process of a supply chain has also been enhanced through effective delivery of goods and services thus cutting on time. Therefore, the effectiveness of the organization and cost-cutting help in building consumer trust and loyalty to the brand if the drone delivery services meet their convenience. The technological invention also has advanced humanitarian aid, safety, and security in UAV.

However as mentioned above, there are several challenges facing drone technology thus making their large scale and usage difficult. Inadequate regulations governing the usage of drones have been proven difficult from state to state. Insurance policy, flights time, distance covered and amount of load carried is still a contentious matter in regulations. Safety and privacy of the population have made the technology unpopular among a majority of people. Incidences such as drones attacking the President of Venezuela Nicolas Maduro and the Gatwick Airport incident where drones interfered with flights have maintained individual skepticism regarding drone technology.

VII. Recommendations

Several benefits have been implanted by drone technology to the economies of various countries and diverse organizations as already discussed in this study. However, it is essential to note that certain existing limitations need to be addressed.

Extensive researches should be done to establish the causes of drone-phobia which represents an obstacle to the implementation and full adoption of the technology. When such reasons are determined, it will be significant in helping companies like Amazon and drone manufactures. They will invest in advertisement and announcement which will spur the public's confidence in the innovation.

The researches have to be conducted on relevant results that the government can be presented with in order to realize full adoption on the technology. The government has been very reluctant on fostering the innovation by poor regulations and licensing laws. Few laws exist in regulating the operations of drone technology and they are also discriminative. In the optical where the government is presented with accurate results on the full potential of economic growth and job creation that UAVs will generate, it may be forced to advance the technology. The relevant authorities can be proactive in ensuring the regulations in insurance claims, public safety concerns, security and privacy issues, all addressed promptly to allow a massive manufacturing and rolling of the technology in large numbers not just at the rural areas, but also in the urban settings.

Corporations such as Amazon and Coca Cola Company use UAVs in their supply chain, also partner with responders and humanitarian aids in their respective corporate social responsibilities programs. Such actions will help to popularize the innovation and ease in gaining the public confidence and support for the technology. When huge brands will be associated with

the progress, skeptics will be converted to supporters of the technological advancement of drones. The manufactures have to be more careful and improve on the technology use to avoid accidents and misfortunes. Technology failure in some instances, such as low battery and lost or weak signals, have to be tested and resolved. It will surely involve costly investment, but technology advancement, innovation and implementation are expensive at first.

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