



Department of Innovation, Tourism Industry  
Development and the Commonwealth Games

# (DITID) - Drones Project



TOUR7040 Report



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## 1

## Executive summary

Drones are referred to as Unmanned Aerial Vehicles (UAV), and there are many types of drones which are: agriculture drones; underwater drones; racing drones; and camera drones. This report will focus on the characteristic of drone technology that is most suitable for the tourism industry.

Drones represent a promising marketing tool for the tourism industry. Drones have the potential to make destinations attractive by capturing unique and creative images from the sky. Drone racing and drone light shows have also changed the traditional organisation of events. Drones are changing the tourism industry by providing a bird's-eye view of properties and landscapes, which greatly enhance tourists' experiences. Traditional hotels are also adopting drones to deliver packages and room service quickly and autonomously.

With greater accessibility of drones, there are increasing privacy concerns (many models have attachable cameras) with recreational and commercial drone use. There are also other concerns, such as safety, regulatory issues and skill level of amateur pilots. The Department of Innovation, Tourism Industry Development and the Commonwealth Games (DITID) commissioned the University of Queensland, Tourism 7040 students to conduct a desk-based research study on the use of drones to explore the issues as well as understand the opportunities to support Queensland tourism business.

Based on study findings, we have provided recommendations which include:

- suggestions for working with universities to evaluate drone technology and ways that could contribute to increasing visitor numbers and tourist expenditure;
- changes to policy;
- industry training and licensing;
- ways that could help business operators provide easier access to key information of drones.



# 2

## Purpose, Scope and Objectives

### ► Purpose:

According to the Department of Innovation, Tourism Industry Development and the Commonwealth Games (DITID) Strategic Plan 2018-2022, Queensland will embrace economic development and employment growth by adopting technology innovation in the tourism sector (Queensland Government, 2018). The policy director, Mr. Meddick stated the department's main goal is to increase visitor numbers and tourist expenditure in Queensland through drone technology experiences. The DITID is also committed to facilitating business operators in Queensland by providing improved visitor experience through policy development. To align with the vision of DITID, the main purpose of conducting the DITID Drones project is:

1. To find out how can drones enhance tourists' experiences and contribute to increasing tourist visitation and expenditure.
2. To find out how can drones technology increase employment opportunities in Queensland tourism sector.
3. Providing constructive advice on strategic planning for the Tourism Queensland by interpreting advanced examples of Drones applications to tourism attractions around the world.

### ► Scope:

The scope of the report focuses on the impacts of drone technology on Queensland tourism, especially commercial drone projects and their impact on the tourism industry, as well as the broad economic, social and environmental impacts. Meanwhile, we will also recognize the opportunities from the recreational purpose of drone use by visitors to Queensland.

The main focus of the project will be on the impact of drones in the development of tourism economy, such as enriching tourism products, innovation of destination marketing and management method, and the resulting new employment opportunities. At the same time, the positive impacts of the innovative application of drone technology on sustainable tourism development will be discussed.

While discussing the positive impacts of drones, this project will also analyze the issues of drone technology from three aspects: First is the drone technology itself, such as the short battery life and power failure; second is public safety and associated risks and privacy issues to the visitors or local residents who are in close proximity; Last but not least, public understanding on where and how drones should be used.

The project report will also address new challenges and potential government response to improve relevant laws and regulations.

### ► Objectives:

1. Conduct research and inform DITID of trends, opportunities and gaps of drone technology use that could benefit Queensland tourism.
2. Evaluate current and potential impacts of drone use and advise Queensland government to support the development in government funding, policy making and new technology education.
3. Advise how the Queensland Government can help support the development and application of drone technology; and recommendations for future research or potential feasibility studies on drone travel opportunities.
4. Develop a list of key facts for business assist access to the information required to use drone technology in tourism business, and the information includes available funds/ grants programs, business development support, government regulations and policies, and any other relevant resources that help promote the drone travel business.



## 3

## Research Methods

### Interviews

In our research, we explore the opinions of different stakeholders about drone use in tourism to increase research integrity and comprehensiveness. We selected interviews as our method for primary data collection because of the different working backgrounds and experiences of our stakeholders. Individuals who participated in or witnessed the development of drones in tourism are the key research subjects.

Interviewee/Institution	Introduction	Interview method
Tourism and Events Queensland (TEQ)	Government agency	Face-to-face interview
Queensland Tourism Industry Council (QTIC)	NGO	Email Interview
Department of Innovation, Tourism Industry Development and the Commonwealth Games (DITID)	Government agency	Face-to-face Meeting
Jackson Grives	Famous blogger	Telephone interview
Giacomo Rafanelli	Drone Photographer and business operator	Telephone interview
Adam Chaperman	Wine maker	Telephone interview

Table 1

In our research, social or interpersonal interactions cues are not considered important sources of information and do not influence the analysis approach for this research. Therefore, we selected the following approaches to conduct our interviews: face-to-face, telephone and e-mail interviews (Table 1). In order to ensure we would achieve reliable results and conclusions, as well as the development of a thorough hypothesis,

secondary research was conducted to collect the background on each interviewee. According to individual experience, we designed different interview questions. Each interview lasted less than 1 hour.

### Our Participants

**TEQ** - As a government organisation, TEQ plays an essential role in destination marketing and experience development by connecting tourists and destinations (Tourism & Events Queensland, 2019). TEQ focuses on innovation of visitor experiences in Queensland tourism. The organisation has extensive knowledge of research and a deep understanding of tourists' expectations and destination management. Therefore, our interview focused on potential impacts of drones on tourists and destinations.

**Queensland Tourism Industry Council (QTIC)** is a not-for-profit, membership-based and non-government organisation, working closely with tourism operators and industry employees. QTIC is regarded as a key influencer in Tourism Queensland. QTIC marketing material notes that it is "The Voice of Tourism", representing the interests of Queensland's tourism and hospitality industry (QTIC, 2019). Hence, the main focus of QTIC is to facilitate growth in the tourism industry of Queensland through the help of commercial drone operators.

**Jackson Grives** is a blogger and creator of free travel guides, content and photo blogs from destinations around the world. Drones are considered necessary in his travels as he conducts gorgeous photo shoots and videos for his internet web page. He has developed deeper insights from his travel experiences around the globe in relation to the use of drones. Our interview with Mr Grives focused on the issues and potential applications of drone photography.

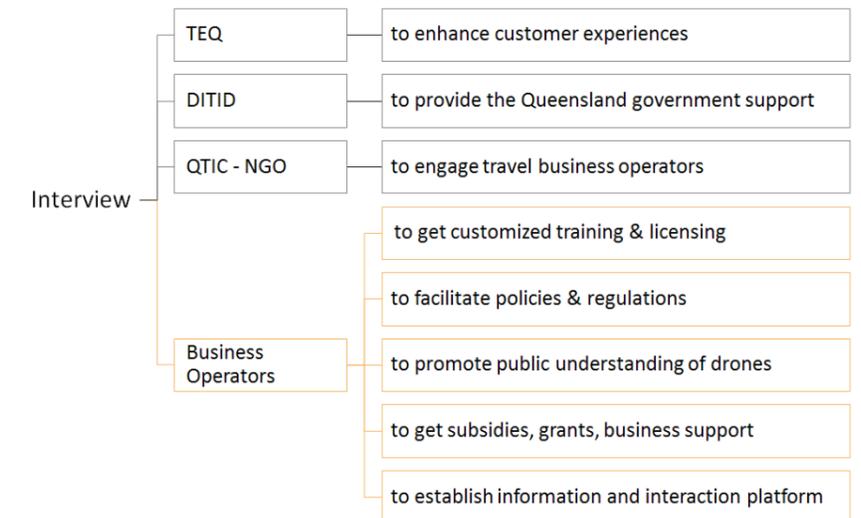


Figure 1 Illustrates and Summarizes the Key Interview Outcomes.

**Jamie Rafanelli** has his own business conducting drone photography and video footage for events or marketing campaigns. He has been using drones in business for a few years and passionately shared his perceptions about business operations in tourism. He provided in-depth insights in commercial drone application in regards to; initial training, licensing, regulation, policies, accessibility to government information resources. He also shared the challenges and difficulties he encountered as he navigated establishing his business. His stories provided insights about new companies learning to apply drone technology in travel and tourism.

Since time was limited, we focused only on interviewees' views specific to drone tourism based on their working background.



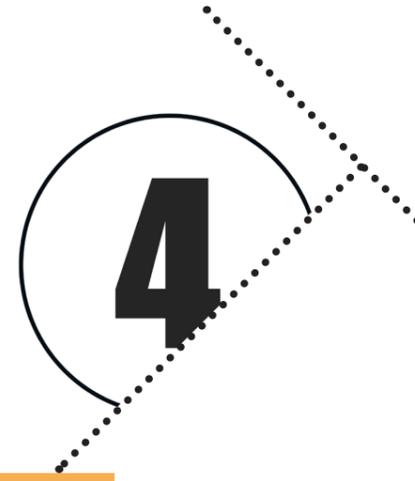
## Secondary Data Research

In addition to the interviews, secondary data was collected and synthesized. By analyzing secondary data, we complemented the interviews with industry-specific information. Secondary data collection and analysis improved our understanding of gaps, opportunities and other key areas of drone use in the tourism industry.

Our secondary data research was based mainly on online sources and focused on three areas: drone technology, drone regulations and successful drone case studies. Due to particular characteristics of drone technology and the type of clients, secondary data was also collected from government publications, tourism surveys, economic surveys, national leisure participation surveys, industry reports and tourism departments' websites.

Our study identified best drone use in other industries and in-depth analysis was conducted on these cases to determine relevant drone applications in Tourism Queensland. Following data collection, we conducted a PEST \* analysis which provided insights into the external influences of drones in the tourism industry. PEST analysis is a strategic business approach used to discover and evaluate external factors impacting businesses now and in the future. It mainly concentrates on political, economic, social, and technological forces to inspect problems and opportunities in order to provide a better improvement way. In our research, PEST analysis provided an in-depth understanding of drone use in Queensland tourism. Our aim is to provide key information based on our analysis to support DITID decision makers for planning and policy development.

\*PEST: Political, Economic, Social and Technological factors



## Literature Review

### PEST

Drone is a word used to refer to any unmanned aerial vehicle (UAV) that is remotely controlled or pre-programmed to fly autonomously (Vergouw, Nagel, Bondt, & Custers, 2016). Drones have been widely used in military industry, public safety and crime investigation (Canis, 2015; Sandvik & Lohne, 2014), and in increasingly innovative ways for entertainment and commerce.

Drone use has increased in the tourism industry in recent years. According to the current research literature and various practical examples, drone application in tourism can be distinguished in two main ways. Drones can:

- be used as a means for sensing or recording objects or activities at a destination which are further used for management or marketing purposes;
- be used to improve services or experiences for tourists, such as the delivery of goods or fast-food, drone shows, or flyer distribution at festivals.

As drones evolved through social use, we believe that exploring the PEST factors as a will enable us to find, evaluate and track factors that may impact current and future tourism business.

### Political Factors- Regulations and Policies

As drones become more popular, many countries around the world have issued relevant regulations for drone flying. Policies are continually changing to adapt to the rapidly advancing technology. In Australia, the Civil Aviation Safety Authority (CASA) is the Australian national aviation administration. All states are subject to CASA regulation. Individual's use, either for business or leisure, determines how the rules are applied. Many urban areas in Australia have considerable restrictions and most national parks impose further restrictions on drone use. For example, South Australia National Parks only permit drone use for scientific research and commercial filming. In New South Wales National Parks, visitors must obtain consent from the park administrator to fly their drones. As drones become more popular, many countries around the world have instigated new regulations for drones use and policies continually change to adapt to advances in technology.

In China, any drone operator, flying their vehicle above 400 feet must hold a license from the Civil Aviation Administration of China (CAAC). In addition, a drone weighing more than 6.8kg also requires a license. The UK Civil Aviation Authority (CAA) restricts drones flight to 500 feet, and drones that weigh more than 0.27kg must be registered through the official government website. In the United States, drone regulation varies from state-to-state and all are subject to the Federal Aviation Administration (FAA) regulations. For example, Minnesota law requires commercial drone operators to pay for commercial operating licenses and hold drone

insurance. Alaskan law limits the use of drones, including the manner and location in which images and videos are captured. As more substantial and intensive regulations limit drone flight, some stakeholders in the industry are concerned policies may negatively impact any further development of drone technology.

- **Economic factors:**

The consumer and commercial drone market is continuing to grow (Global Market Insights, 2018; Luppincini & So, 2016). Experts are only beginning to explore the many possibilities for drone use. Drone spending is anticipated to reach \$13 billion by 2020 (BCG, 2018). UAVs also provide employment opportunities for business or government work, particularly for agriculture, mining, surveying, photography, shipping and tourism. Due to the integration of cameras, drones are also widely used for photography and filming in both individual and commercial use. Drone photography and filming are only a fraction of the greater drone industry. According to National Drone statistics (2019), the US drone fleet will increase ten times from 42,000 to 420,000 between 2016 to 2021, and the global drone market is estimated to be US\$100 billion by 2020.

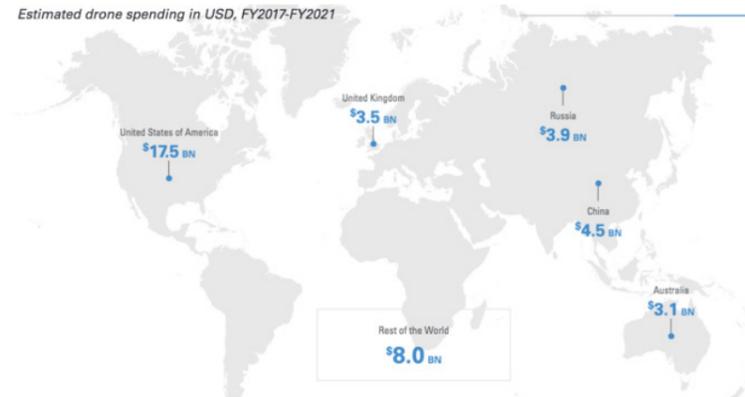


Figure 2 Estimated drone spending in USD, FY2017 – FY2021(Goldman Sachs Research)

- **Social factors:**

Technology is often used as a tool for social change. Similarly, drones will contribute to and influence broad social change. From a personal privacy perspective, peepers and paparazzi have used drones to obtain images of normally inaccessible private places or homes. The use of drones for military and civilian applications has increased attention in regard to the ethical implications and how they may violate privacy and civil liberties (Kreps and Kaag, 2012). Many people do not accept the changes occurring in society due to drone use. There is increasing fear in the community in regard to misuse or abuse of drone technology.

In order to build trust and security in the community, many governments have set strict guidelines on the use of drones. However, increased regulation also constrains drone innovation. Therefore, governments must use good judgement in balancing judgements between the rapid advancement of drone technology and the various social phenomena that occur in the use of drones.

- **Technological factors:**

The popularity of consumer and commercial drones has increased dramatically over the past decade. Technological advances have enabled civilian drones to be manufactured at a lower cost, with sophistication functions such as waypoint navigation and GP; smartphone-based control systems; functional platforms such as HD video and thermal imaging; and the ability to transport people. Drone platforms include hybrid multi-rotor systems, single-rotor and helicopter fixed-wing aircraft.

Further development of technology is expected to increase opportunities in the civilian drone market. Anti-collision systems are also considered as a key focus in future drone development, allowing drones to identify

and manipulate obstacles and significantly improve autopilot functionality. Another key area for development is minimising noise from drone engines and equipment, which is currently considered a public nuisance.

A wider range of technological innovations in drones may also drive development of new areas as niche drone tourism. Such developments include high-speed drone video capture, infrared functions for crop monitoring, fluid dynamics, heat sensors, sound wave system structural mechanics, systems engineering, robotics, electrical components, sensor system signals and information processing technologies. Technological advancements will continue to increase opportunities for use in tourism. Big data and artificial tourism information is also a potential area for research and testing in the future.

## ▶ QLD tourism industry

Queensland is famous for friendly country towns, natural assets and the environment, such as tropical islands, national parks and beautiful beaches. Queensland is a desirable destination of choice for travellers (Budget Direct, 2019). Tourism contributes \$25 billion to the Queensland economy, which accounts for 7.9% of the gross state product. Also, tourism supports more than 217,000 jobs in Queensland. In 2018, Queensland welcomed 24 million domestic and international overnight visitors. Tourism in Queensland grows sustainably by international and domestic visitation and expenditure. The main Queensland visitors are from China, New Zealand, US UK, Japan and Singapore (Tourism Research Australia, 2018).

The tourism industry is becoming increasingly competitive. From a global perspective, distance makes Queensland a difficult destination for people in the Northern hemisphere to visit. Lower cost destinations with similar features, such as Thailand and Fiji impact the number of tourists visiting Australia. Australia ranked 39th in the worldwide for the incoming international visitors in 2017, which may be due to factors such as flight duration and relative cost. Furthermore, Queensland faces competition from other states. In 2017, it welcomed 2.7 million international visitors. However, New South Wales (4.2 million) and Victoria (2.9 million) tourism numbers were significantly higher (Tourism Research Australia, 2018).

Tourism Australia believes Queensland tourism is growing and estimate the visitor intake to increase by 5.8% each year (Tourism Research Australia, 2017). To keep pace with the forecasted growth in demand, and retain Queensland as a premier tourism destination in an increasingly competitive global economy, Queensland government intends to implement a series of strategies to support businesses and the industry in creating jobs, products, and experiences for tourism growth.

The global addressable market of commercial drone applications is estimated around \$127 billion (PWC, 2018). Due to the unique geography and climate, Queensland has become a global leader in the field of drone use. With the announcement of a new drone research center for the state and the annual world of drone congress held in Brisbane, DITID is leading innovation by embracing drone technology as one of the key platform technologies. In 2017, Queensland Government launched the Queensland Drone Strategy, which aims to strengthen the existing Queensland drone industry and unlock the potential use of drones for other areas. With \$650 million funding in the Advance Queensland Initiative (DITID, 2018), DITID is exploring the considerable potential of drones use in tourism, such as market generation, destination marketing and management.

► **Case Studies**

The following section describes the areas of potential and existing use for drone technology. We also discuss potential areas of use suitable for tourism in Queensland based on other industries.

● **Drone Delivery Services**

Drone delivery services in commercial use are triggered by the introduction of the “Ambulance Drone”. Actually, Jeff Benzons', the founder of Amazon, is the first person who sees the potential of drones in delivery services. However, his thoughts and proposal was turned by the FAA. One year later, a Dutch student created the first prototype of delivery drone called the "Ambulance Drone" (Prigg, 2014). For such a breakthrough product, the United States deregulated commercial use of UAVs, and now allows small UAVs to operate for commercial purposes (weight must be less than 25 kg, is constrained to a flight speed up to 160 km/h, and an aerial limit up to 120 meters). Drone operators must be qualified pilots and be at least 16 years old (Lorenzo, 2014).

In Australia, Google's world-first drone delivery business won approval in Canberra to deliver food, drinks and medication. This significant concession demonstrated the Australian governments' approval for the use of drone technology (Martin, 2019).

Medical Delivery—Zipline

**Company Name: Zipline**

Drone Type:	Zip (Self-designed)
Drone Weight	Approximately 10 kg
Energy Type	Electric, battery powered
Package Maximum Weight:	1.8 kg (Three 500ml blood bags)
Maximum Speed:	100 km/h
Usual Delivery Time	30 minutes
Service radius	80 km
Safety Feature:	500 deliveries/day; Proven to work in extremes (Rain or Shine; Day & Night; real-world weather); Redundant systems—Backup motors; Parachute landing system; More than 40,000 km every week
<b>Others:</b>	
Requires launching pad and special trained pilots	

Table 2

Drones have the potential to significantly change healthcare. The first sentence on the popular drone delivery website proclaims its success under the banner of “6,246 Lifesaving Deliveries Drone”. Due to poor ground transportation conditions (muddy and often washed-out roads), traditional transportation is delayed, especially in severe weather. The medical system of Rwanda and Ghana has insufficient infrastructure to support the health requirements for their citizens and therefore the two countries are often faced with a shortage of urgent medical supplies (such as blood or vaccines). The drone delivery service has impacted mortality by providing 13 million people with instant access to urgent medicines.

Although the health system and infrastructure for Queensland is well-established it may also be enhanced



Figure 3

through the use of drone technology and faster delivery of medical supplies. Queensland has over 1,000 national parks, covering 1,345,000 square kilometers). Such wide area often makes ground transportation impractical for the delivery of urgent medical supplies. Visitors in national parks who encounter wildlife, or are bitten by one of the many venomous native creatures (such as redback spider, tiger snake and Irukandji jellyfish) may need urgent medical attention. In such remote places there are many challenges for immediate medical assistance. Even though these accidents may

be rare, medical delivery of vaccines or other supplies using UAVs may reduce or even eliminate fatalities. UAVs may also mitigate the need for helicopter rescue in dangerous conditions.

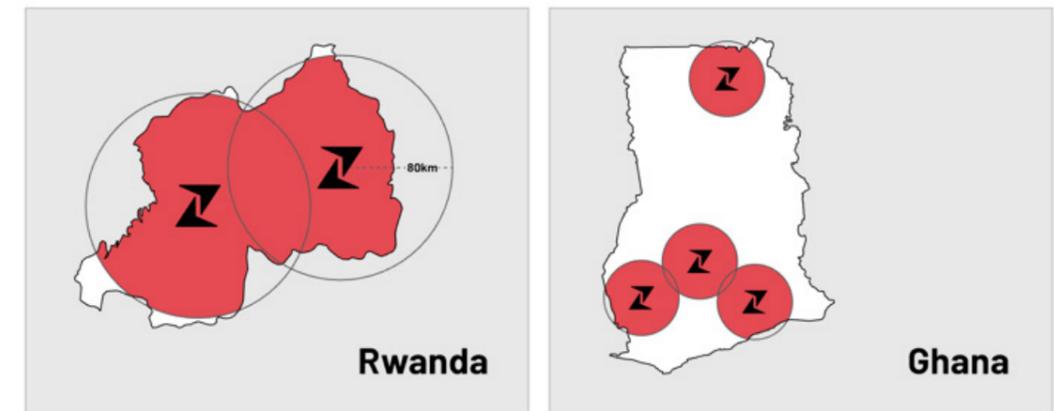


Figure 4

**Company Name: Matternet**

Drone Type:	Matternet M2 V7
Drone Weight	9.5 kg
Energy Type	Electric—Lithium ion battery
Package Maximum Weight:	2 kg
Maximum Speed:	72 km/h
Temperature:	-10 to + 40°C
Service radius	20 km
Safety Feature:	Automatic-deployed parachute & Multi-factor 3D geofence

Table 3

There are many companies that have launched their own parcel delivery drone programs. Although the weight of drones ranges from 5kg (Project Wing) to 25 kg (Amazon), the maximum package weight a drone can carry is around 2kg (including the medical supplies delivery drone). One of the most significant benefits of UAV deliveries possess is the extremely low variable cost.

In the above picture (Figure 6), it cost only \$1 to use a 30 minute Amazon Prime Air delivery. Drone delivery significantly reduces delivery and cost as actual is only 10 cents per delivery (Smith, 2015). Furthermore, energy consumption in UAV delivery is incredibly low, making it also environmental-friendly. However, such deliveries are only possible when the parcel is under the maximum weight for UAV delivery and within the delivery radius. These are current restrictions due to the size of available drones. Traditional transportation is still used for the majority of service delivery for companies such as Amazon. In Queensland, the image of remote destinations may be enhanced through the use of UAV parcel delivery

**Company Name: Amazon**

Drone Type:	Amazon Prime Air (self-designed; different types)
Drone Weight	Up to 25kg
Package Maximum Weight:	2.25 kg
Maximum Speed:	100 km/h
Energy Type	Electric
Usual Delivery Time	30 minutes
Service radius	12 km
Safety Feature:	Multiple redundancies & sophisticated "Sense and Avoid" technology
Others:	Landing and dropping parcel instead of parachuting—required helipad your garden; live close to distribution center

Table 4

service. Most restaurants and cafes in visitor centers in national parks only serve a limited number of customers. The introduction of drone delivery service would increase the restaurant customer base by delivering food to visitors in remote areas of the national park. Drones could deliver snacks or hot meals to remote tourists, even those in the middle of a national park. UAVs could also be used to transport small crucial items across the national park such as batteries, lighters, first aids, and so on. Drone use in combination with mobile phone technology and GPS tracking could significantly enhance the safety and the comfort of outback or bush tourism.

**Company Name: Project Wing**

Drone Type:	Project Wing Drone
Drone Weight	5kg
Package Maximum Weight:	1.5 kg
Maximum Speed:	120 km/h
Energy Type	Electric
Usual Delivery Time	3-4 minutes
Safety Feature:	Machine learning algorithms; 70,000 test flights
Others:	The drone enters hover and descends to delivery height 7m above ground; Order food with app

Table 5

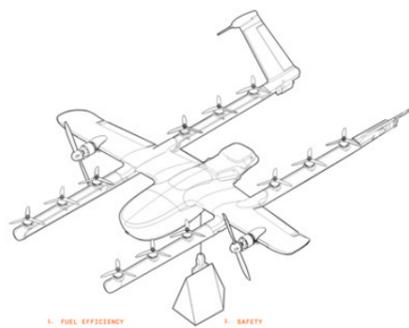


Figure 5

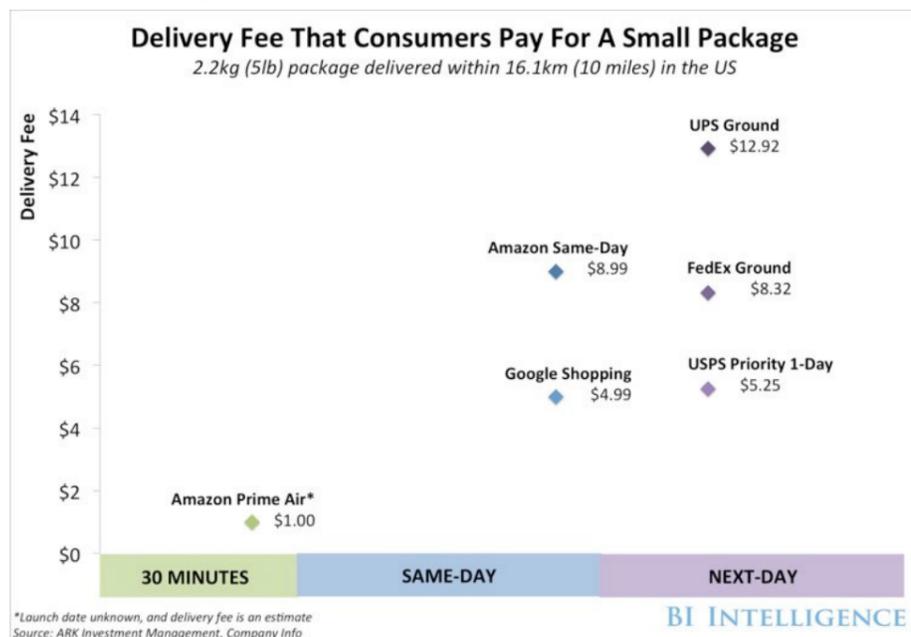


Figure 6

● **FPV (First Person View) Drone Racing**

A new sport—FPV Drone Racing is becoming increasingly popular for tourists interested in drones. Competitive games are conducted pilots wearing VR glasses to see through the front-facing camera. Participants are attracted due to the combination of speed and safety. Players must go navigate a course with specific obstacles before reaching the end. Races are enhanced with unpredictable situations during the race such as a sudden change of routes.

• **DRL—Drone Racing League**

DRL is the global, professional drone racing circuit for elite pilots. Custom built racing drones travel at over 90 miles per hour. Pilots’ race in first person view (FPV) through the 3D courses. The high-speed action airs on the sports networks, including NBC Sports, Twitter, and Sky Sports. Most racing is undertaken in a closed indoor arena where lines and obstacles are marked with lasers. The aim of the race is to test participants’ professional knowledge of the drone, knowledge of aerodynamics and the ability to improvise when facing different kinds of obstacles. Each drone has 4 LED lights indicating current location during flight. When photographed, the lights from the drones create incredible pictures which are considered to also be an attractive part of the competition.



Figure 7

• **DR1**

DR1, is the premiere drone racing series showcasing the world's top pilots competing in races and in historic locations around the world. The race is famous and the size of the competition is four times the size of traditional drone racing competitions. Unlike DRL, DR1 select famous tourists' attractions as for the race such as La Mothe Chandeniers, Krvavec Mountain, Castle Sneznik, and Tulove Grede.



Figure 8

Drone racing has a well-established fan base. Queensland could apply to host an event which could be repeated annually. An international event of this kind would have many benefits for Queensland tourism. The drone racing community and participants would visit Queensland locations increasing direct income for tourism. The selection of famous natural locations in Queensland such as the bridges over Brisbane River, would also increase public awareness of the state. As a consequence, increased participation and awareness of drone-related activities may also drive the development of the UAVs industry in Queensland.



Figure 9

## ► Existing Support

The Queensland government has a strong vision for drone technology and its use in tourism (Queensland Government, 2018). The government and relevant organisations have several measures to support drone use in business. Business is supported through:

1. Funding
2. Policy
3. Training subsidies

### ● 1. Funding

To engage small business operators in this growing industry, such as designing, building, providing or using commercial drones, the following programs are available to drone business operators entering or once they have established their operations in Queensland (Queensland Government, 2018).

#### (i) Industry Tech Fund

IndustryTech Fund (ITF) aims to create transformative “step changes” and accelerate the emergence of innovative products and services based on platform technologies. The ITF act as catalysts for innovation and promote the development of follow-up technologies for a variety of industries. The program enables applicant partners including small and medium-sized enterprises (SMEs) in Queensland, startups, research organisations and universities, to receive potential global opportunities from funded projects. The Queensland Government will provide at least \$250,000 and up to \$5 million in funding for each eligible project.

#### (ii) Ignite Ideas Fund

The Ignite Ideas Fund provides funding to support startups and small or medium Queensland businesses to commercialize innovative products, processes and services. The fund is expected to support Queensland business to grow and compete in the global market and create new jobs.

#### (iii) Small Business Digital Grants Program

To assist small business in Queensland, the Queensland government are to provide funds up to \$10,000 to help small businesses access to digital technologies and services. The program is expected to help small businesses to work smarter and engage in online business opportunities brought by digital technologies in the global economy.

#### (iv) The World of Drones Congress (WoDC) in Brisbane

WoDC is all about drone business and how drones are used in industrial, commercial and government services. These include planning smart cities, training, agriculture, health and humanitarian needs, as well as drone laws, regulations and future new jobs. The Department of the Premier and Cabinet provides funding of up to \$350,000 over two years (2018 and 2019) for this project. It would help to increase Queensland’s profile, showcase Queensland’s existing drone industry and attract new investment into the state.

#### (v) The Department of Innovation, Tourism Industry Development and the Commonwealth Games (DITID)

Aiming to establish an independent body to facilitate the development of industry consensus standards, DITID invests \$3 million. The independent body will be completed by 2019, which will play a significant role in supporting the assessment and certification of autonomous and robotic technology in Queensland (DITID, 2018)

### ● 2. Policy

Compared with other states in Australia, Queensland has the least restriction for flying drones both commercially and recreationally. Some of the key points for flying drones in Queensland:

- Drone operators do not need CASA’s approval if they want to fly their drone for fun when their drones weigh less than 2kg.
- Drones operators cannot fly drones without a license for any business purpose. However, there are some limited exceptions where a licence is not required. In such cases, the pilot must notify CASA at least five business days before the flight and he or she must adhere to all the existing rules for recreational drone use (Civil Aviation Safety Authority, 2019):
- Drone operators can make for commercial-like operations over your own land,
- Drone operators can make commercial flights with tiny drones (under 2kg)
- As the land owner/manager, Brisbane City Council allows drone to fly in local national parks (Brisbane City Council, 2019).

### ● 3. Training subsidy

To ensure safety when flying drones and to also enhance professional drone pilot skills, the Queensland government provides training subsidies for the development of future drone technologies. These include:

- up to \$1 million over five years under the Advance Queensland fellowship program for drones targeted scholarships
- support for drone technology in schools through several initiatives, including grants, roadshows, and competitions.
- workshops across Queensland through Innovate Queensland in collaboration with the Impact Innovation Group. This work connects SMEs with the best partners and enables the growth and development of innovating ideas for commercial outcomes (DITID, 2018).

Fund Program	Target	Fund size	Expected
Industry Tech Fund	Small and medium-sized enterprises	\$250,000 and up to \$5 million	The program is expected to promote the development of follow-up technologies for drone industries.
Small Business Digital Grants Program	Small business	Up to \$10,000	The program is expected to help small business work smarter, engage while they access digital technologies with the global economy.
Ignite Ideas Fund	Small and medium-sized enterprises	Up to \$200,000	The fund is expected to support Queensland business grow and compete in a global market and create new jobs
The Department of the Premier and Cabinet	The World of Drones Congress	Up to \$350,000	The event is expected to support planning smart cities, training, agriculture, health and humanitarian needs, as well as drone laws, regulations and future new jobs.
The Department of Innovation, Tourism Industry Development and the Commonwealth Games (DITID)	Independent body	Up to \$3 million	To support the assessment and certification of autonomous and robotic technology in Queensland

Table 6

The Queensland government attaches great importance to business investment and employment growth in the field of drones. Both the Queensland Government and industry stakeholders actively support new drone technology research and development. However, the drone market is rapidly expanding with new business models and opportunities and according to interview results, most of the business operators are not familiar with the available support programs. To enhance the growth of drone use and business in Queensland, direct marketing for new or existing operators in this area should be developed.

## ► Gaps and Impacts

Drone use is becoming commonplace through the delivery of goods, flying billboards or drones at festivals and events. Acceptance of the technology appears promising in these early phases of drone adoption. However, the use of drone technology is also limited due to technical issues, security limitations, or the risk of community dissatisfaction through disruptive activities (Stankov, Kennell, Morrison & Vujicic, 2019). A range of security and regulatory issues challenge operation of UAVs in different environments. These issues include public perceptions; acceptance; and issues associated with the capture of images individuals without permission.

### ● Public Understanding and Privacy issues

Public perception towards drone use and application is a significant factor in acceptance of safety objectives and regulations. According to research, emotional safety and privacy were some of the main concerns for public acceptability of drones (Clothier, Greer, Greer, & Mehta, 2015). Remotely operated drones (pilotless drones) was a main concern, as well as security, liability and ethics associated with the use of drones. These factors will influence the widespread acceptance of UAV technology. Privacy and safety risks associated with drones are not well established in the broad academic research (Clothier, Greer, Greer, & Mehta, 2015). However, the process of acceptance will be influenced heavily by information made available and trust in the safety of public places. The media will therefore play an important role in the development of public position towards drones.

Some areas of the public are against drone applications due to the privacy of their personal space, or either capturing their footage without their consent or whatsoever (Luppacini & So, 2016). Commercial drone pilots believe privacy rights are state issues rather than a federal government issue. However, the Federal Aviation Administration has strict rules and regulations to protect public safety and privacy, which the entire industry of professionals and individuals must follow to limit misconduct (Kerner, Berry, Zammit & Chongolnee, 2017). These issues must be addressed and clarified for the public.

### ● Limitation for existing commercial use

The Australian government has teamed up with Drone Compiler to produce an easy-to-use smartphone app to illustrate whether if it is allowed to fly in any zone of Australia. The ‘Can I fly there?’ drone application reflects the standard operating conditions focused towards drone enthusiasts who fly for recreational or commercial use. This app is considered to be an educational awareness tool for drone flyers. However, commercial drone pilots are frustrated with the limited information provided in the app that has excluded drone category rules for certified operators (Aviassist RPAS, 2018).

Manual calculations and professional knowledge are required to determine whether commercially licensed drone flyers are able to fly in the approved parameters. For example, certified operators should be trained to understand if restricted airspace is active or not, while the professional pilots believe that the government should provide effective and efficient ways to minimise time and costs in understanding the environment of flying commercial drones.

### ● Lack of sufficient information on government regulations

Commercial drone business organisations are not well informed with the grants, opportunities and change of government regulations. According to one participant in our study, commercial drone firms are not informed

about established opportunities to assist businesses to expand or collaborate (Raffanelli, 2019). When investigated during our research, we found that the government grants and information were hard to find on the internet.

Companies and pilots are unsure of proposed changes to regulations, and any legislation passed requires more extensive communication (Montesalvo, 2019). A communication strategy for commercial drone operators should be developed by the state government to ensure new operators are aware of the regulations and that existing operators are kept informed. Commercial pilots also raised concerns about suspension or delays in their regular business due to government events. These firms were not aware of information or regulation banning drones use in certain areas.

### ● Safety & Security risks

The Collision between drones is one factor drone operators face due to excessive use in a single environment and potential accidents in populated areas (Harris, 2017). The risk of collision between conventionally piloted aircraft and drones are also perceived to be high.

Drone accidents due to failure by pilots, or equipment failure or due to weather conditions in urban environments are incredibly dangerous (Harris, 2017). Though Grives (2019) believe that such incidents are unlikely based on existing statistics, increased activity and number of drones are likely to impact the current trend of low risk. These incidents are considered dangerous by government bodies as well as by the public and where they do occur, drone companies and pilots are investigated (Rao, Gopi & Maione, 2016). Critics have also speculated that drones could be used to conduct attacks on a civilian population, although there are no currently reported examples.

### ● Drones have potential but are limited by maturity of development

The limitation of drones includes program failures, battery faults, and carry capacity. The short battery life (approximately 22 minutes – 30 minutes) was highlighted by drone operators, limiting flight range to short distances (Fairs, 2018). Carrying capacity of drones is also a constraint for use with unique experiences, such as drone delivery systems. Hence, the potential of drone offerings is vast but is limited due to the maturity of development.

### ● Drone projects and creating unique experiences are considered expensive

UAV projects are considered costly due to the requirement of professional experts; expensive tools and equipment; and the consumption of time for such projects to accomplish. Moreover, limited funding and grants from private and public sector for such projects have been a challenge for many companies. Thus, unique ideas that could be even utilised in tourism are on hold due to expensive investments (Oswald & Tyler, 2019).

### ● Drones are a source of nuisance concerns

The excessive use of drones has some limited negative implications such as; noise pollution, interferences with animal wildlife habitats, or unknowingly invading aboriginal spaces. According to research, the interference with commercial aviation has been one issue as some operators do not always follow regulations when operating drones (Rao, Gopi & Maione, 2016). Hence, multiple aviation authorities are currently tackling the issues globally by strict regulations, hefty fines, confiscation of equipment, and losing commercial drone operating licenses.

## ► Opportunities

Drones provide opportunities for tourism in four main ways:

- (i) improving tourism experiences,
- (ii) events regarding drones which help attract a new market,
- (iii) showcasing of a destination or product in the region and
- (iv) monitoring conservational initiatives or tourism experiences.

### (i) Improving tourism experiences - destination enhancement

Drones are an innovative marketing tool for destination and private tourism establishments. Aerial filming was one of the first commercial application of drones for destination marketing (Stankov, Kennell, Morrison & Vujicic, 2019). Drone photography dominates destination marketing. Increased demand for aerial videos for tourism marketing purposes, creates exciting new career opportunities in the tourism industry.

- **Destination Marketing: official content by Destination Marketing Organisations**  
Destination marketing organisations (DMO) use recent innovative communication platforms and technologies to attract and retain visitors. One approach by DMOs is aerial footage of the destination to showcase features. Tourists are able to examine videos before committing to travel and marketing agencies have confirmed that aerial footage or virtual tour experiences motivate tourists to travel for specific destinations (Marasco, Buoniconti, Niekerk, Orłowski & Okumus, 2017). For example, Visit Trondheim, the DMO of the Norwegian city of Trondheim used drones to create aerial footage to showcase the city and surrounding areas. This marketing successfully exposed the location and received 200,000 views in the first few weeks. The use of drones for marketing is considered very effective as it cost less than \$30,000 to produce including licensing and agreements (Skytango, 2016).
  - **Drone Application utilised by private tourism firms**  
Drones are used for filming low-cost aerial footage of product experiences. Examples include adventure tourism establishments; national parks; hotels and resorts. Professionals are hired to market materials to provide innovative and creative methods to increase tourist awareness towards these tourism-related establishments.
- Dana Wharf Whale Watch located Southern California once launched a low-budget and high-success drone marketing campaign by linking their YouTube with drone aerial footage of whales and dolphins to promote their offerings to its customers which attracted more than 24 million views to their channel (King, 2014).
- **Drone application utilised in movie production**  
The movie industry has been using drones for aerial footage in movie production. Drones enable rapid filming on difficult shots that were previously considered impossible. According to research, Queensland has been showcased in several blockbuster films including *Pirates of the Caribbean: Dead Men Tell No Tales*, *Aquaman*, *Thor: Ragnarok*, and *Pacific Rim 2*. All of these movies utilised drones throughout filming (Queensland Government, 2018). Local professionals were hired to do these jobs according to their experience and professional portfolios.

### (ii) Drone as a tool for destination monitoring and management

Drones play an important role in destination management. Some examples include landscape monitoring, destination maintenance and wild flora and fauna conservation.

- **Drones for observation and conservation**  
Drones are utilized by wildlife conservational parks by training their employees in using commercial drones (aerial or underwater drones). In addition, drone technology has been regarded as a handy tool locating wildlife for ground tours; whale watching excursions; and fishing expeditions. Drone use reduces tour operators' expenses in petrol and vehicle maintenance costs. Thus, improving the customer experience and also reducing business costs. In Taiwan, drones have been used to investigate number and routes of visitors to monitor the change of landscape and to conduct maintenance in Penghu Kuibishan geopark (Lu, 2018).
- Scientists use images from satellites to identify and count animal species. Drones enable greater monitoring than traditional methods; but low resolution limits the use of these images. Researchers in Queensland equipped drones with heat sensors to map marsupials' population in Brisbane from 60 metres above the tree canopy. This technology may be a more cost-effective method of identification and mapping of koalas and other endangered species than the current invasive approaches (Sydney Morning Herald, 2018). Also, Australian researchers are also trialling the use of UAVs equipped with hyperspectral cameras to collect more detailed images and data on the health of coral reefs and explore the technologies possibility in mapping coral reefs (Hamyton, 2017).
- **Drones for monitoring emergency situations**  
Drones are considered essential for lifeguards, and other relative agencies to get aerial footage of the situation and helps to evaluate any given situation for better decisions effectively. According to DJI & Los Angeles, Fire Department Test Life-Saving Drone Technology is being carried out to evaluate its effectiveness in such situations. For instance, a drone is often the cheapest and most efficient tool to find a missing person or survey a disaster scene. A group of researchers in the University of Technology Sydney in Australia has created a new shark-detecting drone capable of spotting out the dangerous fish from the air, and then the "shark shield" devices fitted will bomb sharks with electrical pulses to irritate them and deter them from the area (World Economic Forum, 2017).

### (iii) Drones as customer experiences

Commercial drone professionals provide tourists with innovative experiences through visiting destination through virtual reality, virtual tour guides or professional photography and videography. Tourists also use drones to enhance their own experience by piloting their own small personal UAVs while visiting destinations for aerial photos.

- **Photography & Videography**  
Aerial photography and videography is a growing trend for tourists travelling around the world. The percentage of visitors posting aerial photography and videography on social media platforms has doubled, from 14 to 31% in the United States between 2009 and 2013 (Dinhopl & Gretzel, 2018). One interview participant (Grives, 2019), believed drones were necessary in his travel work. He uses drones to document experiences of a destination and then uses this footage for his blogs.

Business firms sell aerial photography and videography packages to visitors for a destination or event.

For instance, businesses are taking advantage of aerial photography and videography, to provide the best aerial photos at coastal resorts, theme parks, national parks and to event visitors. Photos are then used by visitors as posts on social media or kept as a souvenir. National parks in the United States are developing specific aerial trails to satisfy the demand for drone photography and FPV outdoor experiences through rental of preloaded drone programmes for visitors (King, 2014).

- **Virtual Reality Tourism Experiences of Drones**

Virtual reality creates a sensory experience of a tourist destination or as an attraction and can be used for sales (Gibson & O’Rawe, 2018). Drones offer many possibilities to create complete or partial virtual experiences for tourists. Virtual reality may provide options as an alternative to real tourism for people who are mobility impaired or have other limitations for travel (Mirk & Hlavacs, 2014). Technological advances have enabled businesses to utilise drones to provide aerial views or virtual tours of normally inaccessible cultural heritage sites. According to Sachs (2016), Information Technology companies will spend massive investments in both hardware and software development, with a projected market value of \$80 billion by 2025. The use of virtual reality in tourism is an ideal opportunity for the Queensland Government to increase foreign investments and further improve tourism experiences from drone applications.

Virtual reality and drone use will further assist Queensland Tourism in creating jobs in industry. Advanced Queensland Ignite Ideas program has supported V2i to develop a next-generation 3D virtual reality software (DITID, 2018). It is believed that that the advanced gamification, virtual collaboration techniques, visual literacy and data intelligence will further improve tourism drone experiences for visitors.

- **User-generated content by visitors/drone user**

Drone videos shared by consumers via social media platforms are a specific type of user-generated content (UGC), such as text, pictures or audio. Drone videos may be used as part of a DMO’s marketing strategy. For example, New Zealand’s DMO launched a successful social media campaign for sharing “ultimate holiday selfies” encouraging visitors to capture an eight-second video of themselves to share with their friends on social media using the hashtag #NZdronie. Many regional tourism operators, such as those in South Island locations and ski fields, took part in this campaign by providing support in specific destinations. Many visitors were drone users not motivated by factors connected to travel or sharing tourist experiences. Instead, they were operators who procure, maintain, and use drones in their own video production. This campaign was a great success by reaching over 34 million audiences (Tourism New Zealand, 2015)

**(iv) Drone as a product of Tourism/Event**

Events showcasing drones in the form of sports competitions, conferences or as an experience will benefit Queensland Tourism. Attracting drone users to the region to experience such events, provides opportunities in terms of job creation and tourism earnings.

- **Drone Conferences**

The World of Drones Congress (WoDC) held in 2017, attracted 630 delegates from across the world. Such events provide platforms to promote drone opportunities in Queensland. The success of WoDC in Brisbane has managed to raise \$350,000 in funding to host in 2018 and 2019 respectively (Queensland Government, 2017).

- **Drone Racing and Sports Competitions**

Drone racing and sports competition have gained tremendous support from drone fanatics. Drone Racing

Australia has been conducting outdoor and indoor drone races across the nation; whereby many drone enthusiasts participate in these events either online or at the event venue. The firm believes to increase its audience in the coming years and have competitions at a national level.

- **Drone Performances**

Drones are also used for performances by professional firms. For instance, 500 Intel drones performed a choreographed light show during the Winter Olympics 2018 which was a significant attraction (Gilmer, 2019). Likewise, the Queensland University of Technology (QUT) performed a simple choreographed light show by its students to its visitors during Robotronica event in the year 2013 (Queensland University of Technology, 2013). It is essential to take such opportunities to host performances, drawing considerable numbers of tourists to an event.

According to DITID (2018), the government has allocated grants and funds to 33 tourism business organisations through the Advancing Small Business Queensland Strategy 2016-2020. To gain advantage from opportunities mentioned above, the Queensland Government are delivering workshops across four regions through Innovate Queensland in collaboration with Impact Innovation Group Pty Ltd, which helps to connect small and medium enterprises with the right business relations and innovate ideas into commercial outcomes and incomes (DITID, 2018). These initiatives will further aid in productivity, growth, job creation and long-term prosperity and living standards for local residents.



## ► Future Trends

### ● Unmanned Aerial System Traffic Management (UTM)

As the increasingly improved drone technology will be applied in all walks of life, there will be more drones flying in low-altitude airspace. In order to avoid collision and other safety problems, it is necessary to control the aerial traffic based on UTM just like concepts from the system of roads, lanes, stop signs, rules and lights that govern vehicles on the ground. The UTM system would enable safe and efficient low-altitude airspace operations by providing services such as airspace design, corridors, dynamic geofencing, severe weather and wind avoidance, congestion management, terrain avoidance, route planning and re-routing, separation management, sequencing and spacing, and contingency management. The Federal Aviation Administration (FAA) and NASA are now trying to make the system more available and build a well-established air traffic system.

### ● Passenger Drone

Passenger drone is also known as a drone taxi or pilotless helicopter. As traffic and pollution have already brought many problems to the world, it may be a better idea for people to choose passenger drones to avoid traffic jam in the future. Some companies such as Boeing and Ehang are exploring the use of passenger drones as air-taxis and for air-ambulance services and have already introduced their new passenger drone model and concepts. Problems like aerial traffic coordination, control, and collision-avoidance are the most challenging obstacles that forbid the tech into use.

### ● Solar Drone

Because the applications of drones are now severely limited by batteries, it is a crucial step to find a more efficient drone power to replace those batteries that can only keep drones flying for only several hours. Companies such as Boeing and Titan are now testing their new solar drones. Based on solar cells, their drones can keep flying for five years without charging and refuelling. These drones can be used in many fields, such as traffic and wildlife monitoring. However, because of the large number of batteries, most long-range solar drones are as big as an airliner. Researchers are now trying to make solar cells more efficient to reduce the size of solar drones.

### ● Drones and 5G

The development of ultra-reliable and low-latency 5G networks that would allow proper communication with self-driving cars has already been a topic for many technology experts. Technology that will be ultra-connected and achieve end-to-end latency of 15 milliseconds. Therefore, the 5G drones, as such, would be able to make handovers between towers shared with the smartphone users, which would improve application efficiency of drone using.

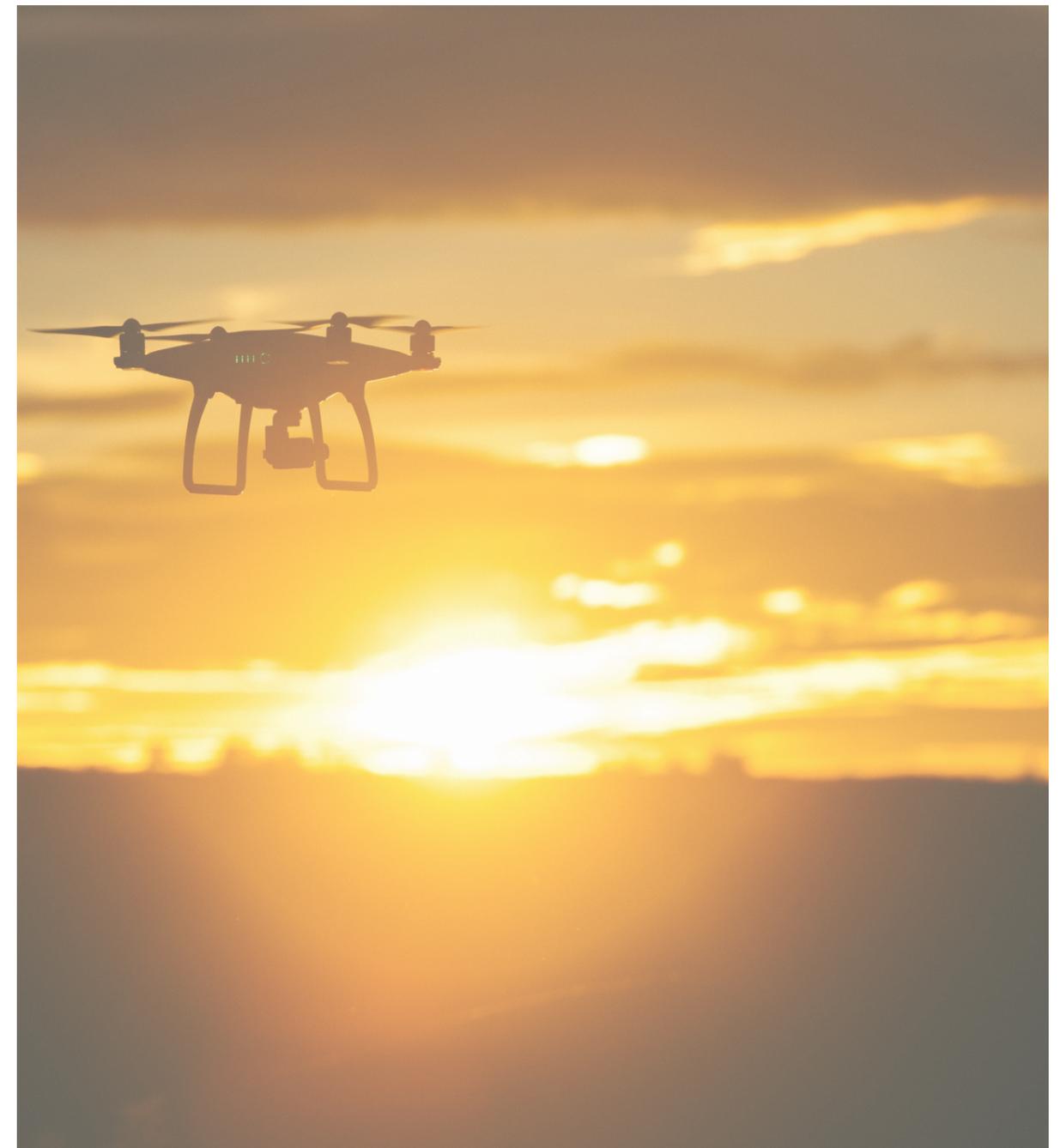
### ● Remote Tourism

People can now immerse themselves in far-away lands through the use of virtual reality and 360-degree media. “Aerial Virtual Reality: Remote Tourism with Drones“, a submitted manuscript published on IED by researchers from the University of St Andrews, UK, proposes a portable system for tourists to use drones as a remote control platform to implement remote tourism. In this system, tourists can hire drones provided by tourism operators and control the drone far away from home to experience the beautiful scenery through the

lens from drones. It can become a new way for disabled tourists to experience tourism more conveniently and make it possible for tourists to see places where they are not able to reach.

### ● Silence Drone

Drone noise can be very annoying and seriously affect the application of drones in tourism. To reduce the noise of drones, researchers have already designed new propellers and tried to use large, slow-spinning propellers but still could not avoid the whine of motors and the hum of propellers. Researchers in MIT are now trying to complete a new kind of entirely new propulsion system which they called “ionic wind”. The technology could offer a means of silently powering drones of the future, as well as being a potentially cleaner source of thrust for even larger aircraft. Although the tech is still a bit far from the application, there is already a bright future for mute drones.



## 5

## Recommendations

Findings	Recommendations
Public understanding of safety and privacy issues	<ul style="list-style-type: none"> <li>Develop Marketing campaigns to improve the drone image, clarify the misunderstanding of the unsafety of drones, develop a positive understanding of the capability and benefits of drone technology and promote the application of drones as a professional career or as a positive business opportunity.</li> </ul>
Limitation on existing drone application for commercial use	<ul style="list-style-type: none"> <li>Effective and efficient ways offered to certified operators and professional pilots to minimize time and costs in understanding the environment of flying commercial drone, for example, whether the public drone restricted airspace is active or not to commercial drones.</li> <li>Information panels should be set up to inform prominent stakeholders (companies and pilots) about the latest government grants, any legislation passed, future regulations, the updated temporary banning the use of drones in certain areas and any established opportunities that could help their businesses to expand or collaborate.</li> </ul>
Safety and security risks of drone	<ul style="list-style-type: none"> <li>Set up the pilot profile recording their location, length of flight, weather conditions, any crashes or unexpected landings, noise pollution complaint, wildlife habitats or aboriginal spaces disturbed and past training.</li> <li>Build up a standard process to check whether the commercial drone data and image meets licensing, privacy and environmental requirements.</li> <li>In some special areas, such as ocean and reserves, specific drone models designing with quieter, non-polluting and safer components could be certificated.</li> <li>Drone operators should be trained on suggested flight patterns which have lower impacts on wildlife and ecosystems.</li> </ul>

### Great opportunities of drone use in 4 main ways in tourism industry

- Discounts on the training fee if that kind of drone use is new to the region which aims to encourage the new use and develop the diversity of drones use in tourism industry.
- Collaborating with universities to do the feasibility study of certain drone use in specific regions, for example, use drone to find new attractions which could separate the Outback Queensland from other destinations; study what factors impact the experience when tourists participate in the current drone activities in Queensland tourism.
- Combine the features of drone use of other industry into tourism industry, such as instant delivery and virtual tour guide
- Amplify the role of drones as an attraction itself and apply it in current Queensland tourism activities, for example, drone racing in the appealing locations in Queensland or using drones to carry firework in the Brisbane Firework Show
- Making more use of user-generated drone videos of Queensland attractions and promoting these as well as producing 'professional' drone footage.
- Encouraging drone enthusiasts to share their destination footage in professional drone platforms or Queensland tourism related websites.

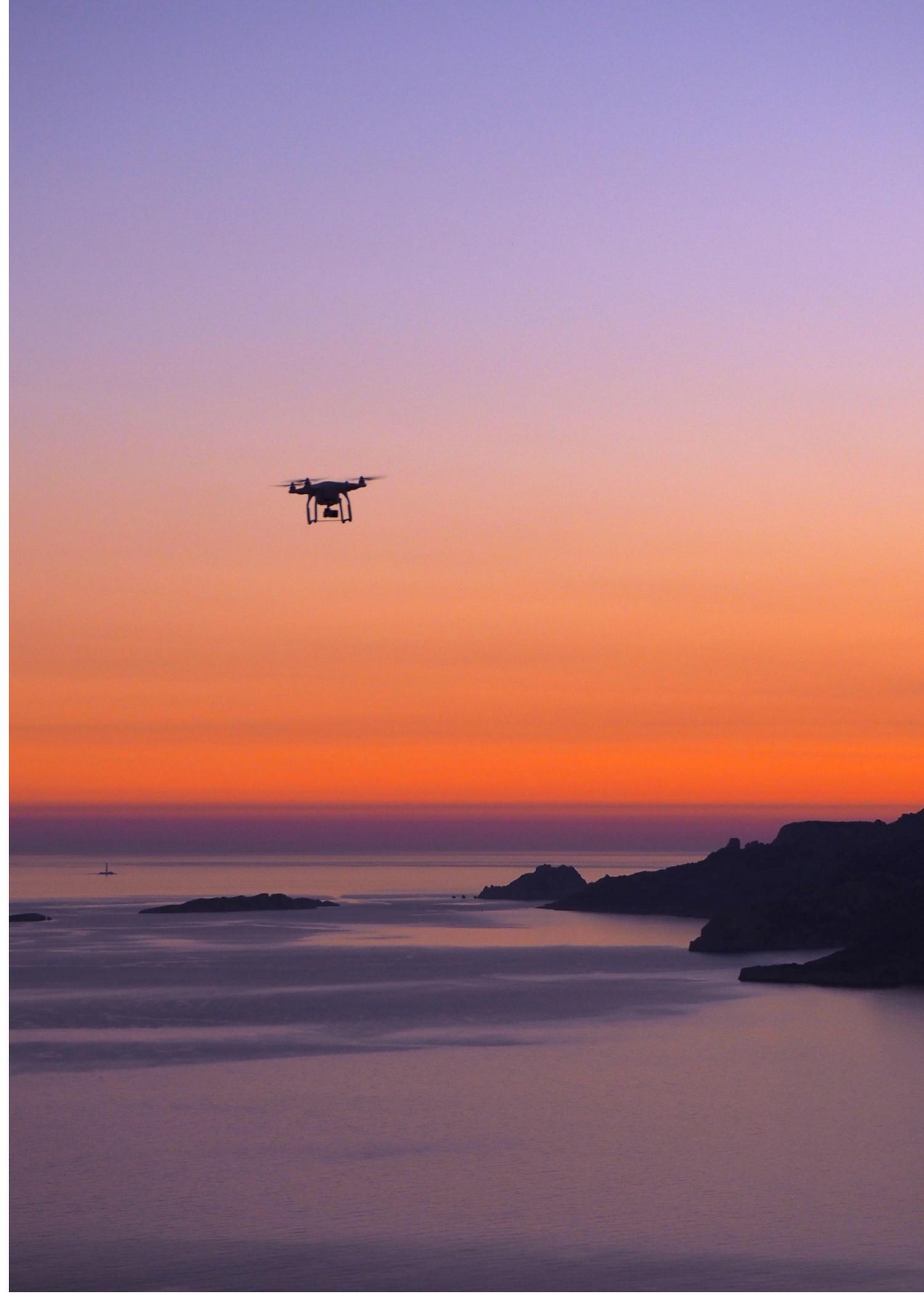
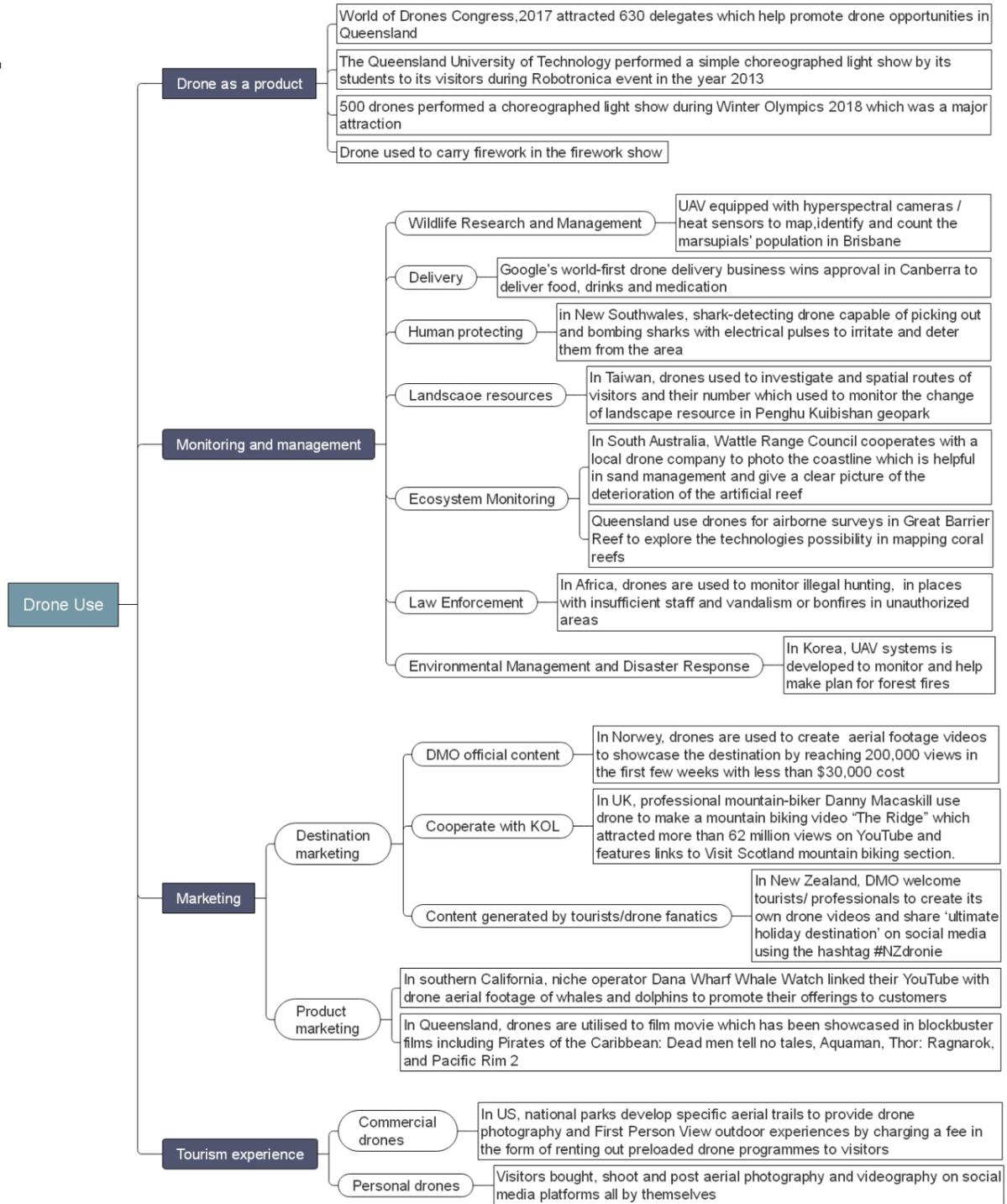
Table 7

### ► Possible projects (opportunities) for investment

1. Drone Remote tourism in outback Queensland.
2. Virtual Drone tour guide
3. Instant Drone delivery Project to help emergent rescue, or parcel delivery.
4. Drone Racing Events, which can act as a strong force for destination marketing.

# 6

## Appendix



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