Drones' Challenges to Public Safety

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http://www.rogerclarke.com/SOS/Drones-PSA{.html, .pdf}

Unmanned Aerial Systems Conference

Flinders University, Adelaide – 17 February 2014

Rogers Clarke "drones" in a flight of fantasy

Posted on February 13, 2014 by jay

http://commonsenseja.wordpress.com/2014/02/13/rogers-clarke-drones-in-a-flight-of-fantasy/

Agriculture ministry mulls drones to combat fish poachers

Thursday, February 13, 2014 13 Comments

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http://www.jamaicaobserver.com/news/Agriculture-ministry-mulls-drones-to-combat-fish-poachers_16027005

The Current Regulatory Framework

- **International**
  - Convention on International Civil Aviation aka the Chicago Convention
  - International Civil Aviation Organisation (ICAO)
  - No drone-specific provisions

The Current Regulatory Framework

- **National**, e.g. Australia
  - Air Navigation Act
    Air Navigation Regulations
  - Civil Aviation Safety Authority (CASA)

  - Civil Aviation Safety Regulations (CASR)
  - CASR 101-1 (UAVs) since 1998/2002
  - CASR-101-3 (Model Aircraft) since ditto

The CASA Regulatory Regimes

DETERMINATIVE FACTORS						
Controlled Airspace	√	–	X	X	X	X
> 150kg Fixed-Wing / 100kg Rotorcraft	–	√	X	X	X	X
< 150kg Fixed-Wing / 100kg Rotorcraft	–	X	√	√	√	√
Commercial Use	–	–	√	X	X	X
2-7 kg	–	X	X	X	√	X
< 2kg	–	X	X	X	X	√
APPLICABLE REGULATORY REGIME						
Full Regulatory Framework (CASR)	√	√	–	–	–	–
Limited Regulatory Framework (CASR 101-1)	–	–	√	–	–	–
Model Aircraft Framework (CASR-101-3)	–	–	–	√	√	√
(Emergent light regulatory scheme)	–	–	–	–	(√)	–
(Emergent even-lighter regulatory scheme)	–	–	–	–	–	(√)
Damage by Aircraft Act	√	√	√	–	–	–

The CASA Regulatory Regimes

- **Big Drones** are subject to Aircraft Rules:
  - Fixed-wing aircraft – >150kg
  - Rotorcraft – >100kg
- **Non-Big Drones** – a very light-handed regime
  But only outside controlled airspace, < 400ft,
  >3nm from aerodromes, > 30m from people
- **'Model Aircraft'** – a very light-handed regime
  But UAV cf. model aircraft is ambiguous
  (Non-commercial cf. hobby/entertainment use)

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Game-Changing Factors

- Substantial increase in capabilities
  - Payloads
  - Capacity to carry cameras
- Much more useful to business and government
- Much more attractive to consumers
- Much lower entry-points
  - Costs, Expertise, Effort

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  - Costs, Expertise, Effort
- Model Aircraft Clubs are no longer the venue
- Street Mentality (cf. remote-controlled model cars)

The Policy Response

- **Technology Assessment?**
  - Only Europe has TA Agencies
  - Only Norway has published anything
- **Risk Assessment?**
  - Little sign of corporate RA
  - No sign of society-level RA
- **Law Reform Commissions?**
  - Mention in an ALRC Privacy Study

<u>What</u> Policy Response??

Challenges

1. Airworthiness under Normal Conditions
2. Airworthiness under Challenging Conditions
3. Suitability for the Task
4. Noticeability and Detectability
5. Pilot Performance
6. Airspace Congestion
7. Electronic Congestion
8. Quality Assurance
9. Weaponisation
10. Loss of Human Control

1. Drone Survival Factors

- Awareness of Location, Attitude, Direction, Speed
- Sensors and/or Remote Data-Feeds in Real-Time
- Controls over Attitude, Direction, Speed
- **Drone Responsiveness to controls (Manoeuvrability)**
- Power for movement, controls, sensors, data-feeds
- Navigation to destinations in the operational space
- Situational Awareness within the operational space
- Navigation around obstacles (Collision Avoidance)
- Robustness e.g. cf. wind-shear and turbulence

2. Challenging Conditions

- **Aerodynamics** are affected by:
  - Extreme Weather – wind, precipitation, lightning
  - Aircraft Turbulence
  - Fire, Smoke and Heat
- **Line-of-Sight Visibility** is affected by:
  - Weather Events – cloud, ground-mist, precipitation
  - Landscape – land-form, vegetation
  - Human-Made Structures – buildings
- **Electronic Communications** are affected by:
  - **Weather Events – lightning**
  - **'Signal-Jamming', both accidental and intentional**

3. Suitability for the Task

- Ground Proximity
- Operations over water
- Operations at high-altitude
- Operations at night
- **Congested Airspace – inside buildings, forests, in built-up areas, near people, near other drones**
- Functions that require hover-time
- Flight along a pre-determined bearing
- Take-Off and Landing Constraints – obstacles above the ground (e.g. a tree-canopy), and at ground-level, competition for the available space

5. Pilot Performance

- Similar requirements to onboard piloting
- Boredom, interspersed with rapid, complex responses to often complex circumstances
- **Concentration / Distraction issues**
- **Data Availability and Quality issues**
- A 'computer games' mentality?
  A dulling of psych and social constraints?

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6. Airspace Congestion

- In controlled airspace, can drone pilots interact with ATC in the same way onboard pilots do?
- **Emergent congestion outside controlled airspace:**
  - Business Activities mostly in urban areas
  - Hobbyist Activities mostly in urban areas
  - **Surveillance targets cluster**
    Ground-traffic routes, Celebrities and notorieties, Tourism locations, Sports and entertainment events, Accident and crime scenes (the ghoul factor)
- Substantial absence of 'detect and avoid'
  Decision aids (proximity warnings)
  Decision-making tools (auto collision avoidance)

7. Electronic Congestion

- Intensive communications traffic
- Bandwidth competition from other sources
- Signal interference, accidental and intentional
- Airspace congestion implies electronic congestion

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Consequences

- Reliance on command- and data-feeds (e.g. GPS)
- Unreliability of feeds undermines control
- **Accidents to date appear to have been closely associated with communications failures**
- **How to define and implement 'fail-safe', 'fail-soft', 'fail-secure', 'fault tolerance', 'graceful degradation'?**

Challenges

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8. Quality Assurance
9. Weaponisation
10. Loss of Human Control

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The Sole Case Report found in AustLII Databases

Ogden, Contech Technical Services Pty Ltd v Unmanned Systems Asia Pacific (General) [2013] NSWCTTT 378 (30 July 2013)

CONSUMER, TRADER AND TENANCY TRIBUNAL
General Division

KEYWORDS: Breach of contract; fitness for disclosed purpose; reliance on skill and judgment; prior representations or arrangements before incorporation of company

91. The Tribunal finds that the contract referred to in paragraph 73 of this Decision was breached by the respondent. The product supplied to the applicant by the respondent did not have similar attributes as the Gatewing X100 in respect of its flight plan capabilities and its photographic triggering functions.

1. The respondent to refund to the applicant, within 21 days of the date of these orders, the sum of $29,675.00, being a refund of the purchase price of the following goods:

Lehmann Aviation LP960 (**UAV** , small) $27,000.00 ...

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Some Failures

- **First UK law enforcement use**
  Lost in the Mersey River off Liverpool (BBC 2011)
- **First Australian media use**
  Lost off Christmas Island (Corcoran 2012)
- **First US police-owned drone, in Texas**
  Crashed into a police vehicle (Biddle 2012)
- **In South Korea**, a drone crashed into its control truck, killing 1, and injuring 2 'remote' pilots (Marks 2012)
- **Micro-drone crashes in CBDs**
  Auckland (Mortimer 2012), Sydney (Kontominas 2013)

The Regulatory Response International

- ICAO started in 2005, but moves glacially
- ICAO treats 'model aircraft' and 'recreational uses' as being outside its scope
- A group called Joint Authorities for Rulemaking on Unmanned Systems (JARUS) emerged in 2013

The Regulatory Response
National

- CASA's response to drone accidents has been casual
- ATSB has shown little interest in drone accidents

- A CASA review began in July 2011
- Consultations have taken place with industry
- ?No Consultations with the affected public?
- Public information is very scant

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Nancy, France

- High school student Nans les Thomas buys a drone on the Internet, then uses it to film his (Michelin 3-star) city
- He posts the video on YouTube
- > 400,000 views in less than two weeks

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http://www.youtube.com/watch?v=Or_UBTvL5Rw

Nancy, France

- In France, drone use requires:
  - training similar to that of pilots; and
  - in urban areas, specific authorization
- He's been **summonsed**
  not for operating a drone without a licence
  but **for "endangering the life of others"**
- **He's pleaded that no-one told him about the law when he bought the drone**

http://www.lemonde.fr/societe/article/2014/02/14/un-lyceen-poursuivi-pour-avoir-filme-nancy-a-l-aide-d-un-drone_4366386_3224.html

Sydney, Australia

- Rhianna roadie, Edward Prescott, flies his drone from a wharf West of Circular Quay
- The drone control malfunctions
- It auto-redirects back to its point-of-origin
- **It hits two Sydney Harbour Bridge girders, lurches across 6 lanes, a few metres above traffic, hits another girder, crashes on a railway line**
- The next train-driver stops and picks it up
- A Naval event is in progress
- Prince Harry is in town
- International coverage follows (London, Milan)

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http://www.smh.com.au/nsw/mystery-drone-collides-with-sydney-harbour-bridge-20131004-2uzks.html

http://www.liveleak.com/view?i=661_1385456831

Sydney, Australia

http://www.smh.com.au/technology/sci-tech/i-dont-know-whether-its-a-bomb-or-not-train-driver-flummoxed-after-drone-hits-sydney-harbour-bridge-20131126-2y76m.html

http://www.liveleak.com/view?f=dccca42c2905&ajax=1&player_width=512&player_height=384&iframe=true&width=550&height=420

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Sydney, Australia

- **The Police give him back his damaged drone**
- He posts the video it had captured on the Web

CASA provides some quotes to the media (period):

- "There are regulations and fines attached ... of hundreds of dollars"
- "[Drone pilots] must keep them at least 30m away from any people, buildings or structures"
- "Airspace around the Harbour Bridge is restricted"
- **"Check with local council where they can be used"**

http://www.smh.com.au/nsw/mystery-drone-collides-with-sydney-harbour-bridge-20131004-2uzks.html

Drones' Challenges to Public Safety

Agenda

- The Current Regulatory Framework
- The Policy Response
- Drones' Challenges to Public Safety
  - 10 Topics
  - But Few Cases, Yet
- The Regulatory Response
  - International
  - National

    Over-Reaction vs. Under-Reaction

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Series of Papers in CLSR 30, 3 (Jun 2014)

- **Understanding the Drone Epidemic**
  http://www.rogerclarke.com/SOS/Drones-E.html
- **What Drones Inherit from Their Ancestors**
  http://www.rogerclarke.com/SOS/Drones-I.html
- **The Regulation of Civilian Drones' Impacts on Public Safety (with Lyria Bennett Moses)**
  http://www.rogerclarke.com/SOS/Drones-PS.html
- **The Regulation of Civilian Drones' Applications to the Surveillance of People**
  http://www.rogerclarke.com/SOS/Drones-BP.html
- **Drones' Challenges to Public Safety**
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