Use of UAS in Transportation Operations

Anil K. Agrawal, Camille Kamga, Ehssan Hoomaan and Bahman Moghimi

The City College of New York
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Disclaimer

The materials in this presentation discuss general procedures about the use UAS / Drones and don’t represent procedures and policies of the New Jersey Department of Transportation.

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UAS/UAV/DRONE DEFINITION:

NJ Stat § 2C:40-27:

- An unmanned aircraft means an aircraft that is operated without the possibility of direct human intervention from within or on the aircraft.
- Unmanned aircraft system (UAS) means an unmanned aircraft and associated elements, including communication links and the components that control the unmanned aircraft, that are required for the pilot in command to operate safely and efficiently.
- Consistent with FAA definition of UAS.

Small Unmanned Aircraft Vehicle

Why Use UAS?

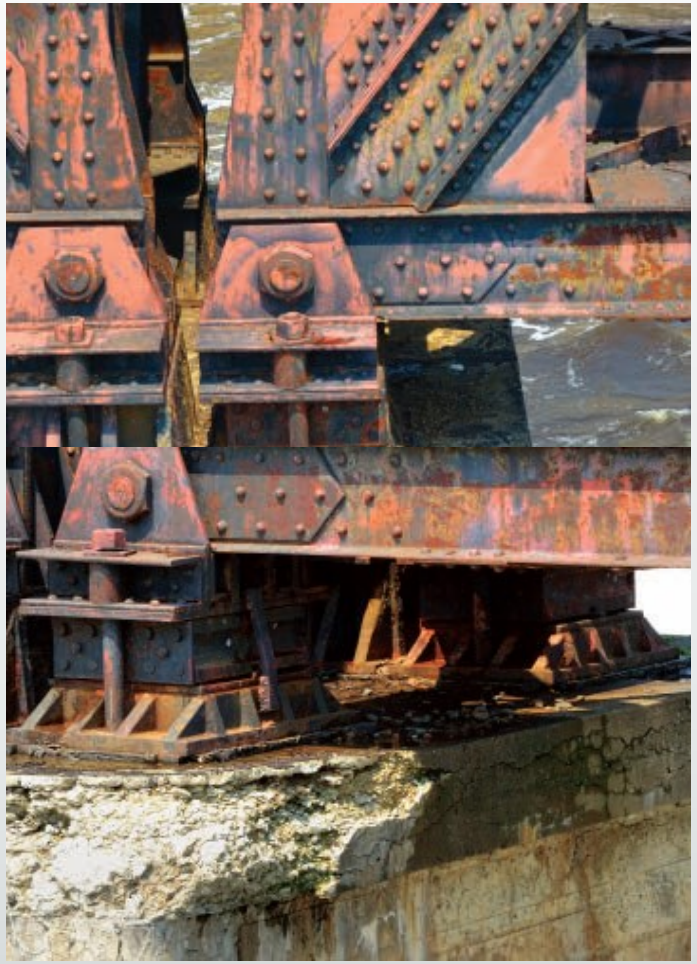
- They can be deployed on demand.
- They have flexibility in tasking: e.g., surveillance, disasters,
- They have “plug and play” capabilities for their payloads, making tailored systems possible.
- They can support high-resolution imagery or sensors.
- They can cover remote areas
- They can be designed to access areas generally inaccessible by human inspectors.
- They can be used to transport small payloads.


NEW JERSEY DEPARTMENT OF TRANSPORTATION
UAS Program

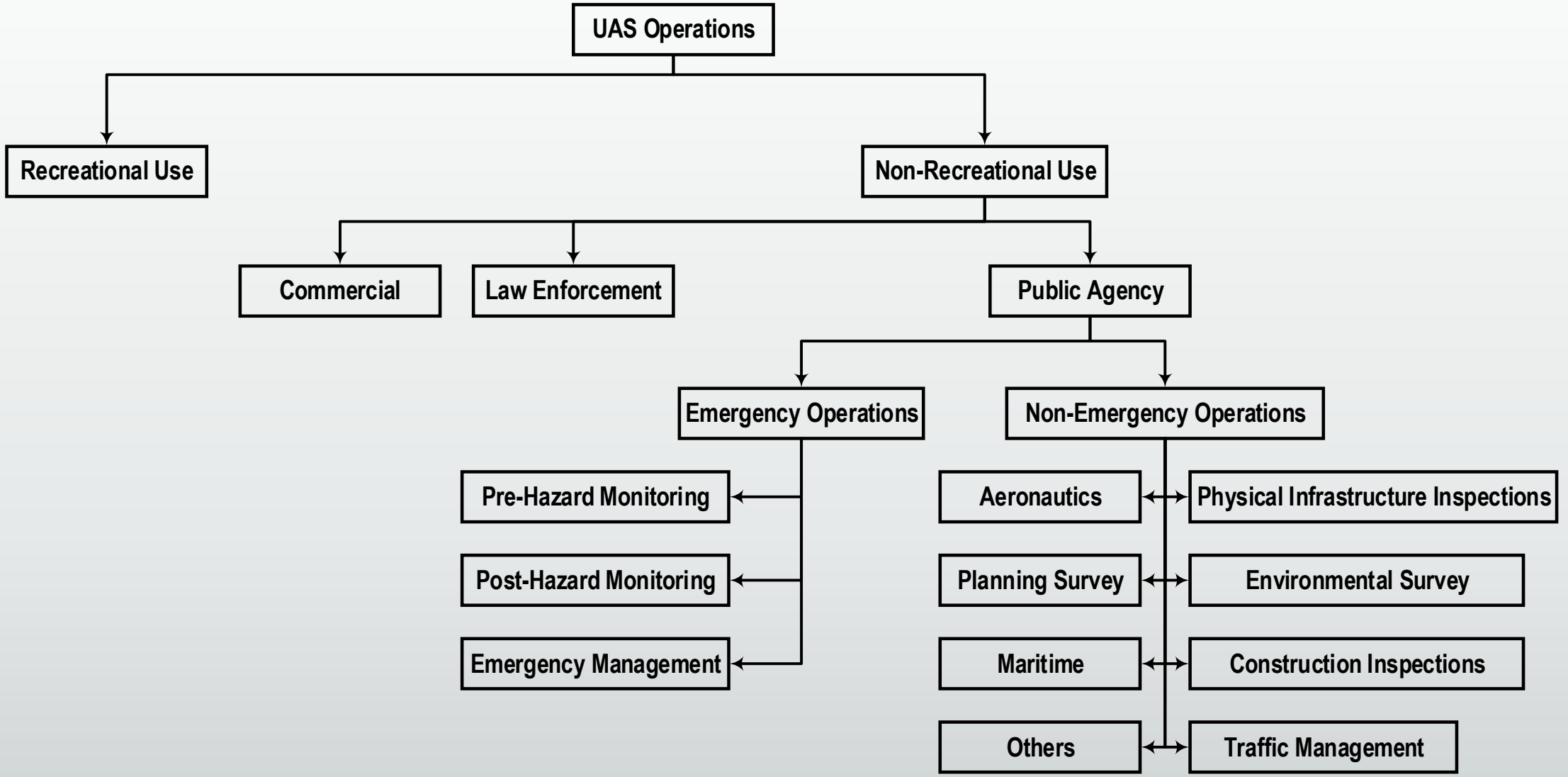
BRIDGE INSPECTION

BRIDGE INSPECTION

CHALLENGES IN BRIDGE INSPECTION USING UAS



USE OF UAS BY TRANSPORTATION AGENCIES



UAS Operations in Transportation

1. Bridge Inspection	2. High Mast Light Pole Inspection
3. Traffic Management	4. Crash Scene Documentation
5. Emergency management	6. Identify areas of large potholes or longitudinal joints that are separating.
7. Identify areas of litter or vegetation needs	8. Periodical assessment of performance by crews on the job. Live.
9. Check for flooding post storm or drainage issues pre storm	10. Monitor pre winter storm brine spreading.
11. Monitor during storm; position of resources. If possible?	12. Bridge scouring monitoring post storm.
13. Better identify vegetation in need of spraying during spring campaigns to stop vegetation spread	14. Identify center barrier hits and guiderail hits.
15. Drainage outfall inspections.	16. Normal, IR or thermal images of concrete surfaces to identify spalling.
17. Inspection or Drainage outfalls.	18. Confirming Straight Line Diagram (SLD) accuracy
19. Assisting in installation mark outs (for signs, etc.)	20. Addressing/observing drainage areas that are not easily accessible
21. Observing traffic back-ups and queue lengths behind highway incidents	22. Use drones to get photos of Department events (internal or external) such as press conferences.
23. Investigate 5010 Obstacle Mapping	24. Aerial Site Surveys
25. Observing queue lengths to provide a qualitative assessment of congested interchanges.	26. Providing cheap aerials to discuss existing conditions and fly overs of corridors for existing conditions/concept development.
27. Record intersections with high volumes and turning movements to really understand what's happening at difficult locations.	28. Parking studies – surveying parking lots and counting spaces
29. Post-disaster inspections of hard-to-reach areas and facilities	30. Search for missing boats and/or boaters/dropping life-saving devices
31. Photography/video for reports and studies/aerial cityscape videos and pictures	32. Inspections of railroad tracks
33. Real-time construction project updates	34. Real-time on the ground conditions of roadways and land use sites
35. Scoping out potential rights-of-way	36. Assisting in cartography/GIS production
37. Surveys for determining transit station center points or location of development footprints inside or outside of a Transit Village	38. Sending consultant packages back and forth

Bridge Inspection by UAS

Key Advantages

- High resolution photogrammetry
- Ease of access
- Inspection using tools such as Infrared cameras
- Possibility of automated crack mapping using complex algorithm
- Automated bridge inspection report generation
- Rapid post-hazard assessment, such as inspection during hurricanes

Challenges

- Hands on inspection
- Direct use of NDE technology
- Under deck inspection

CURRENT NEW JERSEY REGULATIONS APPLICABLE TO UAS

- NJ Stat § 2C:18-3 (Trespassing)
- NJ Stat § 2C:14-9 (Invasion of Privacy)
- NJ Stat § 2C:40-27 (Definitions relative to operation of unmanned aircraft systems)
- NJ Stat § 2C:40-28 (Violations, degree of offense, crime)
- NJ Stat § 2C:40-29 (Provisions preempt existing laws)
- NJ Stat § 2C:40-30 (Authorized use permitted)
- NJAC 7:25-5.22 (Wild animals; possession, killing)

PART 107 REGULATIONS ON DRONE OPERATION

- Unmanned aircraft must weigh less than 55 lbs. (25 kg).
- Visual line-of-sight (VLOS) of RIPC or VO only
- Maximum altitude of 400 feet above ground level (AGL)
- Minimum weather visibility of 3 miles from control station.
- UAS may not operate over any persons not directly participating in the operation
- Daylight-only operations, or civil twilight
- Must yield right of way to other aircraft.

PART 107 REGULATIONS ON DRONE OPERATION

- May use visual observer (VO)
- Maximum groundspeed of 100 mph (87 knots)
- No person may act as a remote pilot in command or VO for more than one unmanned aircraft operation at one time
- No operations from a moving aircraft.
- No operations from a moving vehicle unless the operation is over a sparsely populated area.
- No carriage of hazardous materials.

UAS OPERATIONS CONCERNS IN TRANSPORTATION

- Privacy and Data Management
  - Privacy invasion
  - Data collection and storage policy
- Safety Management System
  - Risk assessment
  - Risk mitigation
  - Safety assurance
- Qualification and Training
  - Qualification tracking
  - Periodical training
- Operational Requirement and Control

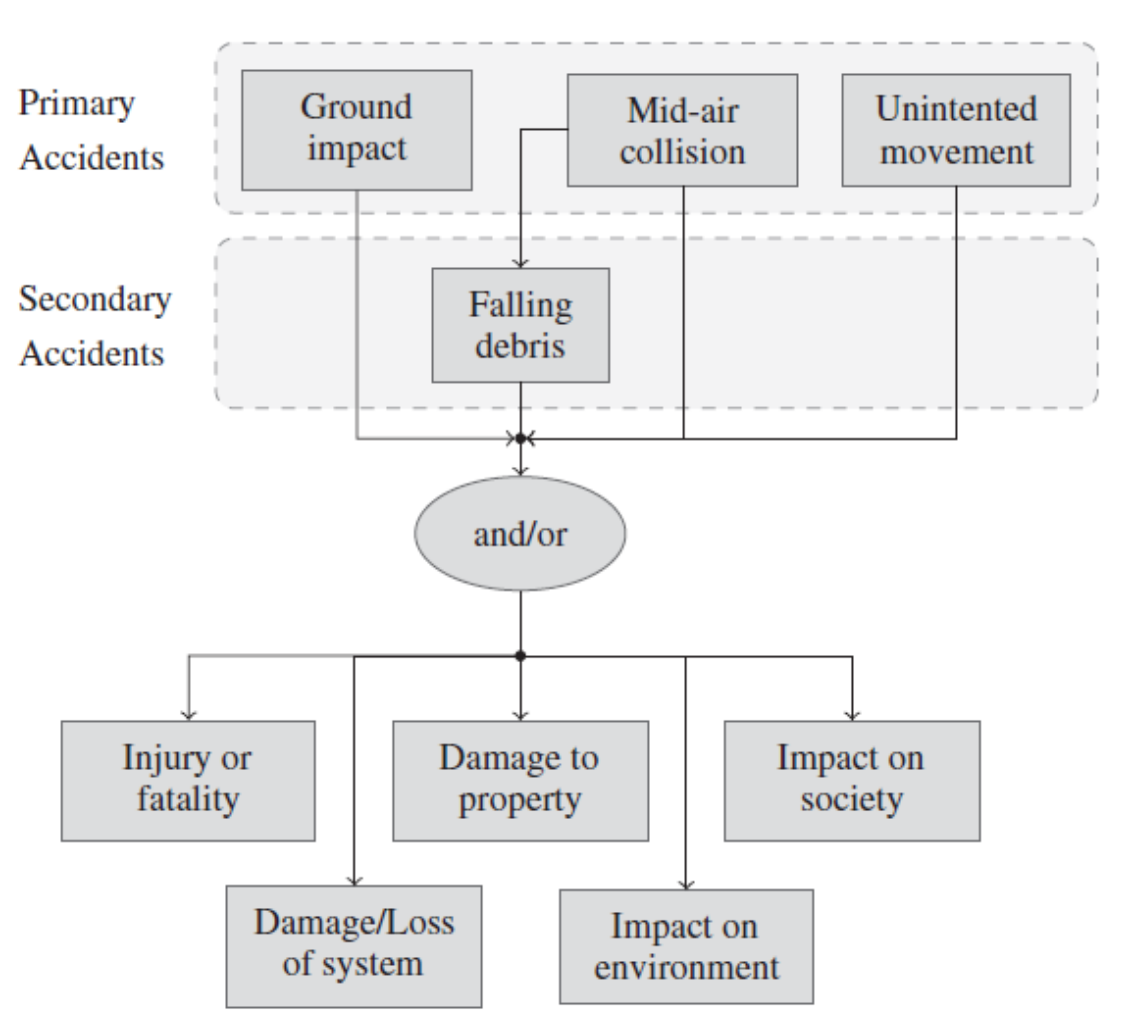
PRIVACY AND DATA MANAGEMENT

- Consent
  - Flying over private properties
  - Emergency situations
- Data Collection
  - Identifiable feature
  - Specific to mission purpose
- Data Management
  - Open Public Records Act (OPRA)
  - Acceptable Use of Data policy of New Jersey
  - Destruction of Public Records Act, N.J.S.A. 47:3-15

PRIVACY AND DATA MANAGEMENT

- Critical Infrastructures
  - Definition of Critical Infrastructures
  - Federal definition per 2339D of Title 18, United States Code
  - Local definition
  - Examples:
    - Gas and oil production, storage, or delivery systems
    - Water supply systems
    - Telecommunications networks
    - Electrical power generation or delivery systems
    - Financing and banking systems
    - Emergency services (medical, police, fire, and rescue services)
    - Transportation systems and services (highways, mass transit, airlines, and airports)

Potential Risks during UAS / Drone Operations



SAFETY MANAGEMENT SYSTEM

Risk Management Procedure (RMP)

- Hazards Identification
- Risk Assessment
- Risk Mitigation

Hazards

- Weather
- Terrain / Obstacles
- Multiple UAS operations
- Crew Fatigue
- Complex High Density Airspace
- UAS Engine Failure
- Lost Link Event

RISK ASSESSMENT

Likelihood	Detail	Value
Frequent	Likely to occur many times or has occurred frequently ("five times during operation")	A
Occasional	Likely to occur many times or has occurred frequently ("Every second operation")	B
Remote	Unlikely to occur, but possible or has occurred rarely ("I know it from some events")	C
Improbable	Very unlikely to occur or not known to have occurred ("it happened once and I heard about it from other operator")	D
Extremely improbable	Almost inconceivable that the event will occur ("never happened")	E

Severity	Customized Detail	Value
Elevated	Serious injury or death to people; Drone, equipment or buildings destroyed	IV
Moderate	Injury to persons; Further operation not possible without major adjustments	III
Marginal	Minor incident to persons; Minor effect on system performance	II
Negligible	No injury to persons; Minor consequences on system	I

RISK ASSESSMENT MATRIX

	Severity			
Likelihood	**Negligible IV**	**Marginal III**	**Moderate II**	**Elevated I**
Frequent A				
Probable B				High 4
Occasional C			Serious3	
Remote D		Medium 2		
Improbable E	Low 1			

MITIGATION

- Weather
  - Semi-annual training
  - WX mitigation policies in flight operation manual
  - Standard Operating Procedures
- Terrain / Obstacles
  - Site Survey
  - Obstacle Map / Drawing
- Multiple UAS operations
  - Marked A/C Operation areas
  - Use of visual observers
  - Assumed Responsibility for Separating UAS from other air traffic

MITIGATION

- Crew Fatigue
  - Fatigue management program
  - Duty Day limitations
  - Rest requirements
- Complex High Density Airspace
  - Controlled / uncontrolled airspace
  - UAS Geo-Fencing
  - Standard Operating Procedures and training
- UAS Emergencies / Contingencies
  - Minimum Launch / alternate landing sites
  - Emergency brief by RPIC on every flight
  - Yearly open and closed book emergency procedures exam

RISK ASSESSMENT MATRIX

DATE	MISSION/FLIGHT PURPOSE	N-NUMBER	UAS TYPE	NJDOT DIVISION

REMOTE PILOT-IN-COMMAND	VISUAL OBSERVER	COA/PT 107

Mission #	FREQUENCY	AIRSPACE CLASS

*Weather briefings will be obtained and provided for inspection before flight operations.

Select an applicable risk from drop-down list, and read the totaled score below.

WEATHER*			TERRAIN		
ITEM	VALUE	SCORE	ITEM	VALUE	SCORE
CEILING (FT) Minimum 1000'	>1000	1	LAUNCH/RECOVERY SITE	FAMILIAR	1
VISIBILITY (SM) Minimum 3 miles	>3	1	OPERATIONS AREA	FLAT	1
WINDS (KTS) + 1/2 Gust	<5	1	POPULATION	RURAL	1
RAIN/SNOW	MIST	1	COMPLEX AIRSPACE (TRAFFIC,	N/A	0
THUNDERSTORMS	NONE	1			
LOW LEVEL WIND SHEAR WITHIN 10MI	A	5			
TEMPERATURE (Degrees F°)	30-90	1			
DENSITY ALTITUDE (FT)	0-1999	1			
*FLIGHTS ARE NOT AUTHORIZED WHEN T-STORMS AND/OR LIGHTNING ARE OBSERVED WITHIN 5 MI OF OPERATIONS AREA.					
CREW EXPERIENCE			**CREW REST/DUTY DAY**		
ITEM	VALUE	SCORE	ITEM	VALUE	SCORE
RPIC EXPERIENCE	EXPERIENCED >30	1	HOURS OF REST	>10	1
CREW CURRENCY(DAYS)	<90	1	LENGTH OF DUTY DAY	<12	1
CREW MISSION	PROFICIENCY	1			
MISSION			**EQUIPMENT/AIRCRAFT**		
ITEM	VALUE	SCORE	ITEM	VALUE	SCORE
TIME OF DAY	DAY	1	AIRCRAFT	FULL MC	1
OPERATING OVER WATER	WITHIN GLIDE	1			
OPERATING FROM A BOAT	A	1			
FLIGHTS PLANNED	N/A	0			
MISSION COMPLEXITY	N/A	0			
ELECTRICAL INTERFERENCE	N/A	0			
OPERATING OVER TRAFFIC	N/A	0			
ANY FACTOR RATING '3' OR HIGHER, ADEQUATE CONTROL MEASURES MUST BE DOCUMENTED AND PROVIDED TO SUPERVISOR.					

QUALIFICATION AND TRAINING

FAA General Requirements:

- Minimum 16 years old
- English reading, speaking and listening skills
- Medical condition to safely operate a small UAS
- Passing aeronautical knowledge exam (every two years)

Potential Specific Training Requirements:

- Phase 1
  - FAA Remote PIC Certification
- Phase 2
  - Practical training including weather condition check, preflight checklist, inspection, mission brief, landing, camera control, log book, taking photos, hands on flight maneuvers
- Phase 3
  - Mission Specific / Solo, includes practice flight

OPERATIONAL REQUIRMENT AND CONTROL

- Operations near Aeronautical Facilities
- Crew Members Effective Communication
- Temporary Flight Restrictions
- Mission Planning
  - MISSION-GENERAL
  - MISSION-SPECIFIC
  - SAFETY PROTOCOLS
  - EMERGENCIES
  - OPERATIONAL REQUIREMENTS
  - MISSION DEBRIEF
- Launch and Recovery Sites Selection

CONCLUSIONS

- Operation of UAS / drones for infrastructure inspection quite complex and requires detailed procedures on safety, security and data management.
- Still numerous challenges in successful application of the technology for inspection of bridges.
- Allows for rapid assessment / monitoring of large number of transportation operations.
- UAS / drones procedures for NJDOT currently in progress and is expected to be available by May 2019.