

**EXPONENT**  
TECHNOLOGY SERVICES



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# UAS Training Curriculum

## Multicopter and Fixed Wing

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# Exponent Profile

## **Company Ownership/Legal Entity**

Exponent Technology Services, LLC is a UAE based Information services provider that specialises in helping firms develop asset management and tracking solutions. Its USP revolves around its ability to provide bespoke solutions in areas where others dare to tread. Exponent's philosophy is rooted in the ethos that any problem is surmountable given the correct and intelligent application of technology. Beginning with our roots in developing RFID and barcode-based solutions - we have now embraced the use of (Unmanned Aerial Vehicles (UAS) and their ability to integrate auto-ID technologies to provide a unique set of mission capabilities that were previously not possible or even envisioned.

## **Location**

Exponent was founded in Dubai in 2012 and soon opened offices in Montreal (2014) and Boston (2016) to support its growing customer base. Head Office, Middle East Regional Support & Business Development and Research and Development functions are based out of Dubai, North America Customer Support from Montreal and North America Business Development is handled by the Boston office. Plans include the opening of Brussels and Singapore offices in 2016.

## **Products and Services**

Our products and services revolve around the development of bespoke solutions aimed at providing organisations with asset tracking capabilities. We also provide management consultancy and help organisations understand their current needs and ability to adopt various technologies to meet those needs. Our services also extend into system development, implementation and outsourcing. We are focused on helping organisations comprehend what is where and when and to improve their bottom line via the reduction of non-value-adding activities. We are technology-neutral and have no specific bias towards particular platforms or vendors. Our approach is to understand our customers first and then to join them with the technologies that are a best fit for their current organisational cultural state. We believe that change must never be forced but must be embraced in order to breed successful outcomes.

## Industry Verticals

Exponent does not like to see itself as industry focused but more as industry spread - we like to see our solutions applied across a wide range of enterprises - proving not only the adaptability of our solutions but also of our skills. To date we have the following implementations either complete or underway:

- Waste Management in Chicago, USA
- Steel Tracking in Dubai, UAE
- Aviation Parts Tracking in Dubai, UAE
- Power Utilities in Dubai, UAE
- Port Surveillance in Dubai, UAE
- Infrastructure Inspection in Boston, USA
- RPAS Tracking Services in Singapore
- Presentation overviews of our Waste Management, Healthcare, Aviation Parts Tracking and Steel Tracking Solutions are provided under separate cover.

## Exponent Team

Exponent's core strength is its people. Our ability to analyse problems and design bespoke solutions is unparalleled in the region. Our speed of execution is also a source of pride. From problem statement to prototype to production, our team of dedicated professionals moves swiftly to provide exceptional technical skills and value.

Exponent Dubai consists of 6 software professionals with skills across the breadth of technology including the latest move towards mobile applications; Our UAS team includes 6 engineers (3 Mechanical and 3 Electrical Payload specialists) and a UAS Manager with over 10 man-years of experience in UAS design and builds activities. Both groups (Software and UAS) are supported by 2 full time project managers who provide critical management support in helping coordinate activities not only internally but on behalf of our clients as well. Senior Management at Exponent consists of a Chief Executive Officer, Chief Operating Officer, Chief Technology Operator and Business Development Director who also serves to head our Montreal Office in charge of North American Business Development activities.

Our US and Canada based offices are focused on Customer support and Business Development. We are also in the final stages of establishing partnerships with Singapore and Belgium based entities to represent and market Exponent's unique breed of UAS and RFID based technologies.

## **Research & Development**

Exponent is fully committed to providing its staff with the resources needed to invest their time in researching and developing new solutions, products and services. Our UAS based RFID Inventory tracking solution grew out of this program - and has been nominated by RFID Journal as the Most Innovative Use of RFID for 2014. A link to RFID Journal's article on Exponent's pioneering use of UAS with RFID technology can be found at <http://www.rfidjournal.com/articles/view?12209/>. Exponent's client Age Steel secured second prize for most Innovative Use of RFID - where the winner was NASA. We consider a matter of pride that our innovations helped contribute to our client's nomination against such strong competition - <http://www.rfidjournal.com/articles/view?12779>.

Exponent dedicates a full 30% of its annual budget to R&D activities, which includes not only the provision of hardware for prototype activities, but also a dedicated budget for training for each staff member to use at their discretion. Exponent is currently in advanced discussions with two leading UAE based educational institutes for establishing fully funded laboratories that will be managed by Exponent and provide a cadre of upcoming engineers and technologists access to industry problems involving UAS and RFID technologies to solve.

Our current research areas include:

- UAS based traffic monitoring

- Micro UAS and inter-UAS networking and communication protocols
- UAS operational protocols for urban environments
- UAS collision detection and avoidance technology
- UAS based monitoring of RFID tagged assets
- Enhanced/Optimised Power management in UASs for increased endurance
- New UAS propulsion technologies (laser ionisation and electromagnetic acceleration)

Innovative solutions that we have developed over the past 2 years include:

- The use of UAS to detect faults on solar panels deployed in solar arrays using a combination of RFID (to detect panels uniquely), Infra-red (IR) sensors to detect temperature fluctuations between cells within a panel and air compression technology to provide a reliable and environmentally friendly means of cleaning solar panels.
- The use of UAS based RFID sensors to accurately locate and identify over 1000 individual bundles of steel products spread over a 10,000 square meter yard in under 6 minutes with a 99.2% accuracy rate. A video presentation of the solution can be found at <http://exponent-ts.com/autonomous-tracking.html>.
- UAS based IR sensors to detect methane pocket build up in landfills - that help direct maintenance personnel towards appropriate locations to drill wells to relieve pressure build up.
- UAS based traffic monitoring system (currently under development) - to help detect and report on vehicle incidents and provide a means of performing video analytics in-flight to provide traffic statistics for key city intersections and highway traffic.
- UAS based window-cleaning mechanism (currently under development) that utilises RFID to identify specific windows and the area to be cleaned. The encoded RFID data then provides specific guidance control to the UAS flight controller to initiate a flight hover pattern to allow the UAS to clean windows.
- UAS tracking technology based upon cellular 3G networks to enable a centralised tracking capability of multiple drones within a particular defined zone of operations with SMS alert capabilities & optional 4G live HD video broadcast capability.

All of Exponent's UAS platforms are custom built to industrial standards, tested rigorously prior to any commercial deployment and are not to be compared with commercial grade UAS systems currently available for sale. Exponent's UAS systems are built for extreme safety and incorporate multiple redundant systems to provide an extremely high level reliable and safety. Additionally, all our UAS incorporate a flight system data logging capability that streams data live back to our control center for continuous monitoring and fault detection.

# UAS Training Curriculum



## Scope

The scope of the Curriculum is to impart the necessary knowledge to the trainee to conduct the UAS (Unmanned Aerial System) operations safely and within the rules and regulations pertaining to the UAE. This would involve the understanding to the basics about the UAS, principles of flight, aerodynamic forces acting on the UAS, the functionalities of the major components of the UAS, the ability to plan and fly the UAS while performing different manoeuvres, pre-flight and post-flight procedures, emergency/fail safe procedures and understanding of the regulations laid out by the authorities in UAE.

## Training Curriculum

The course is divided into two main sections, Ground School and Flight School.

The **Ground School** covers the theory part of the UAS. Ground school training is primarily theoretical in nature and is composed around class room sessions whereby instructors are required to engage trainees via presentation materials and open discussions.. This includes the introduction to the UAS, the principles of flight, the functionalities of the major components, aviation weather, UAS procedures and the rules and regulations pertaining to UAE.

The **Flight School** includes the simulators and flight training. The simulators help to develop the correct techniques and motor skills to control the UAS while in flight. simulator and Flight training is more “hands-on” and requires direct application of the knowledge gained in real life situations where timing can often be critical. In Flight training , the pilot will fly the UAS and incorporate a series of drills and manoeuvres that aim to assess the trainee’s ability to safely operate a UAS to acceptable standards.



The syllabus itself aims to develop the required proficiencies to allow UAS pilots to demonstrate a higher level of competence and accountability in all their UAS related planning and operations. The curriculum includes a staged assessment program, whereby each phase of the training imparted is assessed against benchmarked standards and progression is dependent upon satisfactorily demonstrating the necessary skills. This approach is adopted with the aim of maintaining enthusiasm and interest while also allowing trainees to directly apply their knowledge.



Exponent Technology Services provides UAS (drone) training course and certification for various operators. Please find the curriculum details for the various training courses:

## Hobbyist Level UAS Certification

The Hobbyist level UAS Certification is for operators who are planning to fly their UAS for recreational purposes only. The duration of the course is about 3 hours. The Hobbyist Level Training Curriculum includes:

### A. UAS Ground School Course:

1. Introduction to UAS
2. Principles of Flight
3. UAS Components
4. UAE Air Law, Principles and Definitions, and Classification
5. Final Assessment for Ground School

### B. UAS Flight School Course:

1. UAS flight training in GPS/Optical mode
2. UAS SOP (Standard Operating Procedure); Pre-flight, In-flight and Post-Flight
3. Final Assessment for Flight School

Note: The UAS flight training is conducted using DJI Mavic Pro and the all flights are conducted in GPS/Position Mode.

## Commercial Level UAS Certification

The Commercial level UAS Certification is for operators who are planning to fly their UAS for Commercial purposes. The duration of the course is for 2 days. The Commercial Level Training Curriculum includes:

### A. UAS Ground School Course:

1. Introduction to UAS
2. Principles of Flight
3. UAS Components
4. UAE Air Law, Principles and Definitions
5. UAE Air Law, Classification
6. UAS Ground Station and Payload
7. Aviation Weather (Understanding weather phenomenon, Standard aviation weather reports, UAS operational limits in adverse weather, Decoding standard aviation weather reports for UAS flight planning)
8. Final Assessment for Ground School

### B. UAS Flight Simulator Course:

1. Advanced UAS flight simulator training in GPS mode
2. Advanced UAS flight simulator training in ATTI mode (non-GPS mode)
3. Final Assessment for Simulator

### C. UAS Flight School Course:

1. Advanced UAS flight training in GPS mode
2. Advanced UAS flight training in ATTI mode (non-GPS mode)
3. Emergency protocols and Manoeuvres
4. UAS SOP (Standard Operating Procedure); Pre-flight, In-flight and Post-Flight
5. Final Assessment for Flight School

The UAS flight training is conducted using Phantom 4 Pro or higher drones. The training flights are conducted in GPS/Position mode as well as ATTI (non-GPS mode)

## Professional Level UAS Certification

The Professional level UAS Certification is for operators who are planning to fly their UAS for commercial purposes. The course includes the training of the operator on Multirotor as well as Fixed Wing. The duration of the course depends on the type of the training and the proficiency of the pilots. The Professional Level Training Curriculum includes:

### A. UAS Ground School Course:

1. Introduction to UAS
2. Principles of Flight
3. UAS Components
4. UAE Air Law, Principles and Definitions
5. UAE Air Law, Classification
6. UAS Ground Station and Payload
7. Aviation Weather (Understanding weather phenomenon, Standard aviation weather reports, UAS operational limits in adverse weather, Decoding standard aviation weather reports for UAS flight planning)
8. Final Assessment for Ground School

### B. UAS Flight Simulator Course:

1. Advanced UAS flight simulator training in GPS mode
2. Advanced UAS flight simulator training in ATTI mode (non-GPS mode)
3. Final Assessment for Simulator

### C. UAS Flight School Course:

1. Advanced UAS flight training in GPS mode
2. Advanced UAS flight training in ATTI mode (non-GPS mode)
3. Emergency protocols and Manoeuvres
4. UAS SOP (Standard Operating Procedure); Pre-flight, In-flight and Post-Flight
5. Final Assessment for Flight School

The training flights are conducted in GPS/Position mode as well as ATTI (non-GPS mode)

## Proficiency Criteria

For Ground School assessment, the trainee will have to sit through a test. The test will have multiple choice questions. The number of questions depend on the level of training (Hobbyist or Commercial). The trainees will be scored accordingly. The pass percentage is 70%. The trainee has to answer at least 70% of the questions correctly to pass the ground school.

For Flight School assessment, the Instructor will ask the trainee to perform the demonstrated and practiced manoeuvre 3 times and will score the trainee on a scale of 1 to 5. An average score for the 3 manoeuvre attempts will be calculated and recorded and will be shared with the trainee. Trainees will continue practicing a manoeuvre until they can demonstrate an average score of 3 or higher.



# Sample Manoeuvre Procedure Sheet



## Session 02

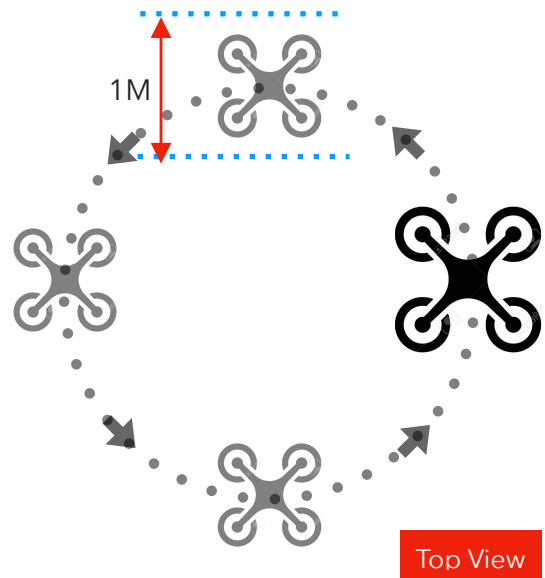
Type	Platform	Manoeuvre
GPS - Flight	Multi-Rotor	Circle (CCW) - Pitch and Yaw

### Pre-requisite skills

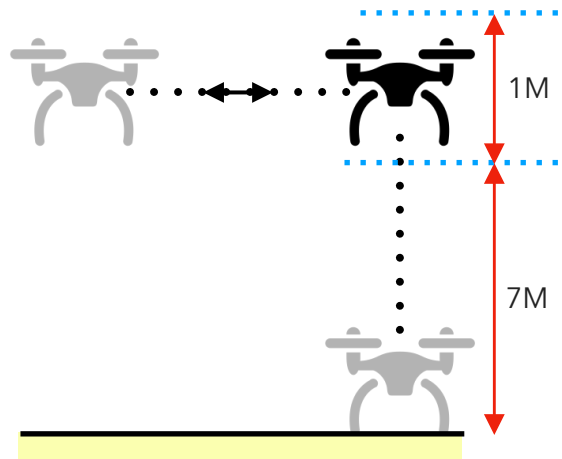
Turn on procedure of the drone.  
 Insight about Throttle, Pitch, Roll, and Yaw. Hovering of the drone.

### Description of the manoeuvre

The drone has to track a path of a circle of suitable dimensions in the anticlockwise direction at an altitude of 7 metres. The drone has to traverse the path using **pitch** and **yaw** only while stopping at the start/end point.



Top View



Pilot View

### Proficiency Standards

Altitude Stability	+ / - 1 metre
Path Accuracy	+ / - 1 metre
Time Duration	2 minutes

# Sample Manoeuvre Procedure Sheet



## Session 03

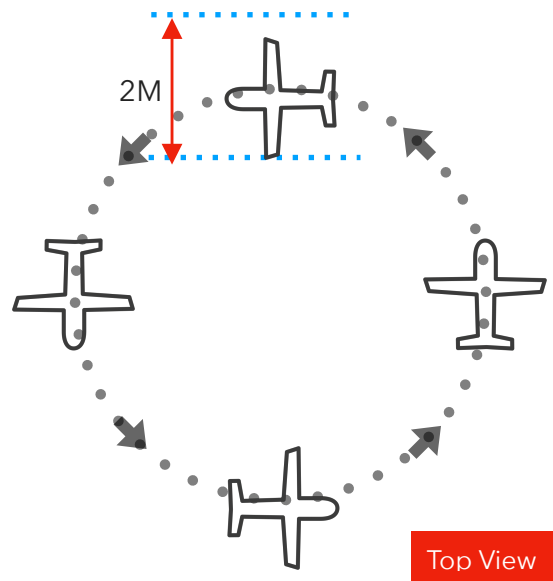
Type	Platform	Manoeuvre
GPS - Flight	Fixed Wing	Circle (CCW)

### Pre-requisite skills

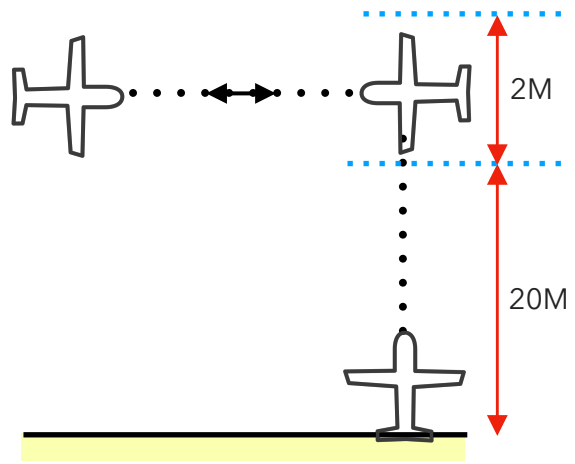
Turn on procedure of the drone.  
 Insight about Throttle, Pitch, Roll, and Yaw. Hovering of the drone.

### Description of the manoeuvre

The drone has to track a path of a circle of suitable dimensions in the counter clockwise direction at an altitude of 20 metres. The drone has to traverse the path while maintaining the altitude.



Top View



Pilot View

### Proficiency Standards

Altitude Stability	+ / - 2 metre
Path Accuracy	+ / - 2 metre
Time Duration	4 minutes

# THANK YOU

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