UNMANNED AIRCRAFT SYSTEMS COURSES

INTRODUCTION
Unmanned Experts provides international civilian and military clients with various Unmanned Aircraft Systems (UAS) and Remotely Piloted Air Systems (RPAS) training courses around the globe. The UAS Market is out-performing all other areas of Defense-related expenditure and investment and with the imminent ‘opening’ of National Airspaces to civilian UASs, the need for qualified, experienced and knowledgeable professionals in this field is critical.

Our UAS Training Courses cover the entire spectrum of UAS/RPAS operations to include principles of flight, UAS concepts & terminology, design considerations, payload and sensor requirements, maintenance, tasking, human factors and finally flight operations. The Courses are modular to enable maximum, and cost-effective, targeting of knowledge, skills and attribute gaps within your organization.

Groundschool classes are primarily classroom, practical, simulator and hanger-based with excellent instructor: student ratios and all attendees receive top quality Course material including lecture notes, relevant literature, STANAGS, forms and some complete presentations.

Online e-learning versions of our most popular Groundschool classes have been developed and allow for fully-narrated, self-paced, ‘on the go’ training on all platforms (laptop, tablet, phone), all fully backed by instructor support.

Flight Operations classes are offered in the most widely used airframe classes and encompass both Basic flying skills as well as Advanced operational procedures.

INSTRUCTORS
All of our teachers are award-winning instructors and evaluators on numerous operational UAS platforms. We have extensive experience in UAS training system design and implementation and have been delivering leading-edge UAS
training material to current operational platforms. We will provide simulator and practical support throughout the relevant Courses. For a list of our instructors and their biographies, visit www.unmannedexperts.com/about-us/

**FLIGHT & GROUND TRAINING LOCATIONS**

All of our Flight Training is currently conducted at the UMEX Flight Center near Oxford in the United Kingdom. Ground school courses are run at various training venues across the globe, depending upon demand, as well as at our office facilities in Bicester, UK. Please check our website for updates schedules and locations.

**UAS / RPAS PLATFORMS**

Unmanned Experts have chosen a number of simple representative UAS/RPAS platforms on which to teach students Basic and Advanced (Operational) Flight skills. These platforms vary with availability and course requirements, but current airframes are similar to the types shown below:

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**COURSES AVAILABLE**

- **A: Flight Training**
  - A.1: Class 1 / Group 1 Fixed Wing
  - A.2: Class 1 / Group 1 VTOL Multi-copter
  - A.3: Class 2 / Group 2+ Fixed Wing Basic Course
  - A.3. Class 2 / Group 2+ Fixed Wing External Pilot Course
  - A.5. Class 2 / Group 2+ Fixed Wing Advanced Course

- **B: Ground School:**
  - B.1: Introduction to UAS Course (1 Day)*
  - B.2: UAS Fundamentals Course (3 Days)*
  - B.3: UAS Foundation Course (5 Days with Simulation Training)
  - B.4: UAS Advanced Course (1 Day)*
  - B.5: UAS Career ‘Boot Camp’ Workshop (1 Day)

- **C: Specialist Courses:**
  - C.1: Human Factors / Crew Resource Management (3 Days)
  - C.2: Law Enforcement Tactical Operations Course (3 Days)
  - C.3: Oil & Gas UAS Utility Course (1 Day)

- **D: Long Courses:**
  - D.1: Imagery Analysis Training Course (2 weeks)
  - D.2: Intelligence, Surveillance & Reconnaissance Course (4 weeks)
  - D.3: UAS Maintenance Course (4 weeks)

- **E: Client-defined Specialist Courses** (upon request)

*Now Available Online
A.1: Class 1 / Group 1: Fixed Wing Flight Training

A.2: Class 1 / Group 1 VTOL Multi-copter

A.3: Class 2 / Group 2+ Fixed Wing Basic Course

A.3. Class 2 / Group 2+ Fixed Wing External Pilot Course

A.5. Class 2 / Group 2+ Fixed Wing Advanced Course

Please contact us for our separate Flight Training Brochure
B.1: Introduction to UAS Course

This one-day, classroom-based instructional program is designed for senior management and field engineers who are entering the UAS market. The course begins with an overview of UAS terms, definitions and possible configurations, followed by a study of current operations (both military and civilian) and the systems in use around the globe. A look at possible payloads and sensor suites is followed by a review of typical UAS issues and difficulties, including an update on the current regulatory environment. Finally a look at the near-future capabilities and market considerations concludes the Introduction Course.

COURSE DELIVERABLES
The Introduction Course should provide Delegates with a solid grounding in all of the following fields:

- UAS Basic Principles
- UAS Types & Roles
- UAS Concepts of Operations (CONOPS)
- Payload & Sensor Options
- UAS Components & Systems
- Airspace Regulations
- UAS Case Study
- Future Capabilities

TYPICAL SYLLABUS

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<td>Payloads</td>
<td>LUNCH</td>
<td>Sensors</td>
<td>Airspace Regs</td>
<td>Case Studies</td>
<td>Future Capes</td>
<td>Debrief</td>
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*Now Available Online

EXPERT INSTRUCTORS

EXCELLENT FACILITIES
B.2: UAS Fundamentals Course

This 3-day, classroom and practical instructional program provides individuals or teams entering the UAS market with the need to ‘hit the ground running’. Delegates will gain a working knowledge of UAS system classification, roles and command and control options. UAS design considerations, payloads and limitations are studied, culminating in challenging UAS design and mission practical exercises. Items from the Introduction Course are refreshed, but in depth consideration of operational and maintenance difficulties as well as a look at a number of case studies complete the Fundamentals Course.

COURSE DELIVERABLES
Delegates should leave the Fundamentals Course with a thorough understanding of the following:

- UAS Terms & Definitions
- Spectrum Management, Datalinks & C2
- UAS Basic Principles
- UA System Design & Practical Exercise
- Human Factors & CRM
- UAS Types & Roles
- UAS Concepts of Operations (CONOPS)
- UAS Components & Systems
- Mission Planning Considerations
- Payload & Sensor Options
- UAS Licensing & Regulations, including STANAGS
- UAS Maintenance & Logistics
- UAS Case Studies & Lessons Learned
- Future Capabilities

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<td>UAS Payloads</td>
<td>EO/IR Sensors</td>
<td>Radar Sensors</td>
<td>LUNCH</td>
<td>UAS Weapons</td>
<td>Human Factors</td>
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<td>Components 2</td>
<td>Mission Planning</td>
<td>LUNCH</td>
<td>Planning Practical</td>
<td>Case Study</td>
<td>Future Capabilities</td>
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B.3: UAS Foundation Course

The Unmanned Aerial Systems Foundation Course is designed to provide a thorough understanding of all aspects of UASs. This week-long, classroom, practical simulator and live fly-based instructional program begins with an introduction to aircraft systems, UAS design, roles, classification, command and control payloads and operations. It is followed by instruction on practical UAS issues, tasking and integration of UAS assets. Mission planning, logistics and real-world case studies. These are all covered in considerable detail and supported by challenging practical workshops and supervised simulator lessons. Attendees will also be introduced to piloting a Small UAS in internal and external pilot tasks.

COURSE DELIVERABLES

The Foundation Course combines Fundamental and Employment Courses taught over 5 days of instruction and practical sessions. Delegates should leave with a solid grounding in all of the following fields:

- Aeronautical Terms & Definitions
- Spectrum Management
- UAS Basic Principles
- Navigation Systems
- UA System Design
- Human Factors & CRM
- Datalinks & C2
- UAS Types & Roles
- Sensor & Payload Options
- UAS Licensing & Regulations
- UAS Support Requirements
- UAS Weaponisation
- ISR Tasking & TPED Process
- UAS Integration Issues
- Mission Planning & Execution
- Safety Management Systems
- UAS Maintenance Issues
- Future Capabilities

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<td>LUNCH</td>
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<td>Civil Case Studies</td>
<td>Future Capabilities</td>
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UAS SIMULATORS

LIVE FLY
B.4: UAS Advanced Course

This specialized Course provides experienced UAS professionals, or Fundamental Course attendees, with high-end comprehension of the more complex, ground-breaking or controversial aspects of UAS operations. Personnel should have completed the UAS Fundamentals Course or be a professional in the UAS field.

**COURSE DELIVERABLES**
The Advanced Course modules include the following areas, however additional specialist briefs will be added to the Advanced Course as they become available.

- Threats to UAS Operations
- Counter-UAS (C-UAS) Operations
- UAS Costs & Business Planning
- Multi-Aircraft Control (MAC)
- Processing, Exploitation & Dissemination (PED)
- UAS Ethics

**TYPICAL SYLLABUS**

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*Now Available Online*
B.5: UAS Career ‘Boot Camp’ Workshop

The fascinating UAS career field is only just beginning to expand into the civilian market place. Individuals seeking entry level opportunities in the UAV / ‘Drone’ Industry, or those transitioning to a second career, should kick start those ambitions with this intensive one-day workshop.

COURSE DELIVERABLES
The Career Boot camp will provide attendees with updates in the following areas:

- UAS Basics & Concepts of Operation
- UAS Market – Current & Future Trends
- UAS Career Paths (including Industry Guest Speakers)
- UAS Technology Update
- Airspace Integration efforts

PRACTICAL SESSIONS
Attendees will get some ‘Hands On’ experience of live and simulator UAV / RPAS operations and flying:

- Tactical UAV Simulator scenarios
- Small UAV Flight Challenges as both Internal & External pilot

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<td>UAS Roles &amp; Payloads</td>
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<td>UAS Technologies</td>
<td>Practical Session 2</td>
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C.1: Human Factors & Crew Resource Management

Unmanned Experts provides a 3 day training package examining the Human Factors aspects of unmanned aviation and the challenges posed by remote piloting of highly automated systems. Aimed primarily at the UAS pilot, it is highly relevant to UAS designers and engineers and also to pilots in manned aviation.

Research into human error in aviation tempts us to believe that the topic is well understood, but it is still a feature in most aviation accidents. Engineers and designers push for ever increasing levels of automation to reduce human error rates, so we might conclude that unmanned systems, by removing the man from the cockpit can enjoy lower accident rates.

This course, presented by experienced UAS operators and Human Factors trainers, looks at the reasons why the role of ‘the human in the loop’ and the provision of adequate data demand more consideration to improve safety standards in unmanned aviation and to enable the industry to break out of segregated airspace. With an introduction that covers the history and development of unmanned systems, the course goes on to look at the role of human fallibility and error before looking in depth at the unique challenges of taking the pilot out of the cockpit while giving him enough information to operate safely and make decisions about the task and the aircraft systems.

The course considers the benefits of automation while looking at the topic of sensory detachment caused by lack of feel and the audio-visual cues available to the pilot on board an aircraft. Case studies are used to examine previous UAS accidents and the role that human error has played in them, while group exercises then give the students the chance to reduce the risk of these accidents occurring in the future.

COURSE TOPICS
• A short history of unmanned aviation
• Safety Management & Human Error & fallibility
• GCS interface design and aircraft behaviour
• Presentation of visual information
• Situational awareness challenge of remote operation
• Automation & Flight Envelope Protection
• Unmanned Aircraft Performance Factors

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<td>LUNCH</td>
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<td>LUNCH</td>
<td>Automation 2</td>
<td>Case Study 3</td>
<td>Case Study 3</td>
<td>Course Debrief</td>
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The HF and CRM Course is designed to assist in answering the following questions, and much more:
• Can a good interface solve the lack of “seat of the pants” feedback?
• How well does the pilot understand how flight envelope protection has been incorporated?
• Did the designer appreciate the operating environment in allocating precedence of information?
• How do we share understanding and information in networked teams?
C.2: Law Enforcement Tactical Operations

This 3-day, classroom and simulator-based course is designed for Law Enforcement personnel actively involved in Tactical Operations. A strong focus on SUAS tactical employment and integration with the Law Enforcement Intelligence function will help agencies to decide whether they want to pursue the adoption of this transformational technology. Expert instructors and the supervised use of SUAS simulators will provide attendees with an opportunity for Hands-On experience, and for developing their agency’s Concept of Operations (CONOPS) before they ‘take the plunge.’

COURSE DELIVERABLES
This course specifically addresses using Small UAS (SUAS) for Law Enforcement Tactical Operations. UAS fundamentals are introduced, including sensors, imaging, and intelligence product development. Several SUAS scenarios will then be covered in-depth:

- **House/Vehicle Takedown**
- **Hostage Rescue**
- **Search and Rescue**
- **Accident Reconstruction & Forensics**

Tactical and operational use of SUAS in these scenarios will be covered, along with law enforcement intelligence exploitation of real-time sensor imagery, developing analytical intelligence products, and capturing forensic-quality products for use at trial. Attendees will understand the following:

- UAS Terms & Definitions
- UAS Basic Principles
- Human Factors & CRM
- UAS Types & Roles
- UAS Concepts of Operations (CONOPS)
- UAS Components & Systems
- Mission Planning Considerations
- Payload & Sensor Options
- UAS Licensing & Regulations
- Law Enforcement (LE) Intelligence Products
- ISR Support to LE Tactical Operations
- Risk Management and Safety Management Systems
- LE UAS Employment Techniques
- LE Intelligence Products

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<td>LUNCH</td>
<td>UAS Payloads</td>
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<td>UAS Regs</td>
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<td>House / Vehicles</td>
<td>Active / Passive</td>
<td>Pre / Post Entry</td>
<td>Intel &amp; Payloads</td>
<td>LUNCH</td>
<td>Search &amp; Rescue</td>
<td>Urban Vs Rural</td>
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<td>Scene Exploit</td>
<td>Evidence Integrity</td>
<td>Risk Management</td>
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<td>Lessons Learned</td>
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C.3: Oil & Gas UAS Utility Course

This one-day, classroom-based instructional program is designed for senior management and field engineers who are entering the UAS market. This course will assist in the decision making process when considering the acquisition of UAS and the situations and roles to which they can realistically be applied. The course begins with an overview of UAS terms, definitions and possible configurations, followed by a study of operations (both military and civilian) and the systems in use around the globe. A look at possible payloads and sensor suites is followed by a review of typical UAS issues and difficulties, including an update on the current regulatory environment. Finally a look at the near-future capabilities and market considerations concludes the UAS into Oil & Gas Course.

COURSE DELIVERABLES
The UAS into Oil & Gas Course should provide Delegates with a solid grounding in all of the following fields:

- UAS Basic Principles
- UAS Types & Roles
- UAS Concepts of Operations (CONOPS)
- Payload & Sensor Options
- UAS Components & Systems
- Capabilities & Considerations

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D.1: Imagery Analysis (IA) Training Course

Aerial reconnaissance is the process of obtaining information by various sensors using the Electro-Magnetic (EM) spectrum. These sensors include (but are not limited to) Optical, Infra-Red and Radar. The process is often referred to as remote sensing.

The imagery product of these sensors is actually the primary motivator for engaging in aerial recce, and also in the use of UAS. The exploitation of this product is paramount to success of the business but is often not fully understood, manned or equipped for. Imagery analysis can only be maximized by understanding the type of platform-to-sensor limitation but, from that point onwards, the limits of the systems are bound only by the operators/analysts understanding of the format in which the product is presented.

The following formats and exploitation models are discussed in the Unmanned Experts IA Training Course:

- Electro-Optical (EO)
- Infra-Red (IR)
- Synthetic Aperture RADAR (SAR)
- RADAR and LIDAR / LADAR
- Commercial Satellite Imagery (CSI)
- Moving Target Indicator (MTI)
- Full Motion Video (FMV)
- Sensors and uses
- Mission Planning
- Products (how to best present to a customer)
- Terminology and Legal considerations
D.2: Intelligence, Surveillance & Reconnaissance Course

The 4 week-long Intelligence, Surveillance & Reconnaissance (ISR) Course is based on years of practical and academic experience. The course builds from the successful completion of the previous UAS training courses and utilizes classroom and real-world derived scenarios that will both inform and test the student in all aspects of ISR. During the ISR Course, the performance and operational use of several fielded UAS platforms will be examined. The ISR course is based on 3 phases:

**PHASE 1: ISR FUNDAMENTALS.** The aim of the ISR Fundamentals course is to introduce ISR as an activity, define the process, and to outline how ISR supports and integrates with other activities. The course will go on to introduce common collect and analytical capabilities and finish with a small tactical, practical training exercise. Topics will include:

- An introduction to the Intelligence Cycle
- An Introduction to the ISR Process
- ISR as an Activity
- Tasking Principles
- Basic Sensor Overview
- Exploitation Techniques
- Dissemination

**PHASE 2: ISR PRACTITIONER.** The aim of the ISR Practitioner Phase is to introduce intelligence personnel or surveillance and reconnaissance operators to the wider world of ISR and to prepare them for operations. The course will go on to introduce and refresh common collect and analytical capabilities but focus on tactical integration of disparate ISR systems against a common target. The course will finish with a small tactical practical training exercise. Topics covered:

- Discuss ISR applications
- Introduce common ISR capabilities
- Introduce tactical integration of ISR assets
- Practice integration during a practical scenario

**PHASE 3: ISR MASTER CLASS.** The aim of the ISR Master Class is to develop tactical acumen of an ISR operator. The course is founded on real world operational experience and is designed to prepare ISR operators so that they will be able to demonstrate at the expert level the knowledge, cognitive skills, leadership ability traits required to be a commander's primary tactical advisor and problem solver, as well as a mentor to others. Topics addressed include:

- Discuss and define ISR
- Understand how ISR integrates with other command functions
- C2ISR
- Tactical integration
- Demonstrate ISR integration during 2 days of mission focused practical scenario

The final part of the course will focus on instructional techniques and culminates with a practical assessment of the student’s ability to present lessons in basic UAS and ISR principles. On completion of this module the students will be qualified ISR Instructors.
D.3: UAS Maintenance Training Course

Unmanned Experts has an auspicious pedigree in UAS Maintenance and Engineering expertise. Our Instructors has operated and fielded every class, group and type of UAS currently in operation. The 8-week long Maintenance Training Course is provided in a mixture of classroom and on the job training, working alongside Unmanned Systems technicians during maintenance of training aircraft on live-fly sorties. Training can be expanded to include specifics in a requested class or group and, subject to agreement with Original Equipment manufacturers (OEM), on specific platforms. The basic course is given in 2 blocks:

**BLOCK 1: GROUND SCHOOL.** This initial 4-week block will provide the students with all the UAS background that is essential in the development of a UAS capability and will give each student a robust grounding in all aspects of the UAS required before moving onto more advanced topics. Lessons include:

- Introduction to Airframes
- Introductions to Ground Control Stations
- Introduction to Payloads & Sensors
- UAS Human Factors
- Safety Management Systems

**BLOCK 2: PRACTICAL MAINTENANCE.** The second 4-week block of ground maintenance training is divided between classrooms and hands on practical training. The Topics covered include:

- Airframe Maintenance
- Engine Maintenance
- Sensor Maintenance
- Ground Accessories
- Data-link Maintenance
- Servicing Schedules

All training materials will be included and all training will be conducted in English.
E: Client-Defined Specialist Courses

As Subject Matter Experts in the UAS / RPAS field, our team is able to offer tailor-made / bespoke courses for groups, companies and units. Please contact us with your general requirements and we will work with you in producing a training package ideally suited to those needs. Generally we will travel to your location and on your timeline for these courses.

Individual Training Modules

F1. Aviation Basics. The 4 lectures in the Aviation Basics Course begin with this review of Aviation Terms and Principles, a study of fixed wing and rotary wing aircraft structures and a brief explanation of the forces in flight. Axes, Balance, AOA and Drag and Power curves are covered and related to the UAV dimension as well as V-speeds, Re and other aerodynamic concepts. A short introduction to EM Spectrum is followed by a thorough explanation of airspace classifications and IFR/VFR rules.

F2. Electromagnetic Spectrum. This 2-phase Module initially explains properties of EM waves including frequency / wavelength, propagation, reflection / refraction / diffraction, sky wave and polarity. The EM Spectrum and bands are then reviewed. The second phase breaks down the workings of a radio, to include Transmitter / Receiver, Modulation (AM/FM), sidebands, CW, bandwidth and receiver types. Signal:Noise ratios and signal quality are also covered.

F3. INS Navigation. A remarkably in-depth study of Inertial Navigation Systems and their application in modern aircraft. Begins with first principles from gyros through accelerometers and on to stabilization. Frames of Reference type comparisons are followed by a study of INS benefits and issues (transport wander, Coriolis, etc.). Strap-down and Gimbal INS comparison discussion continues into the principles and construction of modern ring laser gyros as well as fiber-optic developments and beyond. Finally errors and alignment methods are covered.

F4. GPS Navigation. Another extremely comprehensive Module covering all aspects of the satellite-based navigation principles focusing on the Global Positioning System (GPS) but covering other ‘sat-nav’ constellations. A review of GPS history and architecture (all segments) is followed by GPS Theory in Ranging, Fixing and Time. Message breakdown, Code types and S/A as well as Differential GPS are discussed at length, comparing accuracy and availability. Dilution of Precision and Figure of Merit concepts are also reviewed. Finally the principles are applied to a UAS operational setting, covering GPS/INS navigation and jamming issues.

B1. UAS Basics. Your introduction to the field of unmanned aircraft. The lesson provides Definitions, Principles and Terminology in common usage and to ‘baseline’ comprehension for later modules. Components of a typical Unmanned System are illustrated by numerous current examples then a list of terms and operating parable leads to the surprisingly complex topic of UAS / RPAS definitions. UAS categories are introduced as well as the concept of Levels of Interoperability (LOI) and some of the common Operational methods in use. A brief review of some serious issues and more real-world examples conclude the Module.

B2. UAS Types. The surprisingly complex topic of classification for UAS is addressed in depth. Options that are covered include military and civilian Tiers, Groups, Size / Weight classes, Performance, Level of Autonomy and Airspace access. National and International methods for classifying UAVs are then compared. Finally, ‘standard’ classes are suggested and their defining characteristics (size, range, datalinks, CONOPS) listed to assist in future comparisons. Likely class developments are suggested to complete the topic.

B3. UAS Roles. A broad-ranging study of the rapidly expanding number of military and civilian missions that UAS are employed within. Review of their execution in increasingly complex roles: ISTAR, Force Protection, Kinetic Operations, EW, Search & Rescue, SIGINT, communications relay, law enforcement, disaster relief, fire detection & assessment, customs & border patrol, nuclear inspection, natural resources & wildlife management, surveys, hurricane tracking, photography. Finally the potential for future missions and issues facing civilian utilization as well as cost/benefit analyses versus manned platforms are all highlighted.

B4. UAS CONOPS. Comparative study of different Concepts of Operation for military and civilian UAS. A definition of CONOPS is followed by a review of the numerous factors affecting how UAS could (or even should) be operated, ranging from airframe and legal limitations, through mission requirements and even onto cultural elements. A list of common CONOPS are studied, to include Visual/Radar Line of Sight (V/BLOS); Beyond Line of Sight (BLOS); Remote Split Operations (RSO); Relay Operations and beyond. Restricted Airspace and different Command and Control (C2) arrangements are covered leading to a challenging real-world scenario quiz.

B5.1 Case Study 1: MQ-8B. Our first Case Study is designed to monitor a UAS program from ‘cradle to grave’. This one follows the trials, tribulations and ultimate successes of the MQ-8B Firescout RW VTOL UAS currently being fielded by the US Navy. Using a ‘timeline’ approach, the Module begins with predecessor platforms and requirements and moves through selection and UAS development. An in-depth look at the system and its operation includes payload options and capabilities. The discussion continues with programmatic issues, trials problems (and resolutions) and fielding reports all included. Finally a comparison with ‘similar’ platforms leads to a review of the programs’ likely future.
**B5.2 Case Study 2: Civil.** This extremely dynamic Study is designed to track the global proliferation of UAS in civilian use. The Module is updated every month with latest case studies from around the world, to include GIS ortho-mapping, architectural surveys, wildlife monitoring, radiological studies, weather tracking etc. It is an encouraging introduction to the true potential of UAS currently being deployed.

**B5.3. Case Study 3. Global Hawk HALE Family.** This overview of the much vaunted, and oft maligned, RQ-4 family of High Altitude UAs gives insight into their utility and issues. A look at each member from Block 10, through to 40 as well as the EuroHawk, PolarHawk, BAMS (now Triton) and NATO AGS variants. Payload variants and options are studied. Considerations of cost vs capability are covered as well as a review of incidents and accidents of the system.

**B9. Future Capabilities.** Designed to focus lessons learned from previous Modules on the rapidly developing global UAS field. Covers topics including: Technology advance timelines, automation levels and HItL / HMI; Manufacturing advances; Propulsion and fuel developments. These are followed by a review of novel UAS Types: 'Stratemates', UAV, LTA, Nano and then future civil and military roles: Air-to-air refueling, ultra-long endurance, electronic warfare, agricultural, border security, wide area surveillance.

**C1. Components 1.** The first of three modules examining the various elements of the Unmanned Aircraft System. Provides a breakdown of all hardware elements with a focus on similarities to manned systems, including Ground Control Stations. The aircraft systems are described in detail with a comparison between different UAS classes: Propulsion, Fuels, Auxiliary systems, autopilots and navigation equipment. Introduction of SWaP concept and an overview of developing technology (fuel cells, airframe printing etc.) complete the Module, which assists in preparation for the Design Practical.

**C2. Components 2.** A closer look at hardware elements and software algorithms designed specifically for UAS. A review of Autopilots leads to a study of various Automatic Take Off and Landing (ATOL) systems and both Airborne Sense and Avoid (ABSSA) and Ground-based Sense and Avoid (GBSSA) options. Flight Termination Systems (FTS) and Automatic Recovery Systems (ARS) are discussed, highlighting ‘Lost Link’ logic issues.

**C3. Datalinks.** Introduction of Datalink terminology, concepts and components leads to a study of common datalinks including TCDL, VMF and Link 16. Breakdown of LOS and BLOS hardware and capabilities. Satcom ‘Shadow’ and Lost Link reviews are followed by a section on EM Spectrum management and typical frequency utilization.

**P1. Payloads.** An important Module highlighting the concept of UAVs as ‘Payload Trucks’ and the numerous options for what can be carried internally or externally. A SWaP refresher leads into a very useful series of ‘Rules of Thumb’, used extensively throughout the Courses and the Design Practical. Current and comprehensive examples of all UAS groups, are used to elucidate the concepts. A thorough review of all current major payloads, with civilian and military sub-groups, include Atmospheric / Ground Sensing, Agricultural, Law Enforcement, ‘Mother ships’, Multi-user and Resupply options as a small part of the list.

**P2. Sensors.** This very large and comprehensive brief on such an essential UAS topic is split into 3 sections: Sensor Basics, EO/IR systems and Radar systems. The introduction gives an EM spectrum overview relevant to UAS sensors, and then covers common terminology and concepts from Low Light Fusion, Emissivity, Polarity, Delta-T, NIIRS, Resolution/Swath and FMV equivalence. A detailed look at a ‘standard’ EO/IR/LLTV sensor package and its capabilities (to include Lasers) leads into more advanced systems such as WAASS and Hyperspectral. A survey of the current ‘families’ of fielded EO/IR sensors conclude this section. After a refresher on SAR and GMTI principles, a similar study of a ‘standard’ UAS radar sensor payload is followed by another review of the available systems on the market.

**P4. UAS Weapons.** This specialized Brief within the UAS Payloads genre is focused on the topic of arming UAVs for an ever-expanding array of military / para-public missions. The Module begins with an introduction to standard air-carried weaponry, including propulsion, guidance and damage mechanisms. Current and near-future UAV weapons capabilities are covered in depth, to include SwaP and usage considerations for AGM-114 Hellfire, AIM-92 Stinger, AGM-175 Griffin, GBU-12 Paveway, GBU-38 JDAM, Pyros, Hatcher, GBU-44/B Viper Strike, JAGM. Comprehensive examples and videos are used to illustrate the potential of this field. More extreme examples are also covered, to include ‘suicide’ UAS profiles and ‘Mothership’ payloads. Finally the common methodology of UAV-directed kinetic effects are studied, to include own-ship, buddy lase and artillery support.

**PR1. UAS Design Practical.** This central, popular and engaging Module combines a revision of numerous previous briefs with a challenging Practical exercise that has the option for requesting instructor feedback as well as a presentation of a number of ‘pink’ answers. A brief study at standard aircraft design concepts and procedures are followed by the Review section looking again at UAS Types, Datalinks, Engine / Payload SWaP guidelines and potential CONOPs. The Practical exercise provides a complex tactical scenario with numerous time and mission execution pressures, and asks the students to design a UAS to fulfill the mission requirement. Successful candidates will have an excellent appreciation of UAV airframe options, payload SWaP considerations and datalink types, as well as an understanding of how to produce a realistic and workable UAS scheduled operation. Worksheets are also included in the Course Workbook.

**PR2. Mission Planning & Practical.** This Module studies the numerous steps for successful Mission Planning for UAS operations. A review of the various UAS CONOPS (to add perspective) leads into a summary of normal ‘manned’ flight planning considerations. The significant differences for UAS planning are then elucidated step-by-step, to include ultra-long endurance, limited divert options, tactical LR operations, datalink / C2 limitations, UAS-specific weather strengths and weaknesses, typical UAS airspace options and ‘Lost Link’ planning. Finally mission considerations such as GCS-handovers and Relief on Station, are also implemented in the planning process. A modern-day scenario is then presented in Practical format (and included in the Course Workbook) and the entire planning cycle is illustrated by a series of tactical problems for the student to solve.

**PR3. Tasking & Practical.** This comprehensive look at the entire Tasking – Collecting - Processing – Exploiting – Disseminating (TCPED) process for ISR collection takes place over 3 modules and one Practical session. Beginning with defining each step, as well as updates to the cycle (PCPAD, TPPU, etc.), the Tasking Module reviews current military practices and terminology to include CICRIs, EEL, PIIRs, Collection Lists and ATOs. The Practical session ‘deploys’ you virtually to solve a real-world civilian problem by defining the information requirements and using your UAS assets in the most efficient manner. Weather, Maintenance and other problems are also encountered in this highly engaging scenario. A final PED Module completes the loop and also contains a small Imagery Analysis task for the attendees.

**R1. Airspace Integration.** This extremely important area of UAS study introduces the numerous hurdles, with some solutions, to achieve FINAS: Flight in Non-segregated Airspace. An overview of the difficult international airspace environment, airspace categories, current UAS operations as well as UAS-specific problems from frequency deconfliction to a lack of lost-link standard procedures are all introduced. The obstacles to FINAS are reviewed in depth: UAV / UAS Airworthiness certification, ELOS and TLOS safety measurements, human factors and GCS development, ground and airborne sense and avoid systems, collision avoidance methods, datalink security, spectrum protection, operator training standards and CONOPS. The ‘5 Steps to Certification’ are proposed with a review of relevant global documentation and studies in each step.
R2. UAS Regulations. This supplementary brief for those studying Airspace Integration (see T3.) has a thorough and updated review of all the major global regulations and standards either developed or published to date. They include ICAO Cir 328, EASA E.Y013-01, CASA Pt 101, CAA CAP 722, FAA Order 7610.4, 14 CFR 91.319, AC 91-57, as well as national regulations to include Malaysia, South Africa, Sweden and Canada.

R3. STANAGS. The lack of Standardization is highlighted as delaying UAS Airspace Integration (see T3.) but a number of NATO Standardisation Agreements (STANAGS) has emerged to provide significant and important guidance. This Module gives an understanding of Standards principles and the role of SDOs. NATO UAS Standardization Agreement primarily reviews the following applicable guidelines: 4586 - UAS Control Stations; 4670 - UAS Operator Training; 4671 - UAS Airworthiness; UAS CONEMP - Concept of Employment; 2402 - UAS Airspace; 3531 - UAS Safety Investigations; 4660 - Interoperable UAS C2 Datalinks; 4609 - Streaming Video; 1588 - IEEE Digital Clocks; 1589 - IEEE Time Synchronization; 1596 - IEEE Part 1588 Time Protocol; 1588-2 - IEEE Time Synchronization for High-Availability Systems; 1588-3 - IEEE Time Synchronization for Industrial Control Systems; 1588-4 - IEEE Time Synchronization for Audio/Video Networks; 1588-5 - IEEE Time Synchronization for Industrial and Control Systems; 1588-6 - IEEE Time Synchronization for Audio/Video Networks; 1588-7 - IEEE Time Synchronization for Industrial and Control Systems.

O1. UAS Human Factors & Crew Resource Management. A rapidly growing field of study within UAS communities, this important brief reviews the latest thinking and theories behind complex system Human Factors (HF) and aircraft Crew Resource Management (CRM). Error Management Principles are introduced followed by some relevant HF-related accident examples. The bulk of the Module then applies these principles to the unique UAS crew and operating environments, specifying Organizational, Mission, and Environmental HF / CRM challenges. These include: Communication barriers, Levels of automation, Computer Complacency, Shift Patterns, current GCS HMI examples, and ‘Being There’ amongst many others.

M1. UAS Maintenance & Logistics. This Module gives a close look at this fundamental aspect of UAS operations and one that is significantly underestimated in its importance. An overview of unmanned aircraft as a much larger system from a maintenance perspective: AVs, GCSs etc. are well understood, but parts, tools, POL and the ordering process are not, and all are highlighted in this brief. A look at loadouts, tool kit needs and bench stock is followed by the very important issues of manning levels and the critical AV ratio requirements, with examples. Finally common maintenance issues are highlighted for completeness.

D1. UAS Threats. A very significant topic that is growing in importance: the study of current and developing man-made threats to UAS operations. Beginning with an overview of UAS vulnerabilities, methods to ‘Kill’ or ‘M-Kill’ UAS are listed, to include kinetic and non-kinetic options. ‘Counter UAS’ technologies from air defenses, battlefield lasers, Anti-satellite ops, jamming, spoofing & hijack, snooping and cyber techniques are all studied. A review of some available countermeasures concludes the Module.

D2. Counter UAS. With the increasingly widespread adoption of UAS across the globe, understanding the threat posed to privacy, espionage and operations requires a study of their CONOPS and vulnerabilities. This Module reviews ‘other nation’ UAS programs and highlights areas that may provide relief from falling victim to their use.

D3. Multiple Aircraft Control (MAC). This Advanced Module looks into the reason behind the drive for ‘MAC’ in UAS operations and the issues / successes that have been encountered. A brief review of current global MAC projects then focuses on an in depth study of the USAF Predator MAC program. A look at hardware / software requirements leads to the significant training and Human Factors issues due to system limitations. MAC’s operational record and lessons identified are highlighted before future MAC developments are briefly considered.

D4. UAS Costs. A review of typical UAS ‘off-the-shelf’ prices, including UAV, Payloads, GCS, support equipment and datalinks. This is highlighted with a comparative look at Training Course costs and recurrency requirements, as well as an hourly Flight costs and additional management and manpower expenses overview. A fascinating, but little understood area for those interested in the Business Case for UAS operations.

D5. UAS Ethics. This highly topical subject brings together the areas of Ethics, Legality and Public perception of ‘drones’ in the wider community. A review of Just War principles in light of the US ‘Drone War’ campaign is provided for group discussion. A wider debate about Automation and the role / legality of autonomous weapons systems is undertaken. Finally the issue of Privacy rights and the legal basis of civilian surveillance is embarked upon.

D6. UAS Market & Careers. A review of the potential global market in UAS, payloads, spending on R&D, and job availability begins this module. Issues that are likely to drive that market direction, including regulations, conflicts and global finances are listed. The various ‘career paths’ from training through to employment are studies, as well as a look at current job listings and their requirements. Finally some advice on ‘next steps’ is given to continue into the UAS field.

D7. HALE Systems. A list of global High-Altitude Long Endurance systems, including LTA and Ultra-long endurance platforms. The environmental issues and their unique characteristics are covered in-depth, as is their current and potential roles. Reasons for their ‘mixed’ success rates globally are also postulated.

MT-1A. Introduction to Airframe. This is a general topic designed to introduce the various component that make up a RPAV airframe including items such as datalinks, servo’s, power systems and autopilots.

MT-1B. Introduction to Ground Control Station. A comprehensive introduction to the various types of GCS currently in use and development. The standards employed and typical components.

MT-1C. RPAV Human Factors. Human Factors (HF) is a growing area of study within the aerospace industry and has been credited with improving the safety record of military and civil aircraft alike. Operating a RPAS introduces HF significantly different from other manned platforms and these differences are explored in detail during this phase.

MT-1D. Introduction to Sensors. This section provides an introduction to the myriad of sensors typically used as part of a RPAS and includes basic techniques relating to sensor employment, example output and sensor fusion.

MT-2A. Airframe Maintenance. This module covers the aircraft assembly and continues pre-flight and post flight maintenance of the RPAS airframes as appropriate and associated equipment.

MT-2B. Engine Maintenance. This module will be customized to the AV engine type and incorporates all scheduled and un-scheduled maintenance required to keep the AV flying.

MT-2C. Sensor Maintenance. Highly dependent on the type of sensors integrated on the aircraft but will include the basic system maintenance to ensure the system remains operationally effective.

MT-2D. Ground Accessories and Data-link Maintenance. This ‘Catch All’ module covers the GCS and other equipment that is required to operate the RPAS system.
Registration & Course Information

COURSE RATES PER ATTENDEE

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<tr>
<th>Course</th>
<th>Length</th>
<th>Standard</th>
<th>Discount <em>/<strong>/</strong></em></th>
<th>Notes</th>
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<td>Class 2 Basic Flight Ops</td>
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<td>Class 2 Advanced Flight</td>
<td>A/R</td>
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<td>4 Weeks</td>
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<td>Maintenance Training</td>
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<td>Specialist (by request)</td>
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* Payment complete 2 months prior  ** 5 or more delegates  *** Gov & Mil  + Rates available

- Previous Course attendance can qualify for discounted rates on future courses. Please contact us.
- Travel to the course is not included in the training fee.
- Accommodation costs are not included in the training fee.

COURSE MEDIA

- Delegates will receive a Course Folder with all lectures printed out.
- Longer courses will also receive a Course CD containing relevant literature, STANAGS and papers.
- Some Course Modules are available online. Please enquire for details.

SPONSORSHIP OPPORTUNITIES

- Includes exhibition stands, sponsored lunches, cocktail receptions, as well as social network events.
- To discuss options and availability please email training@unmannedexperts.com or call any of the numbers on the website www.unmannedexperts.com

REGISTRATION

1. Go to our website and book at: www.unmannedexperts.com/course-booking-link/
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3. Confirmation of receipt will be sent via email.

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BOTTOM LINE
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“When experience matters”
Terms & Conditions

TERMS & CONDITIONS
- Each booking is subject to UMEX Ltd UK / LLC standard terms and conditions.
- The course may be videotaped / recorded for future distribution and attendance conveys rights of recording.
- If you have no acknowledgement by 2 weeks prior to training, please call us to confirm.
- To qualify for early registration, payments must be received 2 months prior to the course.
- Full payment is required with registration.
- Payment must be received 1 month prior to the commencement of training.
- We reserve the right to refuse training to any delegate, if payment has not been received.
- Please contact training@unmannedexperts.com for further details.

SUBSTITUTION, POSTPONEMENT and CANCELLATION POLICY
- Companies may substitute delegates at any time by providing reasonable advance notice.
- Cancellations received in writing not less than 14 days prior to training will receive a 90% credit for application to subsequent UMEX courses in the following 2 years.
- No credit will be issued for any cancellations occurring within 14 days of training.
- Should UMEX cancel a course for any reason, 100% refund will be remitted.
- Should UMEX postpone a course and the delegate is unable to attend the new proposed dates, then 100% will be refunded.
- No refunds will be given under any other circumstance.
- UMEX is not responsible for any loss or damage as a result of a substitution, alteration, cancellation or postponement of a course.
- UMEX shall assume no liability in the event of a course being cancelled, rescheduled or postponed due to a fortuitous event (e.g. war, fire, labor strike, extreme weather or other emergency), Act of God, unforeseen occurrence or any other event that renders completion of the training impracticable, illegal or impossible.
- UMEX reserves the right to modify the course syllabus and instructors without any liability.

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