VFS CONFERENCE:
NEXT GENERATION PILOTS
TRAINING & CERTIFICATION

VFS MONTREAL-OTTAWA CHAPTER
October 20th 2021
Montreal / Ottawa Chapter

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Vertical Flight Society
McGill University Chapter
Vertical Flight Society
Concordia University
Our Mission

Increase interest in vertical flight across Canada
Create a platform to facilitate networking & collaboration
Provide learning opportunities through exclusive conferences

Join us and reach out if you want to be more involved in the community!
Today’s Event: Next Generation Pilots

Yann Lavallée
Senior Test Pilot, Bell

Giorgio Clementi
President, International Test Pilots School

Stella Hughes
Advanced Air Mobility Strategy, Business Development & Partnerships Leader, CAE
TEST PILOT DUTIES TODAY AND TOMORROW

Yann Lavallee, Bell Textron Canada
Exponential Technology Advances

Not too long ago: Paper charts and wet compass, clock.

Today: Map, Distance, Fuel burn, etc.

Photo of Bell 505 with Garmin autopilot from Vertical magazine
Different phases of an aircraft creation:
- The idea, the vision.
- The market study.
- The preliminary design.
- Establishing the certification basis.
- The development testing.
- The certification testing.
- Commercialization.
- Customer support.

The pilots' inputs and knowledge is beneficial to every phase.
How do the Test Pilots get involved?

Sight (Vision)  Hearing (Auditory)  Smell (Olfactory)

Touch (Tactile)  Movement (Vestibular)  Taste (Gustatory)  Body Position (Proprioception)
Acquiring data via human senses – Sight

Sight (Vision)

The sight:
- Outside visibility.
- Reflections.
- Instruments.
Acquiring data via human senses – Smell

The smell:
- Early detection of failures minimizes consequences and collateral damage.
- Passenger comfort and health safety.
Acquiring data via human senses – Taste

Taste (Gustatory)

The taste:
- Not a sense normally used during flight testing.
Acquiring data via human senses – Hearing

Hearing (Auditory)

The Hearing:

- Detection of anomalies.
- Crew and occupant's fatigue.
- Operational safety.
Acquiring data via human senses – Touch

The touch:
- Operability.
- Control forces.
- Tactile feedback.
- Positive engagement.
Movement (Vestibular)

The movement:

- Aircraft provided cues.
- Steady condition workload.
- Dynamic maneuvers workload.
Body Position (Proprioception)

The muscle memory and sensation:

- Climb in and out safely.
- Rapid Reach of important A/C controls.
- Situational awareness in the dark for crew and occupants.
Acquiring data via human senses – Common Sense

A not so common, common sense:

- Aviation operational knowledge.
  - Environment.
- Flight profiles and procedures.
- Traffic sequencing and separation.
- Helps provide specific desired characteristics.
How will the Test Pilot’s contribute to the future of aviation?

Reality check:
- Gravity
- Planet earth
- Human physiology
- Weather

Future capabilities:
- Air taxi, Air Delivery, Air support.
How will the Test Pilot’s contribute to the future of aviation?

<table>
<thead>
<tr>
<th>Failure Condition Classification and associated reliability</th>
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<tbody>
<tr>
<td><strong>No Safety Effect</strong></td>
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<tr>
<td>No probability requirements</td>
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In other words, if a system failure could result in a loss of life; it must never happen.
How will the Test Pilot’s contribute to the future of aviation?
THANK YOU
NEXT GENERATION PILOTS: TRAINING AND CERTIFICATION

A TEST PILOT SCHOOL PERSPECTIVE

EVENT BY VERTICAL FLIGHT SOCIETY

GIORGIO CLEMENTI
PRESIDENT
INTERNATIONAL TEST PILOTS SCHOOL
Effective and affordable training of flight test personnel including those for UAS/UAM is as much a requirement as it ever was for piloted aircraft.

The traditional test pilot school approach remains relevant, involving a thorough preparation in underlying theoretical concepts coupled with instruction in the flight test techniques and opportunities for students to apply them, gather data, analyze it and report their findings.

Demand for more customization, lower costs, training efficiency can be met leveraging technology

ITPS has been progressing initiatives on multiple fronts to meet these challenges with excellent results.
The only school of flight testing in Canada
One of only four fully accredited in the world
Post Graduate degree granting institution – MSc in Flight Test Engineering

95 full time staff

22 aircraft fleet
HOW WE DO IT FOR PILOTED AIRCRAFT

GRADUATE TEST PILOT COURSE
50 WEEKS DURATION
110+ FLIGHT HOURS
20 AIRCRAFT TYPES
400+ LECTURE HOURS
  ▪ Performance
  ▪ Flying Qualities
  ▪ Digital Flight Control Systems
  ▪ Avionics
  ▪ Test Planning and Reporting
  ▪ Risk Management

CUSTOMERS MOSTLY MILITARY AND MAJOR AIRCRAFT MANUFACTURERS

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EVOLUTION

SIMULATION
• ENGINEERING SIMULATORS
• FULL MOTION SIMULATORS
• VIRTUAL REALITY
• MIXED REALITY

IN ADDITION TO 110+ HOURS FLIGHT TRAINING
Rehearse Hazardous Flight Tests
Enhance Transport Category aircraft training
Enhance Flying Qualities and DFCS training
Enhance Avionics Systems FT training
DISTANCE LEARNING

• Entire fixed wing, rotary and UAS curricula available - 400 + lecture hrs.

• As short courses or part of long course or blended course

• In 2020 delivered entire fixed wing ground school by distance learning

• Immersive video flight demonstration using VR headset.

• Credits towards MSc in Flight Test Engineering
HOW WE DO IT FOR REMOTELY PILOTED

MEET EXPECTATIONS OF:

- START UP MANUFACTURERS
- MAJOR MANUFACTURERS
- MILITARY

VERY DIFFERENT AND VARIED STUDENT BODY

- Academic qualifications
- Previous flying experience

VERY DIFFERENT TRAINING BUDGETS!

- START UP MANUFACTURERS – CLOSE TO ZERO
- MAJOR MANUFACTURERS – BETTER……..
- MILITARY – SOMEWHAT BETTER BUT……..(NO BUCK ROGERS, NO BANG!)
THEY’RE NOT RC AIRPLANES!

PERCEPTION:
• NO PILOT ON BOARD
• SMALL (ISH)
• SOME LOOK LIKE RC AIRPLANES
• THEREFORE: TRAINING MUST BE CHEAP AND SHORT! (VERY CHEAP! VERY SHORT!)

REALITY:
▪ VERY SOPHISTICATED TECHNOLOGY
▪ NOVEL AND VARIED LIFT AND PROPULSION STRATEGIES
▪ FLY-BY-WIRE
▪ HIGH LEVELS OF STABILIZATION AND AUTOMATION
▪ COMPLEX AND SENSITIVE SENSOR PACKAGES
▪ DATALINK AND TRACKING
▪ GROUND CONTROL STATION

COULD EASILY JUSTIFY A ONE-YEAR UAS FT PROGRAM

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EARLY DAYS - 2013

INFINITY 3 & 4 UAV

ROKAF GLOBAL HAWK FT TEAM

Qualified TPs and FTEs

5-week program
Manned Remotely Piloted Aircraft (MRPA)

- Medium altitude long endurance UAV surrogate
- Pilot on board to permit beyond visual line of sight operations
- Three principal components –
  - Air vehicle,
  - Electro optic sensor package,
  - Deployable ground control station
• Developed in-house by ITPS
• COTS software for modelling and real time parameter visualization
• Through MATLAB Simulink it is possible to modify the flight control system and the vehicle’s airframe and engine characteristics.
• Used to demonstrate test methods and rehearse flight test missions.
MODULAR UAM/UAS FLIGHT TEST PROGRAM
ONE WEEK ONLINE THEORETICAL MODULES

INTRODUCTION TO UAM/UAS FLIGHT TESTING
PERFORMANCE FLIGHT TESTS FW/VTOL
FLYING QUALITIES FW/VTOL
ADVANCED FLIGHT TESTS
TWO-WEEK PRACTICAL MODULES AT ITPS

CAT-2 UAS FLIGHT TEST PROGRAM
24 WEEK PROGRAM AT ITPS

PERFORMANCE FW/VTOL
FLYING QUALITIES FW/VTOL
ADVANCED FLIGHT TESTS

GRADUATE + UAS FLIGHT TEST PROGRAM
50 WEEK PROGRAM AT ITPS

PERFORMANCE FW/VTOL
FLYING QUALITIES FW/VTOL
DIGITAL FLIGHT CONTROL SYSTEMS
ADVANCED FLIGHT TESTS
AVVIONICS
SYSTEMS AND SENSORS TESTING
SUMMARY

• More Simulation
• More customisation
• More downloading of aircraft training to simulator
• More downloading of advanced flight training to more foundational programs using simulation
• More remote, online, blended delivery solutions
• Lower costs, better learning, greater efficiency, high quality.
Questions?
Training the Next Generation of Pilots

VFS Montreal-Ottawa Chapter

Stella Hughes
AAM Strategy, Business Development & Partnerships Leader
StellaMarissa.Hughes@cae.com
Civil Aviation Pilot Demand 2020-2029

Active Pilots in 2029:
- Total: 484k
- New Pilots: 45k
- Active Pilots: 58k
- Pilots for Growth: 4k
- Additions: 93k

Business Jet Pilots Needed:
- Business Jet: 54k
- New Pilots Needed: 58k
- Active Pilots: 58k

Airline Pilots Needed:
- Business Jet: 333k
- New Pilots Needed: 426k
- Active Pilots: 426k

2019 vs 2029:
- Active Pilots:
  - 2019: 333k
  - 2029: 484k
- Pilots Replacements:
  - 2019: 41k
  - 2029: 126k
Workforce considerations are critical to a successful roll out of AAM operations

There is a growing industry realization that the development of eVTOL aircraft and launch of AAM operations will have an incremental increase on demand for professional pilots commencing by 2023-2025.

Urban air mobility (UAM) will accelerate demand for pilots.

Number of pilots required to fulfill urban-air-mobility (UAM) need in next decade

- **2018 Total number of pilots:** 380,000
- **2028 Total number of pilots:** 590,000

**Airline**
- 305,000
- Continuing 210,000
- Attrition: 150,000
- Attrition replacement: 150,000
- Airline growth: 10,000
- UAM growth: 60,000

**Business**
- 55,000

Note: Numbers are rounded.

How do you create pilots for a brand new type of aircraft?
How do you create pilots for a brand new type of aircraft?
How do you create pilots for a brand new type of aircraft?

- OEM
- Training Provider
How do you create pilots for a brand new type of aircraft?

Type Certification

- OEM
- Training Provider
How do you create pilots for a brand new type of aircraft?

- OEM
- Training Provider
- Authorities

Type Certification
How do you create pilots for a brand new type of aircraft?

- Type Certification
- Operational Evaluation complete

OEM
- Authorities
- Training Provider
How do you create pilots for a brand new type of aircraft?

Type Certification

Operational Evaluation complete

OEM

Authorities

Training Provider
How do you create pilots for a brand new type of aircraft?

Type Certification  Operational Evaluation complete

OEM
Training Provider
Authorities
Operator
Operator
How do you create pilots for a brand new type of aircraft?

Pilot creation requires careful planning and close collaboration between the OEM, CAAs, ATO, and operator.
Innovation in Pilot Training is Required to Support These Innovative New Aircraft

• Although most eVTOL developers expect their aircraft to eventually become fully autonomous, having a professionally trained pilot workforce will be a critical path to widespread commercialization and public acceptance of advanced air mobility from inception to the considerable future.

• With a sizeable workforce needed, this is an inflection point in aviation that requires a clean-sheet approach to workforce training.

• eVTOL pilots that come from the fixed-wing or rotorcraft pilot corps will need those same skills plus some additional skill-sets to meet the unique capabilities and designs of eVTOL aircraft.

• New training technologies and processes will enable a paradigm shift to train pilots in an affordable, scalable means that ensures safety and meets the unique needs of AAM.
The challenges of developing a training program for eVTOL aircraft

**Unique Operating Environment**
- **Shorter cycles for missions**
  - 5-30 minutes mission duration
  - eVTOL pilots could experience 2-4 critical phases of flight (takeoff/landing) per hour compared to the 2-4 critical phases of flight per day with traditional pilots
  - Limited battery life
- **Congested Air Space**
  - Operations in high density airspace with busy radio transmission requiring more agile decision making and communication
- **Urban Environment**
  - Micro-weather, Comms dead zones
  - Landing in confined, intra-city locations
  - Emergency procedures near populated areas

**Training Challenges**
- **Regulatory**
  - Undefined regulatory requirements for eVTOL pilots (discrepancies between CAAs)
  - Short-term and long-term approach necessary
- **Single-pilot operations**
  - Most eVTOL OEM's developing single-pilot cockpits, driving a change in equipment specifications
  - Need to replace multi-crew communications with UTM and a culture of safety
- **Device challenges**
  - Global deployment need and ability to train pilots with various backgrounds safely, efficiently, and at a never before seen growth rate drives the need for smaller footprint and lower cost devices

Several aspects of AAM operations and training procedures will differ from traditional aviation operations, and these will need to be reflected in eVTOL pilot training.
CAE is embracing next-generation processes & advanced technologies for the Modern Learner

In this innovative new industry, we must be equally disruptive with training

Components of a clean – sheet approach:

- Re-center training around pilot competencies (outcome of training), rather than prescriptive models (the inputs of training) seen in traditional pilot training.
- Modern learning techniques like adaptive learning for recurrent courses as an effective and efficient means forward for the modern training program.
- Integration of data analytics to ensure an efficient training footprint that meets the safety requirements, performance evaluation and mission complexities expected of AAM operations.
- Leverage advanced technologies such as VR/MR that caters to the unique training & operational needs of AAM

New training technologies and processes will enable a paradigm shift to train pilots in an affordable, scalable means that ensures safety and meets the unique needs of Advanced Air Mobility
AAM pilots will be an **integral component** of this industry from its inception and an **essential link to the success of the industry**.

For **widespread operationalization** of AAM, a **unified approach** is necessary to building the AAM workforce, **requiring close collaboration** between OEMs, operators, Civil Aviation Authorities, training providers, and the pilot community.

Training is just the first step to gearing up a workforce – the conversation on building the AAM workforce and **establishing a motivating career path** needs to start now!

The industry must have a forward-looking approach that takes into consideration factors beyond training to ensure the success of a qualified eVTOL pilot workforce.
Thank you!