

5th Military Metrology for Aerospace Symposium

Emerging technologies in
the Aerospace environment

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OBJECTIVES

1. TO HIGHLIGHT THE KEY EMERGING TECHNOLOGIES AND THEIR EMPLOYMENT OR POTENTIAL EMPLOYMENT
2. TO IDENTIFY AND BRIEFLY DISCUSS THEIR APPLICATION TO LOGISTICS IMPROVEMENTS
3. TO POINT OUT PROS AND CONS, SPECIFICALLY RISKS AND SHORTFALLS
4. TO PROVIDE AN OVERVIEW OF THE PERSPECTIVES OF THE APPLICATIONS WRT THE AEROSPACE DOMAIN

DISCLAIMER

Solar impulse aircraft

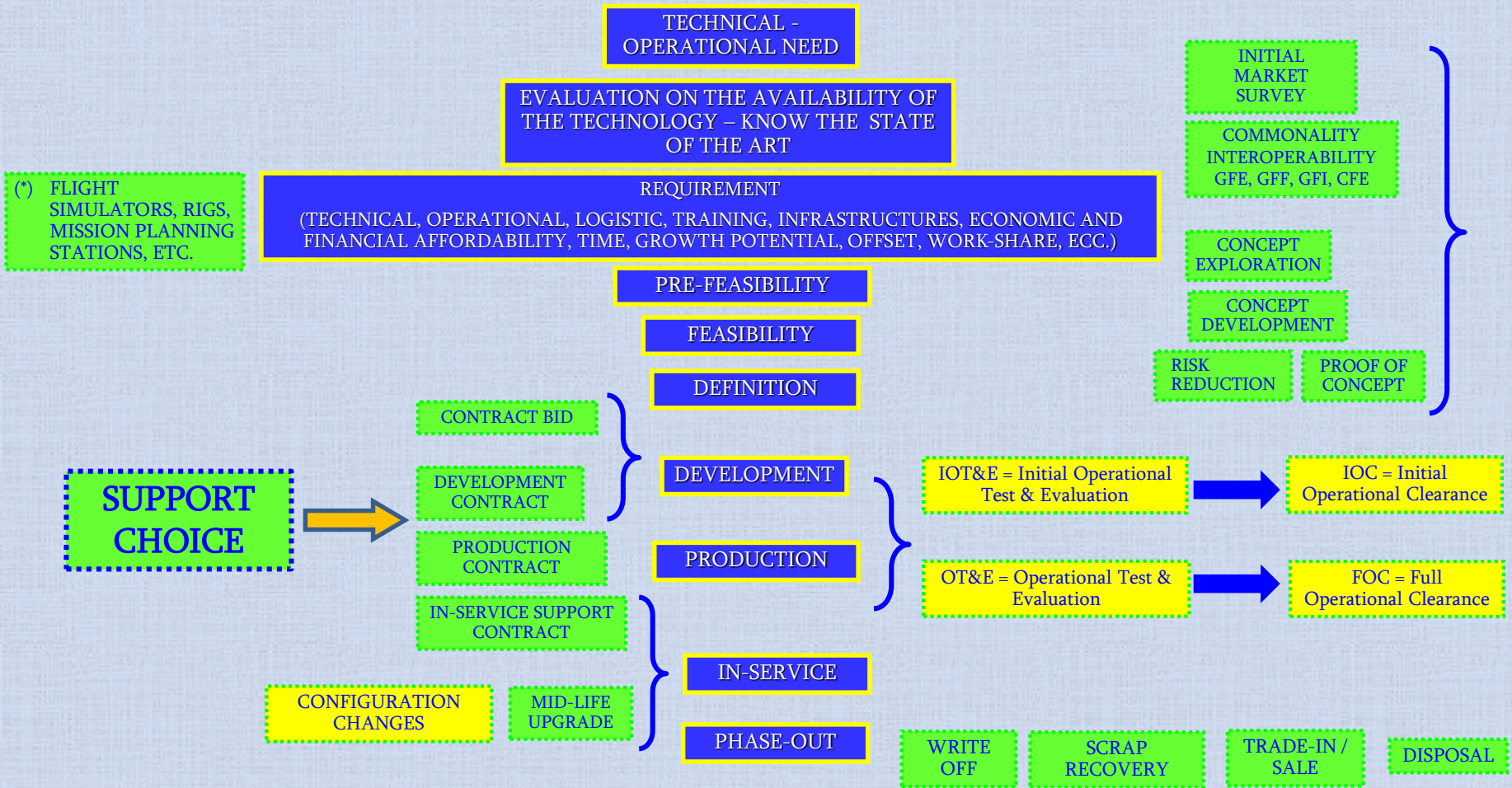
1. THE INFORMATION PROVIDED AND THE CONTENT OF THIS PRESENTATION ARE BASED UPON OPEN SOURCES
2. THIS APPLIES ALSO TO THE MEDIA USED

THE LIFE CYCLE

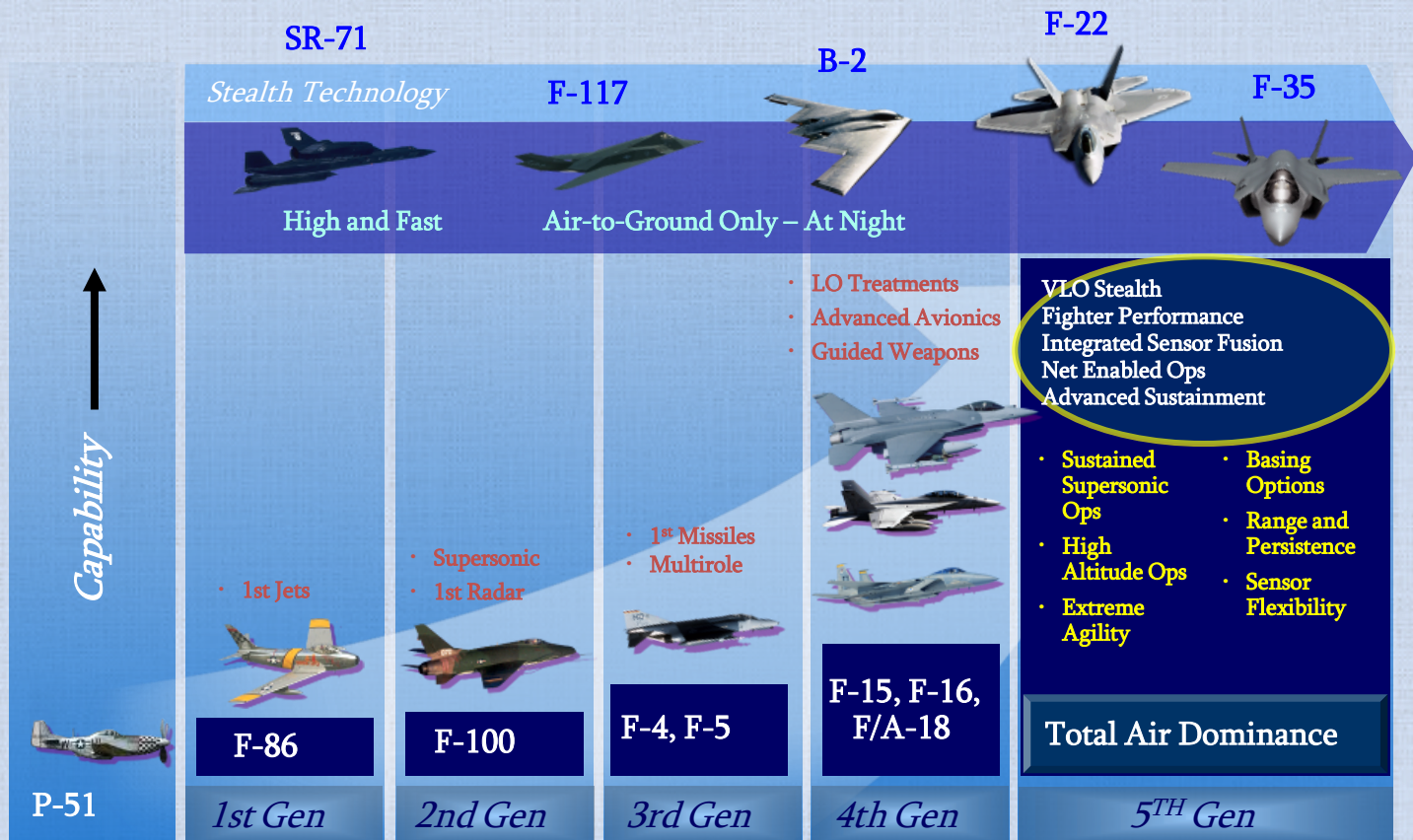
WHY THE LIFE CYCLE

1. THE LIFE CYCLE OF A MAJOR AEROSPACE PROGRAMME PROVIDES ALL RELEVANT MILESTONES
2. IT PROVIDES A CLEAR SEQUENCE OF ALL POSSIBLE PHASES
3. IT ALLOWS TO POINT OUT THE STARTING POINT OF A PROGRAMME, WHICH IS NOT ALWAYS FROM THE BEGINNING
4. IT IS USEFUL TO FOLLOW THE ITERATION THROUGH THE PATTERN

TYPICAL LIFE CYCLE OF A MAJOR AEROSPACE PROGRAMME



FIGHTER AIRCRAFT CAPABILITIES vs GENERATIONS



THE SEQUENCE

KEY TECHNOLOGIES IN AEROSPACE

1. BLOCKCHAIN TECHNOLOGY
2. BIG DATA ANALYSIS
3. ARTIFICIAL INTELLIGENCE FOR CYBER
4. NGS FOR BIOLOGICAL THREAT PREPAREDNESS
5. ARTIFICIAL INTELLIGENCE AND COGNITIVE COMPUTING
6. INTERNET OF THINGS
7. ROBOTICS
8. AUTONOMY
9. ADDITIVE LAYER MANUFACTURING
10. SUB-ORBITAL FLIGHT
11. FUTURE ADVANCED MATERIALS

KEY TECHNOLOGIES IN AEROSPACE – APPLICATIONS TO LOGISTIC SUPPORT

1. DRONES – RPAS (REMOTELY PILOTED AIR SYSTEMS)
2. DESIGN CONCEPTS : DESIGN TO COST / DESIGN TO MAINTAIN / DESIGN TO OPERATE – REDUCE THE LOGISTIC FOOTPRINT / OPTIMIZE THE SUPPLY CHAIN
3. ADDITIVE LAYER MANUFACTURING
4. BLOCKCHAIN
5. INTERNET OF THINGS - DUAL USE TECHNOLOGIES – RESILIENCE
6. ENHANCE THE CAPABILITY IN THE SUB-ORBITAL FLIGHT
7. ENVIRONMENT - SOLAR IMPULSE – ELECTRIC FLIGHT
8. MATERIALS

SUBSET OF THE KEY TECHNOLOGIES IN AEROSPACE AND THEIR APPLICATIONS TO LOGISTIC SUPPORT

1. DRONES – RPAS (REMOTELY PILOTED AIR SYSTEMS)
2. DESIGN CONCEPTS : DESIGN TO COST / DESIGN TO MAINTAIN / DESIGN TO OPERATE – REDUCE THE LOGISTIC FOOTPRINT / OPTIMIZE THE SUPPLY CHAIN
3. ADDITIVE LAYER MANUFACTURING
4. BLOCKCHAIN - AIRATHON INITIATIVE
5. INTERNET OF THINGS - DUAL USE TECHNOLOGIES – RESILIENCE
6. ENHANCE THE CAPABILITY IN THE SUB-ORBITAL FLIGHT
7. ENVIRONMENT – SOLAR IMPULSE – ELECTRIC FLIGHT
8. MATERIALS

KEY TECHNOLOGIES / EUROPEAN DEFENCE

1. BLOCKCHAIN TECHNOLOGY
2. BIG DATA ANALYSIS
3. ARTIFICIAL INTELLIGENCE FOR CYBER
4. NGS (NEXT GEN SEQUENCING) FOR BIOLOGICAL THREAT PREPAREDNESS
5. ARTIFICIAL INTELLIGENCE AND COGNITIVE COMPUTING
6. INTERNET OF THINGS (IOT)
7. ROBOTICS
8. AUTONOMY
9. ADDITIVE LAYER MANUFACTURING (ALM)
10. SUB-ORBITAL FLIGHT
11. FUTURE ADVANCED MATERIALS

KEY TECHNOLOGIES / APPLICATIONS

1. DRONES – RPAS (REMOTELY PILOTED AIR SYSTEMS)
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2. DESIGN CONCEPTS

EVOLUTION OF DESIGN PHILOSOPHY TOWARDS LOGISTICS REQUIREMENTS

- DESIGN CONCEPTS ORIENTED TO THE EMPLOYMENT, TO THE SCENARIO (DEPLOYABLE IS THE KEYWORD)
- SAFE LIFE
- FAIL SAFE
- ON CONDITION
- CONDITION MONITORING (1987, Swissair monitoring EGT in cruise)
- DESIGN TO COST
- DESIGN TO MAINTAIN (DIAGNOSTIC – PROGNOSTIC MAINTENANCE) - MAINTENANCE 4.0
 - Prognosis and Health Management (PHM)
 - Condition-based Maintenance (CBM)
 - intelligent and predictive maintenance system
- DESIGN TO OPERATE UNDER EXTREME CONDITIONS (EMC, NEMP, LEMP, WEATHER, TEMPERATURES, VIBRATIONS, ACCELERATIONS)
- USE ROBOTS
- REDUCE THE LOGISTIC FOOTPRINT (SET OF PART NUMBERS, FLY-AWAY KIT)
- OPTIMIZE SUPPLY CHAIN (SILEF, ALIS), CONFIGURATION MANAGEMENT, MODS ACCOUNTING

50 seconds video



THE HyQReal QUADRUPED ROBOT

DEVELOPED BY A TEAM OF THE IIT (ITALIAN INSTITUTE OF TECHNOLOGY IN GENOA)

HYQREAL IS 1,33 M LONG AND 90 CM TALL, AND ITS WEIGHT IS 130KG

THE ROBOT IS PROTECTED BY AN ALUMINUM ROLL CAGE AND A SKIN MADE OF KEVLAR, GLASS FIBER AND PLASTIC

THE QUADRUPED HAS CUSTOM-MADE FEET MADE IN SPECIAL RUBBER FOR HIGH TRACTION ON THE GROUND AND IS EQUIPPED WITH A 48 VOLT BATTERY WHICH POWERS FOUR ELECTRIC MOTORS CONNECTED TO FOUR HYDRAULIC PUMPS

THE ROBOT HAS TWO ONBOARD COMPUTERS: ONE DEDICATED TO VISION AND ONE TO CONTROL

THE PIAGGIO P-180 AIRCRAFT THE ROBOT WAS PULLING HAS A WEIGHT OF 3,3 TONS

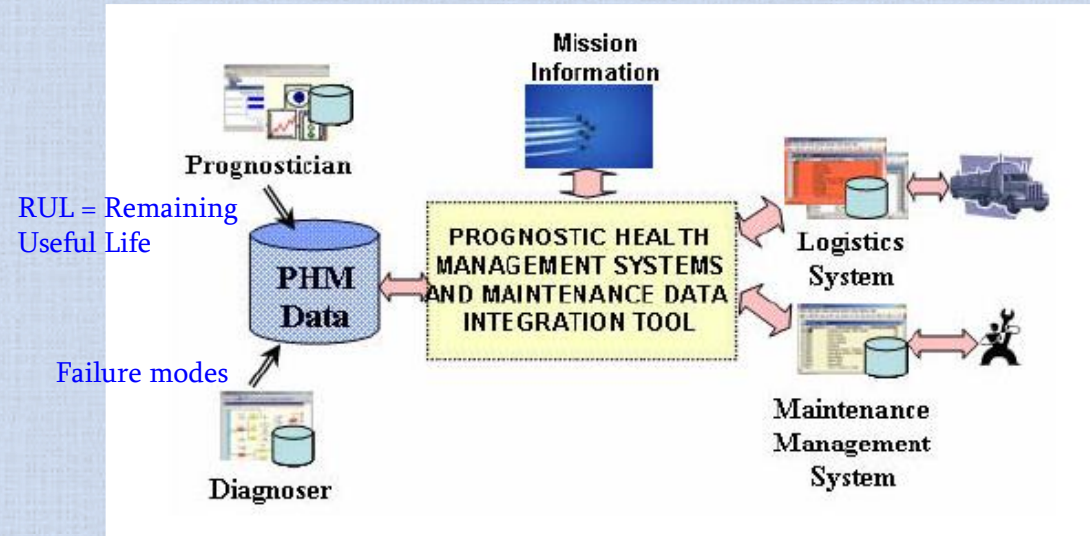


PROGNOSTIC MAINTENANCE

TO REDUCE OWNERSHIP COST AND TO INCREASE AIRCRAFT AVAILABILITY THROUGH A PROGNOSTIC AND HEALTH MANAGEMENT SYSTEM (PHM)

- ✓ RESOURCES (PARTS, PERSONNEL, MATERIALS, TOOLS) REQUIRED FOR MAINTENANCE ACTIONS
- ✓ AVAILABLE RESOURCES IN THE INVENTORY
- ✓ LEAD TIME FOR RESOURCES WHEN ORDERED

- PLANNED MISSION INFORMATION
- IDENTIFY THE RELEVANT PARAMETER
- DISCRIMINATIVE FEATURES (SENSORS) FROM THE PARAMETERS SUBSET



- HEALTH STATUS OF THE COMPONENT ALSO BASED ON MAINTENANCE RECORDS
- OBTAIN VERY LOW FALSE ALARM RATE
- ACHIEVE A HIGH OVERALL ACCURACY

3. ADDITIVE LAYER MANUFACTURING



Avio Aero plant in Cameri (NO), opened in 2013



Airbus A350 XWB Aircraft
Contains Over 1,000 3D
Printed Parts



ALM CLASSIFICATION

- AT LEAST 7 DIFFERENT ALM TECHNOLOGIES EXIST
- THOSE MOSTLY USED ARE :
 - ✓ FDM (FUSED DEPOSITION MODELING)
 - ✓ DLP (DIRECT LIGHT PROCESSING OR STEREO LITHOGRAPHY)
 - ✓ SLS (SELECTIVE LASER SINTERING)
- EACH ONE HAS HIS OWN ADVANTAGES BUT ALSO DISADVANTAGES – WE ARE NOT GOING TO COVER THIS
- IT IS IMPORTANT TO NOTE THAT MANY SERIES PRODUCTION ARE WIDELY CONDUCTED AT PRESENT



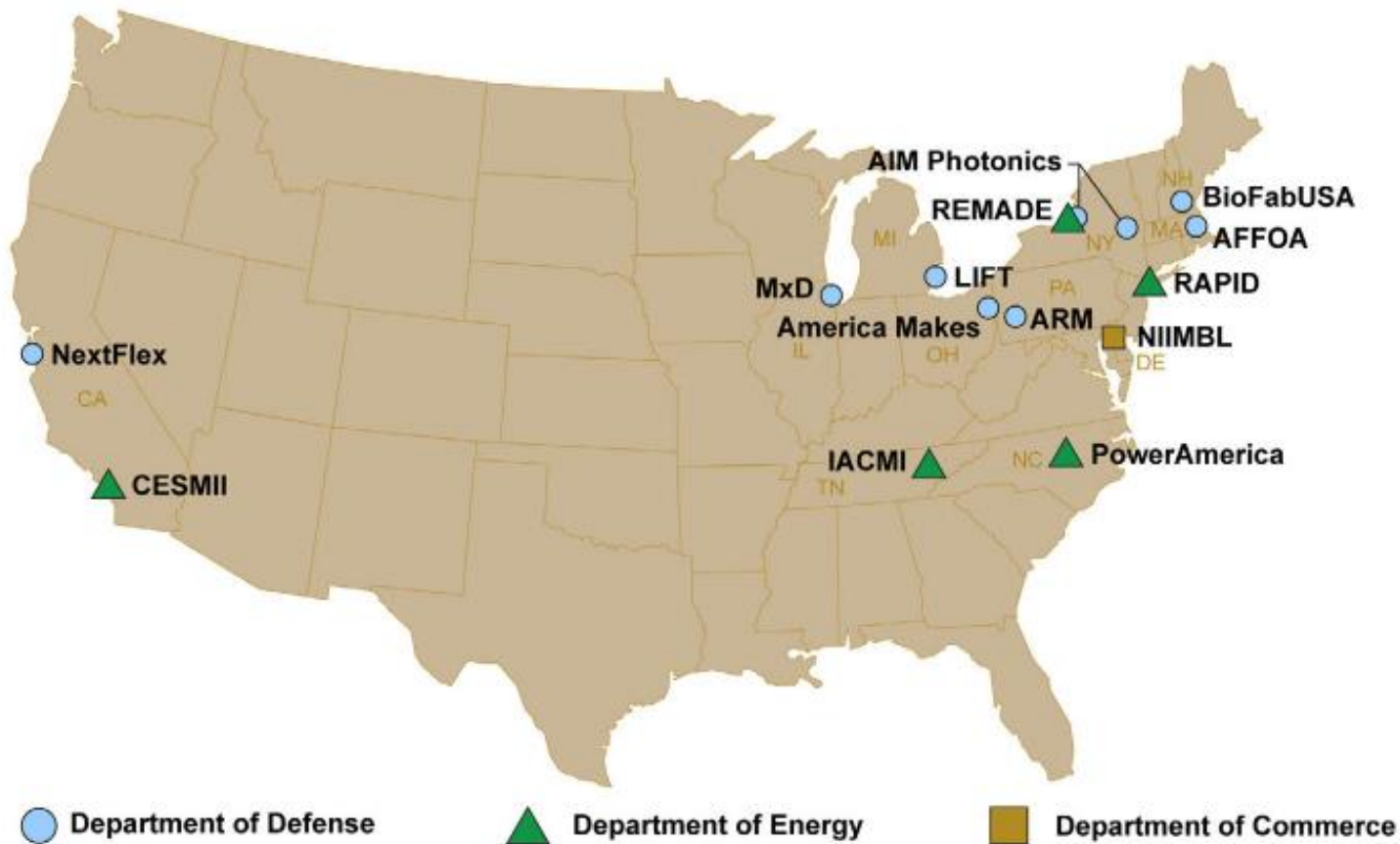
ALM CHARACTERISTICS AND ADVANTAGES

- ALM IS RECOMMENDED IN CASE OF **LIMITED SERIES** PRODUCTION
- ALM CAN REPLACE CONVENTIONAL TECHNOLOGIES, I.E.: FOUNDRY, PRESSING
- ALM ALLOWS NEW SUPPLY CHAIN MANAGEMENT
- A 3D PRINTER CAN PRODUCE A REQUIRED PART ONLY WHEN NECESSARY AND WHERE YOU NEED IT STARTING FROM A CAD FILE
- RAPID PROTOTYPING AND TOOLING
- PART CONSOLIDATION - REDUCED NUMBER OF PARTS TO BE BUILT AND ASSEMBLED
- ALM MUST DEMONSTRATE ADEQUATE QUALITY OF MATERIALS
- MAIN CAUSES FOR FAILURE IN AIRCRAFT COMPONENTS ARE FATIGUE (55%) THEN CORROSION (16%) AND OVERLOAD (14%)



A 3D printed composite layup tool used in the aerospace industry

LOCATION OF THE AI MANUFACTURING USA INSTITUTES



Sources: Department of Commerce, National Institute of Standards and Technology, *Manufacturing USA Annual Report, FY 2017* (August 2018); Map Resources (map). | GAO-19-409

ADDITIVE LAYER – CHALLENGES & PERSPECTIVES

- DIFFERENT TECHNIQUES
- 3D VS CONVENTIONAL – PROS AND CONS – SERIES, TIME AND COST IMPLICATIONS
- POWDERS – SUPPLY, STORAGE, DEGRADATION
- **CERTIFICATION – AIRWORTHINESS (DEMONSTRATE SAME STATIC, DYNAMIC, FATIGUE, CHARACTERISTIC THAN CONVENTIONAL COMPONENTS)**
- INTELLECTUAL PROPERTY RIGHT (IPR) – 3D CAD FILES
- FUTURE: ACQUISITION OF AIRCRAFT MAY INCLUDE THE REPRODUCTION RIGHTS, THE CERTIFIED TRAINING FOR PRODUCTION AND THE RECOMMENDED 3D PRINTER
- FOR LEGACY AIRCRAFT REVERSE ENGINEERING MAY BE AN OPTION, THOUGH **CERTIFICATION OF THE PRODUCED PARTS IS REQUIRED**
- WE COULD THEN PRODUCE CRITICAL PARTS, OBSOLETE PARTS, “ORPHAN” PARTS I.E.: THE INDUSTRY IS OUT OF BUSINESS EITHER FOR PRODUCTION, REPAIR, MAINTENANCE OF THE ITEMS

4. BLOCKCHAIN - The Airathon initiative – Italian Air Force

- IN 2018 THE ITALIAN AIR FORCE HAS ORGANISED THE EVENT CALLED AIRATHON
- PARTICIPATION WAS OPEN TO START-UP, UNIVERSITIES, PRIVATE COMPANIES, INDUSTRIES
- OBJECTIVE: TO MERGE THE IDEAS, CREATE AND PRESENT EMERGING TECHNOLOGIES RAPIDLY APPLICABLE TO THE AEROSPACE LOGISTICS
- THE 48 HOURS COMPETITION WAS HELD AMONG 8 TEAMS, WITH AIR FORCE MENTORS, TRYING TO SELECT THE BEST IDEAS AND APPLICATIONS (BLOCKCHAIN, AUGMENTED AND VIRTUAL REALITY, INTERNET OF THINGS)
- THE WINNERS WERE TWO PROJECTS RELATED TO IMMERSIVE REALITY AND BLOCKCHAIN, APPLICABLE TO THE TRAINING AND TO THE MAINTENANCE



4. BLOCKCHAIN – ADVANTAGES AND RISKS

- GREATER TRANSPARENCY
- ENHANCED SECURITY. IMPROVED TRACEABILITY (INVENTORY TRACKING)
- INCREASED EFFICIENCY AND SPEED. ...
- REDUCED COSTS
- INVOICING AND PAYMENTS
- SETTLING DISPUTES
- PAYMENTS AND MONEY TRANSFERS.
- SMART CONTRACTS
- NOTARY
- DISTRIBUTED CLOUD STORAGE
- DIGITAL IDENTITY
- SUPPLY-CHAIN COMMUNICATIONS & PROOF-OF-PROVENANCE
- GIFT CARDS AND LOYALTY PROGRAMS
- NETWORKING AND IOT



- TRUSTING THE BLOCKCHAIN DEVELOPERS AND MANAGERS – THE MINERS
- IMPLEMENTING DATA PRIVACY LEGISLATION
- POLICY AND REGULATORY RISKS (HACKING OF CRYPTOCURRENCY)
- SPEED OF TRANSACTIONS
- MALICIOUS USERS
- IDENTITY AND SECURITY

Observer business agenda
Facebook

Crypto is coming: get ready to spend Facebook's money

Shane Hickey

Sun 16 Jun 2019 07:00 BST

The social network is likely to release details of its cryptocurrency this week: and it won't be much like Bitcoin



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FACEBOOK CRYPTOCURRENCY

Sun 16 Jun 2019 07.00 BST

Crypto is coming: get ready to spend Facebook's money

Shane Hickey

On Tuesday 18^o of June, 2019, the social media is expected to reveal its own cryptocurrency, which has variously been called Libra and GlobalCoin.

However, unlike other cryptocurrencies, **the new creation will not have been founded in the spirit of libertarianism**, outside the backing of established, conventional authorities. Instead, it appears to have the endorsement of more than 12 corporations, from Uber to PayPal, Visa and Mastercard.

A group of companies have each invested some \$10m to join a consortium and administer it.

The price of Bitcoin, which was initially sold for a few cents before it reached a record high of just under \$20,000 per coin in December 2017. Each one now sells for just over \$9,000.



CONCLUSIONS

- PRESENTED SOME EMERGING TECHNOLOGIES FOR YOUR CONSIDERATION AND APPRECIATION
- TRIED TO POINT OUT PROS, CONS AND RISKS FOR ALL OF THEM
- FOCUS WAS ON THEIR IMPLEMENTATION IN AEROSPACE
- EVOLUTION OF THE LOGISTIC OPERATIONS, DESIGN, IMPLEMENTATIONS, ROBOTS
- ADDITIVE LAYER MANUFACTURING AND ITS POTENTIAL
- MAIN CONCERNS FOR THE BLOCKCHAIN TECHNOLOGY ARE : SECURITY IMPLICATIONS, MALICIOUS USERS, POSSIBLE SATURATION

CLOSING REMARK

"make your life a dream, and a dream a reality"

Antoine de Saint-Exupéry
(1900-1944)

French aviator and writer

