Overview

Honeywell Aerospace
Advanced Technology Europe

Honeywell

Honeywell's Businesses

Aerospace	Automation and Control Solutions	Performance Materials and Technologies	Transportation Systems

Phoenix, AZ headquarters

$12.1-12.3 billion sales*

Minneapolis, MN headquarters

$16.4-16.6 billion sales*

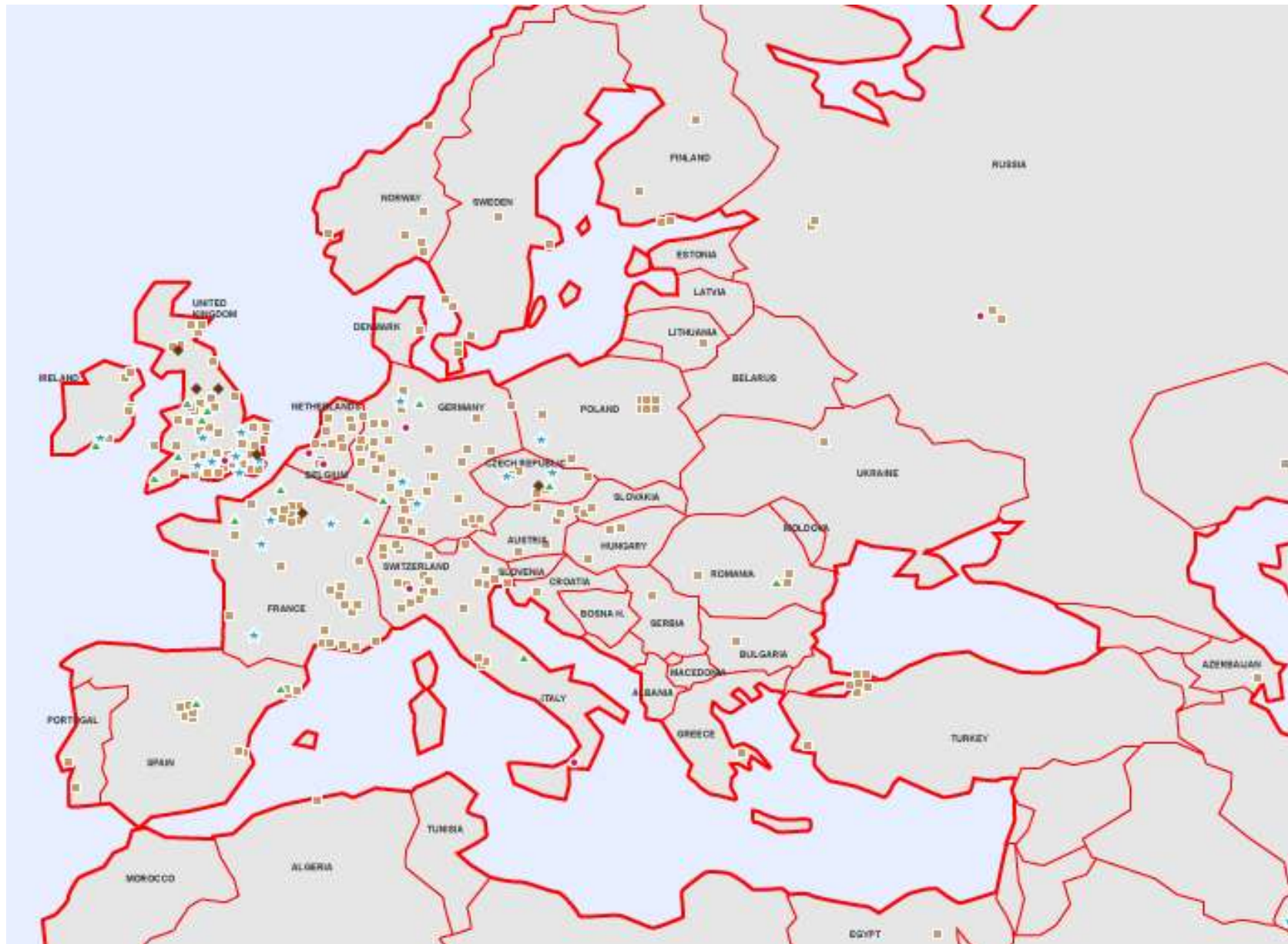**Morristown, NJ headquarters**

$6.9-7.0 billion sales*

Rolle, Switzerland headquarters

$3.6-3.7 billion sales*

* 2013 guidance

Honeywell in Europe

Transportation systems ▲ | Automation & control Solutions (ACS) ■ | Aerospace ★ | Speciality Materials ● | Corporate ◆

More than 30,000 People in the European Union:

- ACS: 16,500
- Transportation: 5,600+
- Aerospace: 4,000+
- Specialty Material: 1,100

Long term investments with

- Manufacturing sites, Field Service Engineer centers
- Repair & Overhaul sites
- 4 R&T sites in Europe, including a Global Design Center in Brno, Czech Republic – expanding R&D capabilities

Honeywell is a major industry player in Europe

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Honeywell Aerospace EU: Key R&D Centers

Toulouse, France

- FMS center of excellence
- Aircraft system architects, ATM

Raunheim, Germany

- APU Lab and test center

Maintal, Germany

- Inertial Guidance & NAV

Yeovil, Boxgrove, Broadstairs, Redditch, UK

- ECS
- Bleed
- Pressurization
- Displays & Helo security
- Turbo Machinery Analysis, CFD, Design & Testing
- Cryogenic cooling

Prague and Brno, Czech Republic

- Advanced Systems
  - Analysis
  - Modeling
  - Simulation
- ATM
- CNS
- Crew Interface & Platform Systems

Honeywell Businesses in the Czech Republic

POLAND

Praha

Plzen

Olomouc

CZECH REPUBLIC

GERMANY

Brno

AUSTRIA

SLOVAKIA

PRAGUE

- ACS laboratories
- Aero R&D center
- Aero EMEA Business Support
  - Sales B&GA, D&S, ATR
  - Customer Quality
  - Customer & Product Support
- Aero EMEA Functional Support
- Law & Contracts
- Communication
- IT Administration
- Finance

OLOMOUC

- HON Aero Olomouc
- OEM: Components for turbine
- engines
- R&O: Repairs of static
- engine components

BRNO

- R&D centre supporting ACS, AERO, TS engineering, ITSS applications
- ECC manufacturing site
- ADI Olympo (SS)
- Sensing & Control
- Corp – Shared services -
- HRS Payroll, Finance,...

Almost 3500 employees across CZ

Aerospace Engineering & Technologies –
Product Development (TRL 7-9)

Engine Controls

Controller Design, modification

Software Design & Certification (FAA)

Flight Controls

System Design & Development Software Tools

Low level board support package

Maintenance & Fault Diagnostics

Electronic Hardware

Electrical/EMC Design

Mech Design

Therm./Struct. Analysis

PCB Layout

Component Eng

ASIC/FPGA Design

Engineering Test Services

Test Automation, Modeling & Simulation

S/w, H/w & Mech Design

Sys Eng & Project Mgmt

Guidance & Navigation

System Engineering, Software Design & Certification

Advanced Technology

Technology Development

ATR , BGA and D&S Segments

- Major contribution to B787, A350 and ARJ21 programs
- Electronic hardware , ASIC design, software, simulation, modeling and prototyping skills

Impact

- Supported & delivered flight controls for B787 & ARJ21 platforms with high level of quality & on time schedule
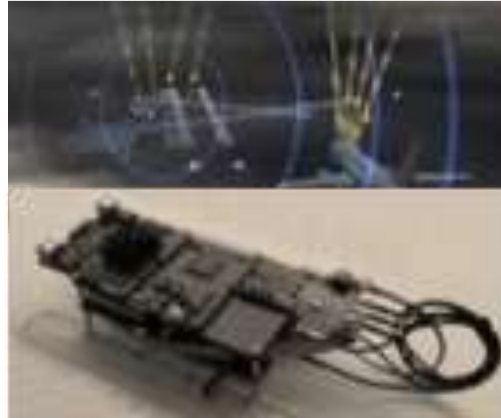- Building systems engineering & domain knowledge

Aerospace Advanced Technology Europe–
Technology Development (TRL 3-6)

## Systems Engineering & Applications

Power Management
Avionics Platforms
Human Centered Systems
Datalink & Flight Operations Services
Precision guidance
Trajectory Management
Surveillance Applications

Electronic Technologies

Satellite Navigation
Navigation & Sensors
Communication
Cooperative Surveillance
Platforms Systems
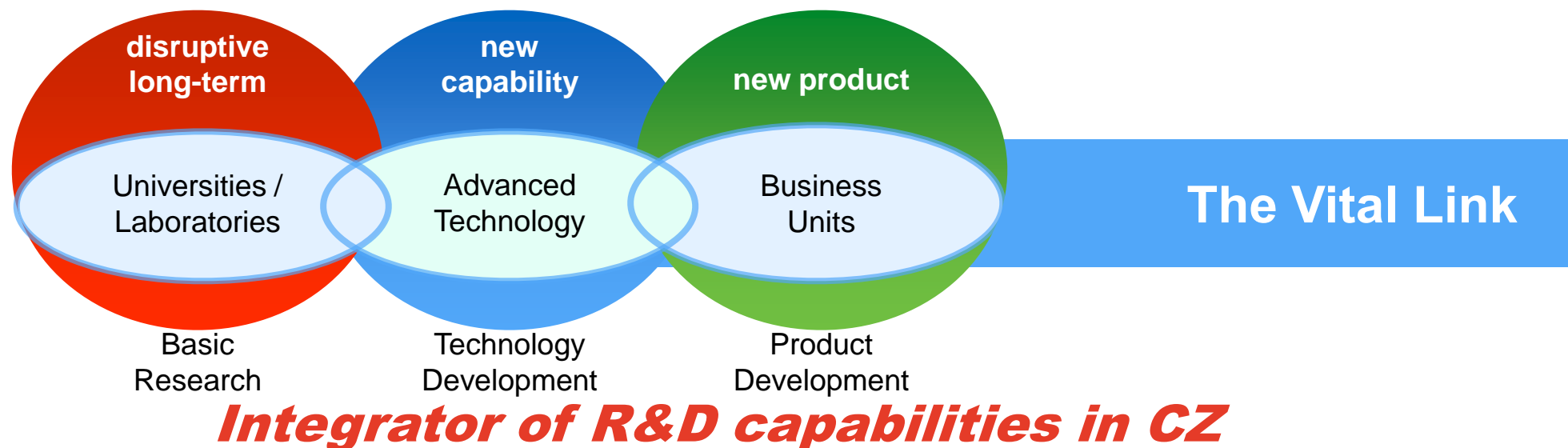Displays & Graphics
Power Distribution

Mechanical Technologies
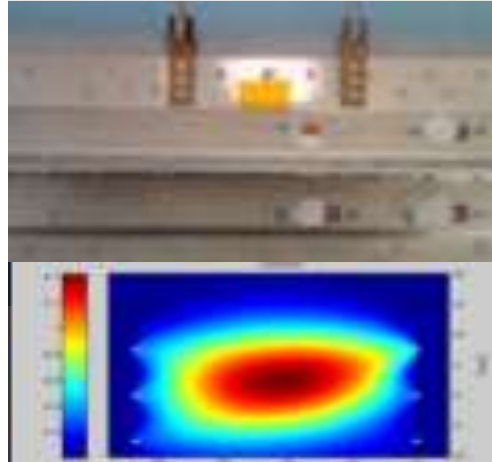
Condition Based Maintenance
Material & Process
Turbo Machine
Electrical generation/ drive

Modeling & Mock up & Simulation

Software prototyping of mockups and prototypes of future Honeywell products

disruptive long-term

new capability

new product

Universities / Laboratories

Advanced Technology

Business Units

The Vital Link

Basic Research

Technology Development

Product Development

Integrator of R&D capabilities in CZ

Advanced Technology COE

V. P. Advanced Technology COE
Bob Witwer

|		
Advanced Sensors & Microsystems Earl Benser	**Components, Power & Controls** Torey Davis	**Crew Interface & Platform Systems** Rakesh Jha
Advanced Systems & Prototyping John Linert	**Communications, Navigation & Surveillance Systems** Jeff Radke	**Engines & Air Management** Eric Blumer
Technology Strategy Bob Rasmussen	**Advanced Technology Europe** Jean Luc Derouineau	**Business Development** Derick Gerlock

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Advanced Technology Locations
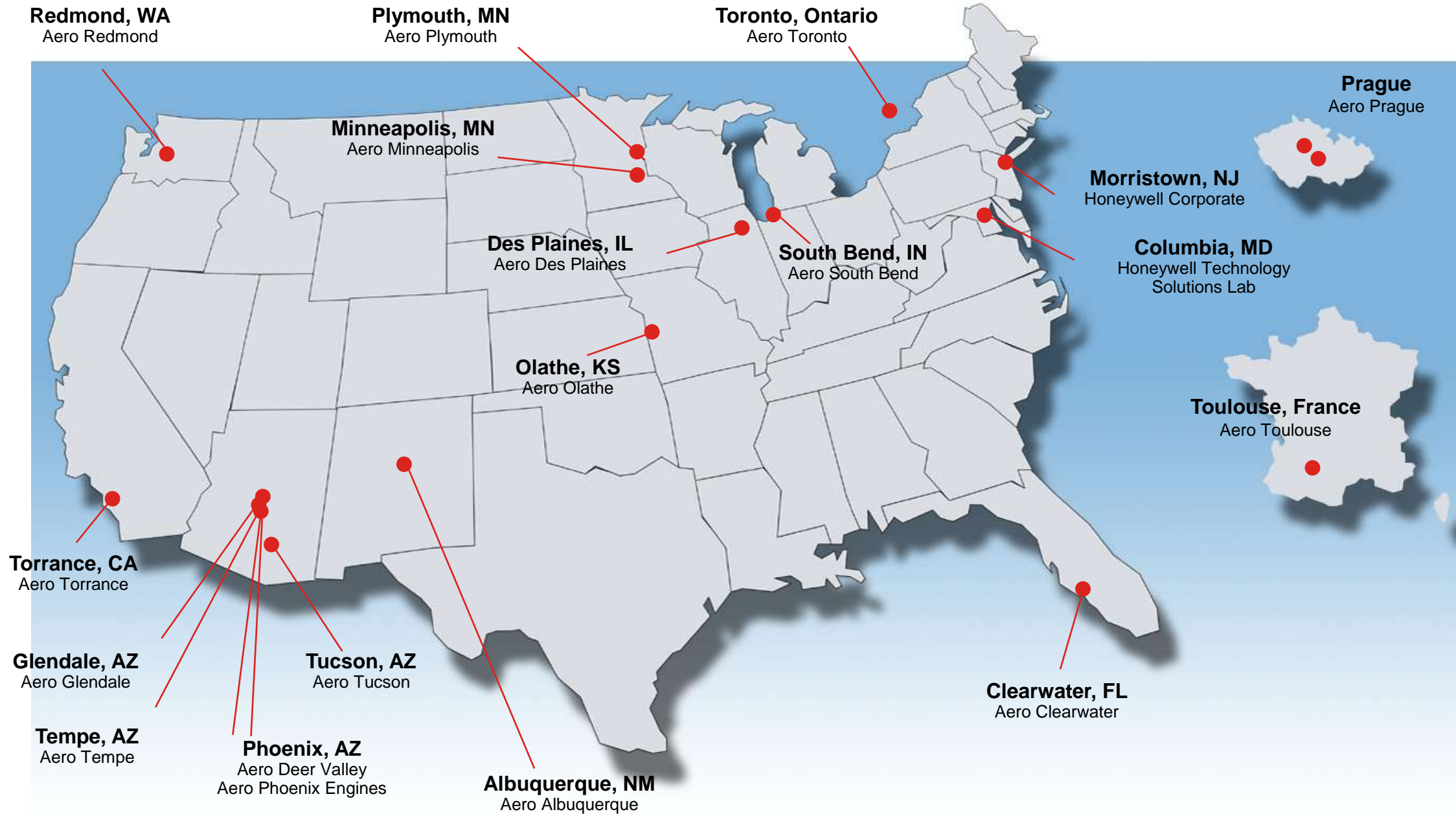
20 Technology Locations Worldwide

B06-428-1

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Advanced Technology Europe

Director Advanced Technology Europe

Jean Luc Derouineau

Systems Engineering & Applications

Power Management
Avionics Platforms
Human Centered Systems
Datalink & Flight Operations Services
Precision guidance
Trajectory Management
Surveillance Applications

George Papageorgiou

Electronic Technologies

Satellite Navigation
Navigation & Sensors
Communication
Cooperative Surveillance
Platforms Systems
Displays & Graphics
Power Distribution

Kurt Kober

Mechanical & Simulation Technologies

Condition Based Maintenance
Material & Process
Turbo Machine
Electrical generation/ drive
Modeling & Mock up & Simulation

Vlastimil Janulik

Architects

Satellite Navigation
Navigation & Sensors
Communication
Cooperative Surveillance
Platforms Systems
Displays & Graphics
Power Distribution

Marche Stephane

Technology Strategy & Operations

Program Management Office
Process and Tools
Strategic Planning
Interface to External Customers

Roosendaal Sander

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Advanced Technology Europe
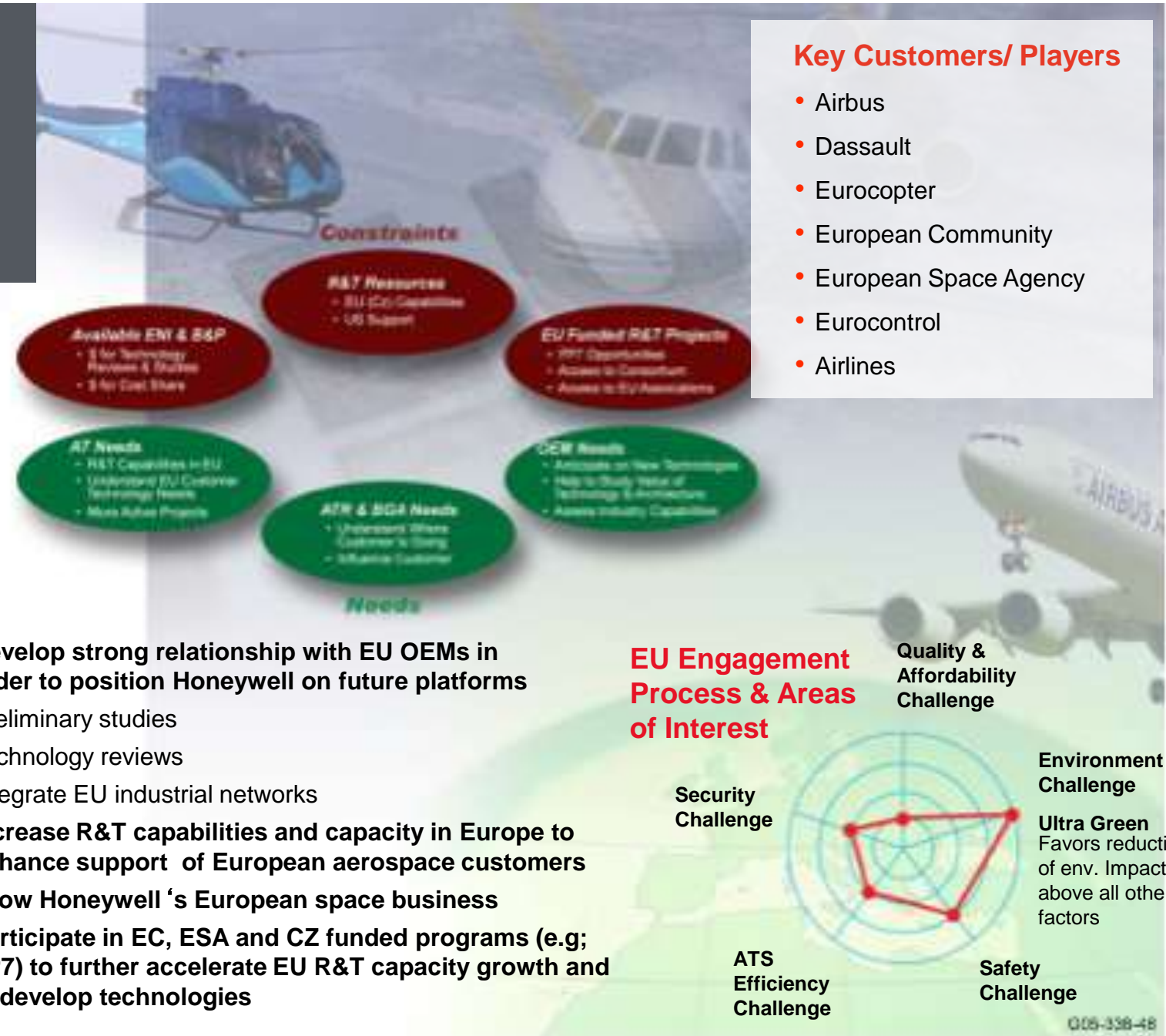
Jean Luc Derouineau
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Advanced Technology Europe

- Systems Engineering & Applications
- Electronic Technologies
- Mechanical & Simulation Technologies
- Programs
- Architects
- Operations

Key Customers/ Players

- Airbus
- Dassault
- Eurocopter
- European Community
- European Space Agency
- Eurocontrol
- Airlines

- **Develop strong relationship with EU OEMs in order to position Honeywell on future platforms**
  - Preliminary studies
  - Technology reviews
  - Integrate EU industrial networks
- **Increase R&T capabilities and capacity in Europe to enhance support of European aerospace customers**
- **Grow Honeywell's European space business**
- **Participate in EC, ESA and CZ funded programs (e.g; FP7) to further accelerate EU R&T capacity growth and to develop technologies**

EU Engagement Process & Areas of Interest

Quality & Affordability Challenge

Security Challenge

Environment Challenge

Ultra Green Favors reduction of env. Impact above all other factors

ATS Efficiency Challenge

Safety Challenge

G05-338-48

Establish Advanced Technology Europe as Technology Leader and Partner in the European Aerospace market

Advanced Technology Europe – Systems Engineering & Applications
Aircraft Power Management System

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Aircraft Power Management System

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Advanced Technology Europe

- **Systems Engineering & Applications**
- *Electronic Technologies*
- *Mechanical & Simulation Technologies*
- *Programs*
- *Architects*
- *Operations*

Core Technologies/Competencies

Air, Thermal & Power Management System:

- **APU: Auxiliary Power Units**

- **Engine: Turbojets, Turbofans, Turboprops**

- **BMS: Bleed Management Systems**

- **ECS: Environmental Control Systems**

- **CMS: Cabin Management System**

- **EPS: Electric Power Systems, Power Generation**

- **Gather and analyze customer requirements**
- **Develop systems architecture**
- **Conduct trade-off studies**
- **Run simulations and conduct performance analyses**

High-level Integrated System Modeling

Solutions that Meet Customer Needs by Integrating Honeywell Technology and Expertise

Honeywell

Advanced Technology Europe – Systems Engineering & Applications
Trajectory Mgmt & Surveillance Apps

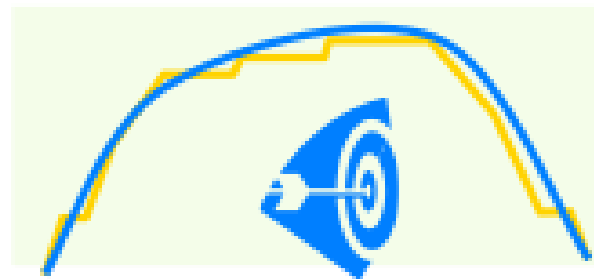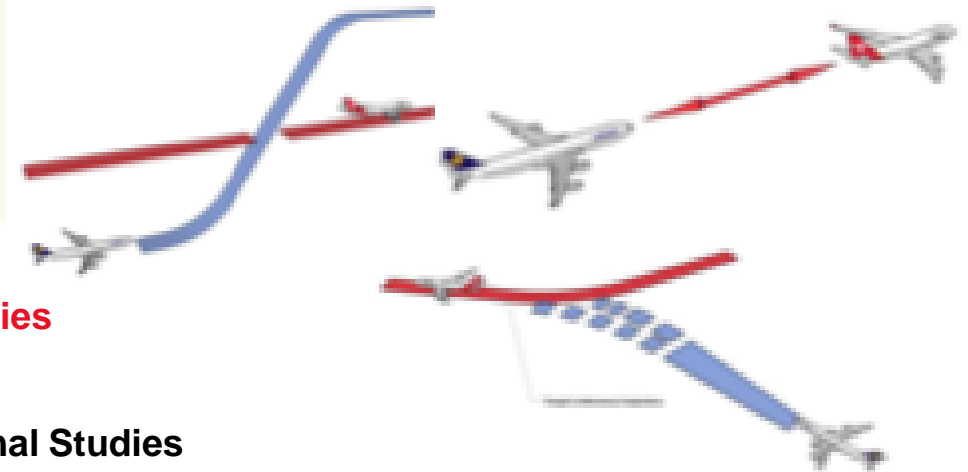**Petr Cásek**

Trajectory Mgmt & Surveillance Apps

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Advanced Technology Europe

- **Systems Engineering & Applications**
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- *Mechanical & Simulation Technologies*
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- *Operations*

Flight efficiency improvement

Spacing, Sequencing & Merging, Oceanic Operations

Core Technologies/Competencies

R&D – Technical and Operational Studies

- **4D operation concepts – initial and full 4D.**
- **RTA FMS prototyping**
- **Trajectory information sharing**
- **TMA Operations**
- **Continuous descent approach and continuous climbing cruise**
- **Flight and performance optimization, weather data processing**
- **ADS-B In applications, airborne separation & spacing concepts**
- **Airborne Collision Avoidance Systems**

Algorithms development

System engineering – functional architecture definitions

Mock-up prototyping for ATM environment

Technical and operational validation (simulations, flight tests)

Benefits studies

To your Destination not just Safely – also with Accuracy of Seconds

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Advanced Technology Europe – Systems Engineering & Applications
Human Centered Systems, Precision Guidance, Datalink Apps

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Application cluster leader

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Advanced Technology Europe

- **Systems Engineering & Applications**
- *Electronic Technologies*
- *Mechanical & Simulation Technologies*
- *Programs*
- *Architects*
- *Operations*

**Core Technologies/Competencies**

Human Centered Systems

- **New/advanced Human-Machine interactions in the cockpit**
- **Human Factor expertise to address safety and situation awareness enhancement**
- **Human Factors validations/experiments (simulator or flight tests)**
- **Design of advanced Decision Aids to provide key information in the complex system (based on the context, state, flight phase..)**

Flight operations and datalink applications

- **Enhance functions of Flight /Wing Operational centers to be compatible with future ATM environment (e.g. 4D trajectory concept, strategic graphical weather)**
- **Bring advantage of new way of digital messages in the cockpit (e.g. clearances, graphical weather)**

Cocpit simulator (Brno)
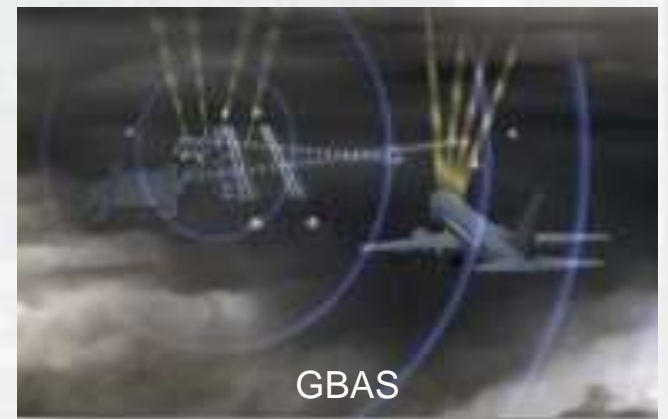
GBAS

Precision Guidance

- **Develop and validate the architecture and systems requirements for precision approach, landing and taxi - (e.g. L1 GBAS avionics, MC/MF GBAS, Advanced Combined Vision Systems)**
- **Precision system prototype development; modeling & simulation, flight testing**

Combined Vision System

Human Centered Design for Ultimate Safety

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Advanced Technology Europe – Electronic Technologies
Navigation & Sensors

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Advanced Technology Europe

- *Systems Engineering & Applications*
- **Electronic Technologies**
- *Mechanical & Simulation Technologies*
- *Programs*
- *Architects*
- *Operations*

Core Technologies/Competencies

Navigation

- **Develop and validate No License Required (NLR) hybridized navigation systems (GNSS/INS/AHRS)**
- **Develop and validate GPS Denied Navigation solutions i.e continued navigation capability when GPS is unavailable (LiDaR, MMW radar and EO/IR camera based approaches, Surface Navigation)**
- **Integration of other aircraft sensors; flexible & scalable sensor fusion; integrity monitoring schemes**
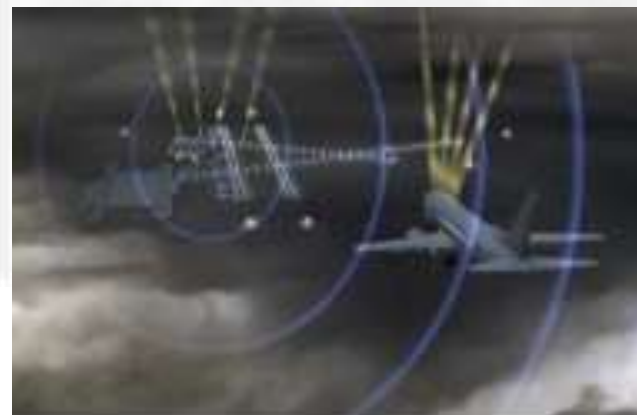- **IMU and other sensors technologies (MEMS)**

AHRS

MEMS inertial sensor

GNSS Receiver

Satellite Navigation

- **Develop multi frequency / multi constellation GNSS receiver with SBAS & GBAS capability; incl. prototype design and demo**
- **Multi-frequency RF front ends; acquisition and tracking algorithms**
- **Advanced Receiver Autonomous Integrity Monitoring schemes**
- **Support GBAS Cat II/III subsystem prototype development; modeling & simulation, flight testing**
- **Drive standardization activities**

Globally Available Flexibie and Scalable Navigation and Sensor Technologies

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Advanced Technology Europe – Electronic Technologies
Communications & Surveillance Systems

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Communication & Surveillance Systems

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Advanced Technology Europe

- *Systems Engineering & Applications*
- **Electronic Technologies**
- *Mechanical & Simulation Technologies*
- *Programs*
- *Architects*
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Core Technologies/Competencies

Communication

- **Contribute to definition of new SatCom system supporting future ATM safety critical communication**
- **Methodologies, simulation & prototypes for SW defined radios**
- **Define future flexible avionics radio architecture for NG aircraft platforms, prototype design and demo; reduce size and weight**
- **Datalink for information exchange between aircraft and ground systems, including aircraft access to SWIM**

Surveillance

Surviellance

- **Consolidation of the requirements for future ADS-B applications**
- **Develop architecture / design of airborne transmitter/receiver incl. frontend based on proposed airborne mitigation strategies**
- **Improve airborne traffic situational awareness on the airport surface by extending the ADS-B receiver with TIS-B features**
- **Study cooperative sense concepts**
- **Drive standardization activities**

Connected Aircraft

Next Generation Communication Radios and Surveillance Systems

Advanced Technology Europe – Electronic Technologies
Platform & Power Systems

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Advanced Technology Europe

- *Systems Engineering & Applications*
- **Electronic Technologies**
- *Mechanical & Simulation Technologies*
- *Programs*
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Core Technologies/Competencies

Platform Systems

- **Advanced WCET analysis**
- **Run-time environments for mixed-critical high-integrity platforms**
- **Methods and Tools for effective requirements engineering and analysis**
- **Formal verification methods for requirements and design analysis**
- **Technologies and architectures for condition-based maintenance (distributed, light-weight, wireless connectivity)**

Displays & Graphics

- **Next generation display technologies**
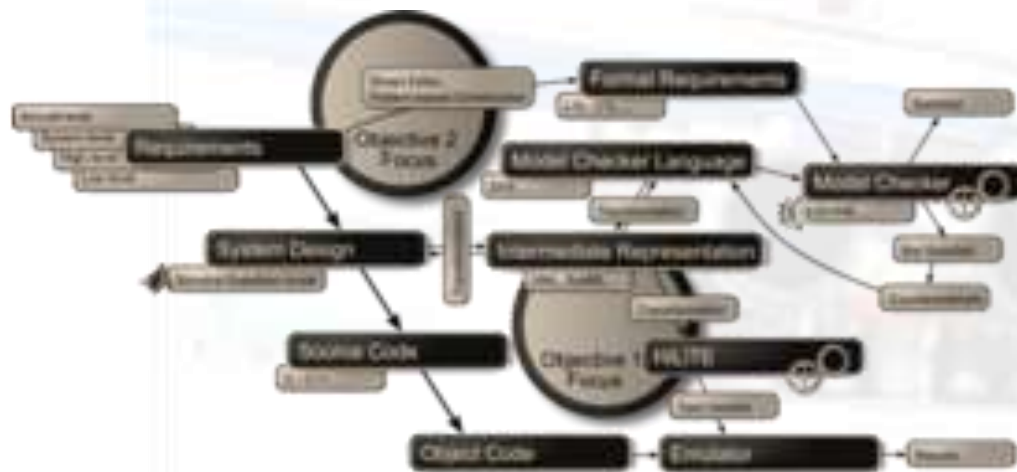- **Tooling for graphics design and analysis**

Power Distribution

- **Solid State Power Controllers**
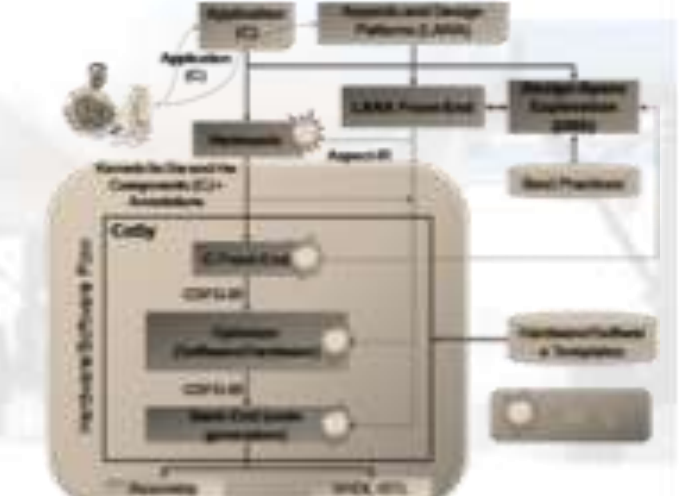- **Controls for load mgmt / Fault Detection**

Displays

Verification of system/subsystems

Smart Health Monitoring System

Reconfigurable Multi-Core Systems

Computing Platforms and Displays for Next Generation

Advanced Technology Europe – Mechanical & Simulation Technologies
CBM/SHM, Material & Processes
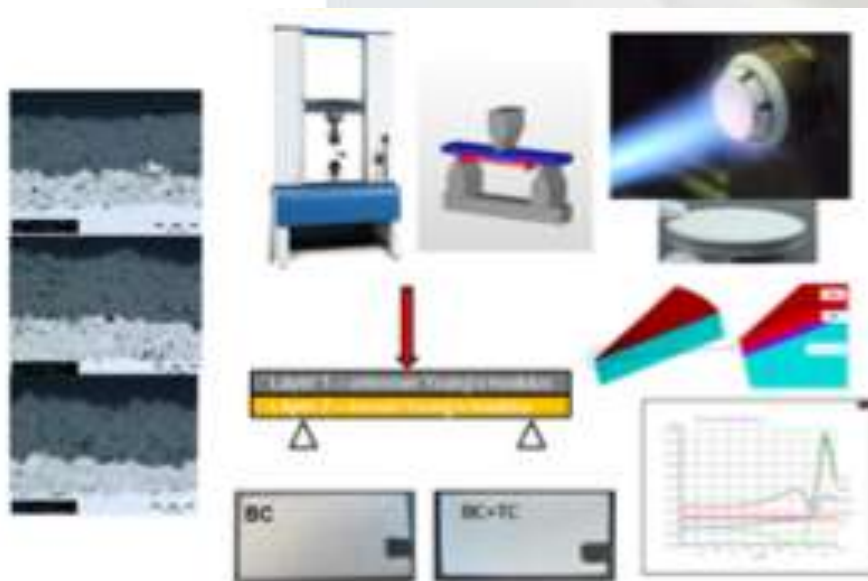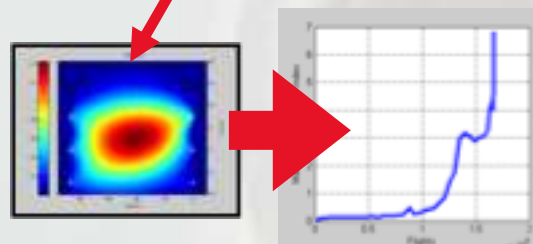
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- *Systems Engineering & Applications*
- *Electronic Technologies*
- **Mechanical & Simulation Technologies**
- *Programs*
- *Architects*
- *Operations*

Condition Based Maintenance (CBM)
- **Structural Health Monitoring (SHM) for metallic and composite aerospace and space structures**
- **Signal / image & data processing**
- Automated defect detection, localization, and size evaluation
- Evaluation of detection system capabilities – POD (Probability of Detection) and PFA (Probability of False Alarm) curves evaluation
- **Prognostic Health Management (PHM)**
- Defect growth modeling and simulation
- Structure remaining usage life (RUL) prediction based on model based prognostic algorithms
- **IVHM**
- Health monitoring systems integration on aircraft level and into enterprise services

Mechanical components
- semi-active damping system for space applications

Material & Processes
- **Material systems validation using testing**
- Tensile, Creep, Fatigue (HC, LC), Welding characteristics, Life cycle tests for TBC (THS, FCT)
- **Analytical modeling capability of material system**
- Ansys, JMatPro
- **TBC development**
- Dense Vertically Cracked TBC, Low Oxide TBC etc.
- **Additive Layer Manufacturing**
- Development of sintering parameters for Ni-based alloys

Shortening technology development cycle by leveraging analytical tools & models

Advanced Technology Europe – Mechanical & Simulation Technologies
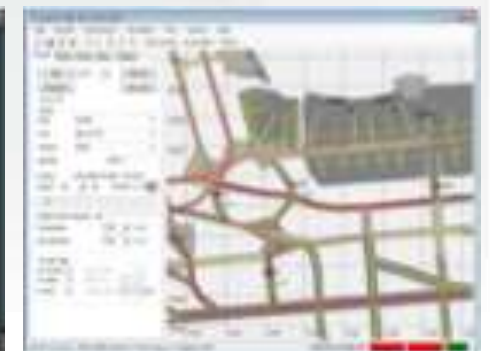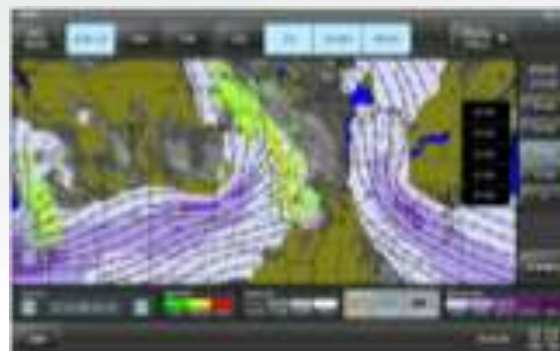# Modeling, Mock up & Simulations

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Advanced Technology Europe
- *Systems Engineering & Applications*
- *Electronic Technologies*
- **Mechanical & Simulation Technologies**
- *Programs*
- *Architects*
- *Operations*

Modeling & Mock up & Simulation

- **Flight simulations**
  - **Owners and maintainers of TRACS flight simulation facilities in Brno, Prague, Toulouse**
  - **A320 cockpit simulator and part task simulator (multi-modal cockpit), demonstration simulators**
- **Software prototyping**
  - **R&D of avionic display prototyping software (IPFD, ENAV, AT Maps) for rapid prototyping of new HMI functions**
  - **Avionic display software prototyping capabilities (EPIC/APEX products)**
  - **Electronic Flight Bag applications development**
- Development of complex simulation frameworks for validation and verification of Avionic Systems and Air Traffic Management
- **R&D of Advanced Visualization methods (Augmented Reality)**

Raising technology readiness level using software prototyping, flight simulations and fast-time simulations

Honeywell

Advanced Technology Europe – Programs
SESAR Program

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SESAR Program manager

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Advanced Technology Europe

- *Systems Engineering & Applications*
- *Electronic Technologies*
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- **Programs**
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- *Operations*

Trajectory Management

The SESAR (Single European Sky ATM Research) program is the technological and operational dimension of the **Single European Sky (SES)** initiative to meet future capacity and air safety needs.

Honeywell supports SESAR objectives

- Better usage of airspace and airports capacity
- Safety improvement
- Environment friendly

Communication

Safety
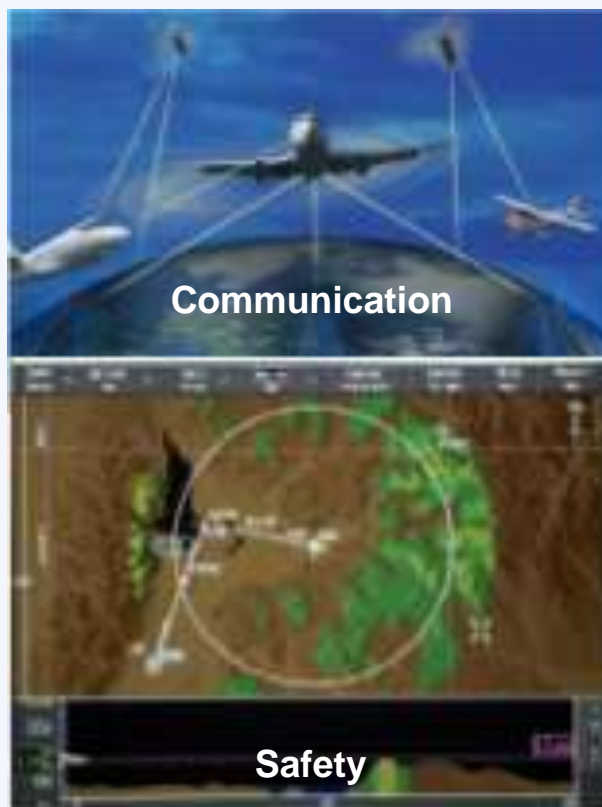
Honeywell's Results

1. **World's first Initial 4D trajectory management test flight – February 2012, with Honeywell FMS prototype on Airbus A320**

2. **Successful Flight Interval Management test flight in November 2012, with Honeywell traffic computer on Airbus A320**

3. **Successful GBAS CAT III test flights in Toulouse and Frankfurt – Honeywell flight test aircraft with GBAS avionics**

4. **Paving the way for SatCom, Air Ground SWIM and many other new technologies**

A unique opportunity to prepare future avionics products for new operations, standards and regulations

Advanced Technology Europe – Architects
Architecture Studies

Stephane MARCHE

Architects

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Advanced Technology Europe

- *Systems Engineering & Applications*
- *Electronic Technologies*
- *Mechanical & Simulation Technologies*
- *Programs*
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- *Operations*

Work with Customers early in the research phase

- Link Operational Requirements with System Requirements
- Understand airspace user needs and OEM constraints
- Ensure consistency of the technical content of Advanced Technology Europe projects
- Technical focal points to European organizations (SESAR JU, CleanSky JU, Eurocontrol, EASA)

Conduct Architecture Trade Offs

- Link value with technical features
- Weight operational, technology and industrial criteria to select the most appropriate solutions

Focus on domains

- Air Traffic Management
- Cockpit integration
- Flight planning and auto flight

Ensure that future products meet customer needs

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Advanced Technology Europe – Operations
Core Processes

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Tech Strategy & Operations

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Advanced Technology Europe

- *Systems Engineering & Applications*
- *Electronic Technologies*
- *Mechanical & Simulation Technologies*
- *Programs*
- *Architects*
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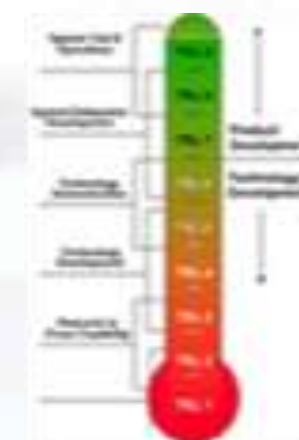**Project Management**

Strategic Planning & Road mapping

Core Processes

- **Strategic Planning and Roadmapping**
- **Project Management Office**
- **Annual Operating Planning**
- **Functional support coordination (Pricing, Legal/Contracts, Finance, …**
- **IP portfolio management**
- **University research and relations**

University Research

TRL Assessments

Driving Excellence in RD&E Investment Decisions

Advanced Technology Europe –
Laboratories

SmartLab

- **Tools for visualization, modeling and simulation for Aerospace communicating via standardized interface**
- **Development of complex simulation frameworks for validation and verification of Avionic Systems and Air Traffic Management**
- **Modeling - creating models of plain, vehicle or terrain for further integration into complex visualization**
- **Visualization - Integration of products being developed into complex visualization environment for presentation , shows and testing of use cases etc**
- **Simulation of complex networks, environment for designing protocols and technologies. Development and testing of new algorithm, controllers and systems**

HF Lab Cockpit Simulator

OpenLab

- **GNSS technology development and testing**
- **HW/SW prototyping and verification (SW defined radios, ADS-B, Nav, etc)**
- **Full set of RF measurement equipment up to 6GHz**
- **Development and testing ADS-B receiver**
- **Testing of inertial sensors**

GNSS & INS Simulator,

Data Generation and Acquisition Station

Part-task simulator

- **Human Factors research simulator**
- **Reconfigurable simulator for cockpit multi-modal Human Machine Interface evaluations**
- **Fixed wing to helicopter simulations**

HF Lab

- **Shell based on Airbus A320**
- **Dassault Falcon F900 layout (including EPIC display system)**
- **High fidelity look'n'feel**
- **All hardware PC-based**
- **Validation of new product/concepts**
- **Human in the loop studies**
- **Combination of real avionic HW and SW with mockups and prototypes**

Part-task Simulator

Validation of new technology before transitioning to product development

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Thank you!

Honeywell