10th EDITION

EUROPEAN CONGRESS

EMBEDDED REAL TIME SYSTEMS

ERTS 2020

FROM 29th TO 31st JANUARY / TOULOUSE FRANCE

PIERRE BAUDIS CONGRESS CENTER

Opening Session

Jean Arlat

ERTS 2020 Programme Chair

LAAS-CNRS

Scientific Advisor
French Embassy to the UK - London

Outline

- ❖ Trends, Challenges and Opportunities for Embedded Resilient & Time-critical Systems
- ❖ About the Congress: The 10th Edition of ERTS
- ❖ Programme Highlights

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Trends, Challenges and Opportunities for Embedded Resilient & Time-critical Systems

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Embedded Systems

- Computerized System Executing Specific Functions within an Host System, Generally with Stringent "Non Functional" Requirements:
  Real-time, Resilience, etc.
- Historically, Deployed in Specific Application Domains:
  Energy Production, Industrial Processes, Telecommunications, Transportation (at large)

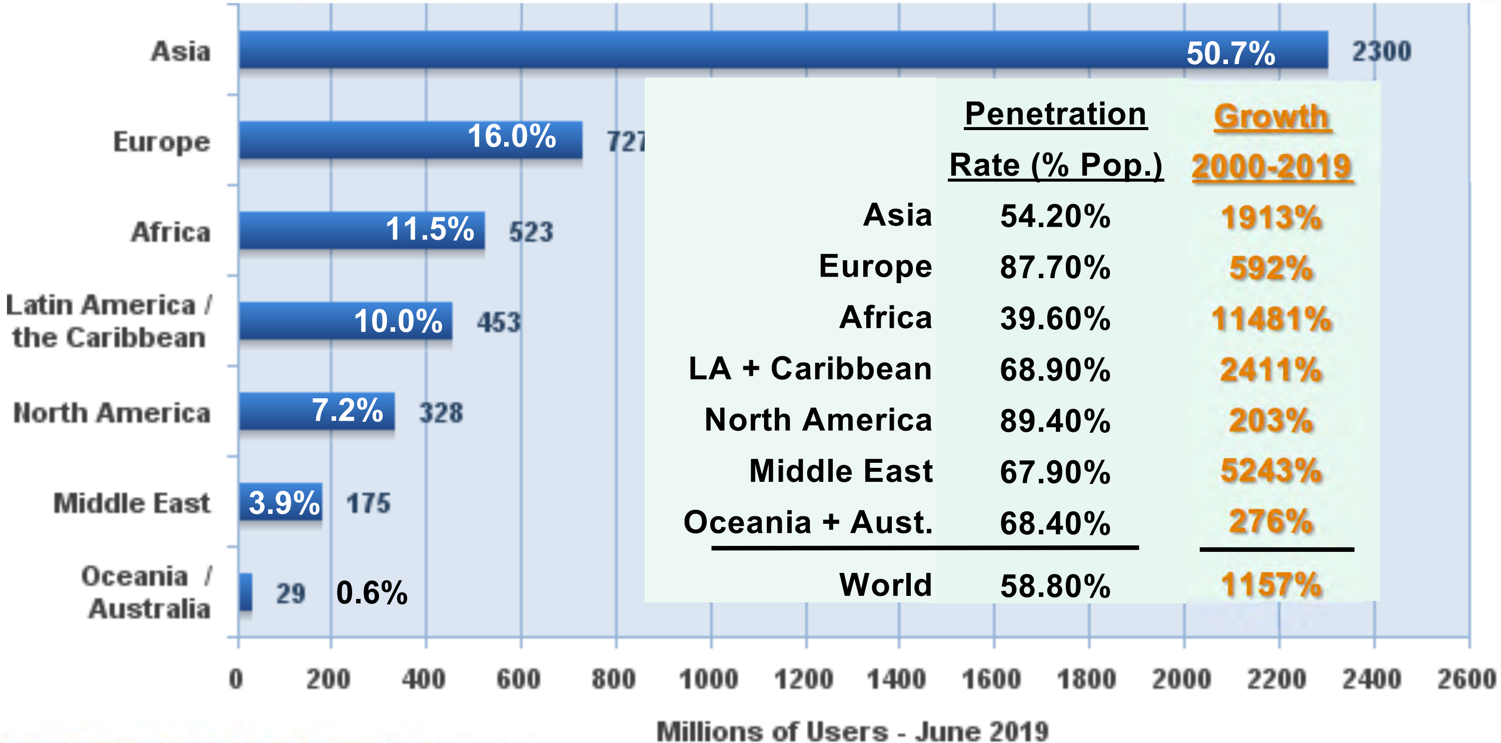
=> The Original Core Target for ERTS!

Trends

- **Penetration/Integration of Digital Devices Beyond Original Application Areas** (e.g., Transportation, Energy, etc.):
  "Smart" People, Home, City, Factory, Health care, Agriculture, Services, etc.
- **Emerging Features: Ubiquity, Mobility, Connectivity, Human Machine Interaction, Autonomy, etc.**
- **Strong Linkage between Information Processing Level (Virtual Dimension) and Physical Resources Level (Real Dimension)**
- **Intensive Deployment of Smart Objects** (e.g., sensors for context monitoring)
- **Development of Research & Enabling Technologies: CPS, AI, IoT, AI, …**

Internet Users ≈ 60%

World population (mid 2019):
7,716,223,209



	Penetration Rate (% Pop.)	Growth 2000-2019
Asia	54.20%	1913%
Europe	87.70%	592%
Africa	39.60%	11481%
LA + Caribbean	68.90%	2411%
North America	89.40%	203%
Middle East	67.90%	5243%
Oceania + Aust.	68.40%	276%
World	58.80%	1157%

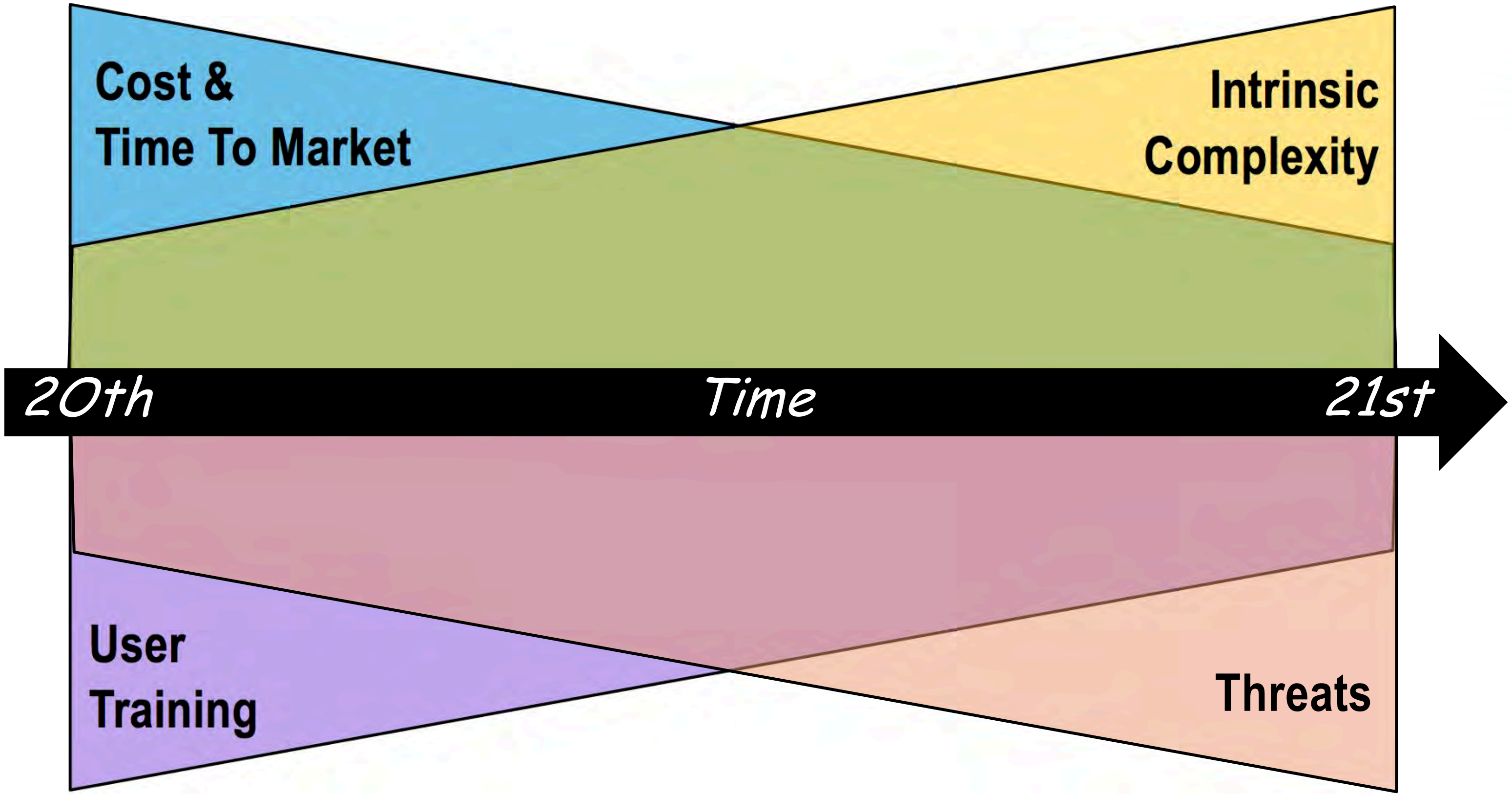
Estimation:
More than 21 billion IoT devices by 2025

Source: Internet World Stats - www.internetworldstats.com/stats.htm
Basis: 4,536,248,808 Internet users estimated in June 30, 2019
Copyright © 2019, Miniwatts Marketing Group

Challenges

- **Intensive Data Processing => High Performance Computing**
- **Autonomy, Multiple Interactions => Complex Decision Making**
- **Strong Dependency on the Infrastructure => Resilience**
- **More Open Systems** (thus Attack-prone) **=> Security => Safety**
- **Multifaceted Issues with Huge Societal Impact**
  [Awareness, Accountability, Acceptability, Privacy,…]
  => Systemic/Holistic and Multidisciplinary Approaches

Much Efforts and Dedicated Skills Required


Cost &
Time To Market
Intrinsic
Complexity
20th
Time
21st
User
Training
Threats

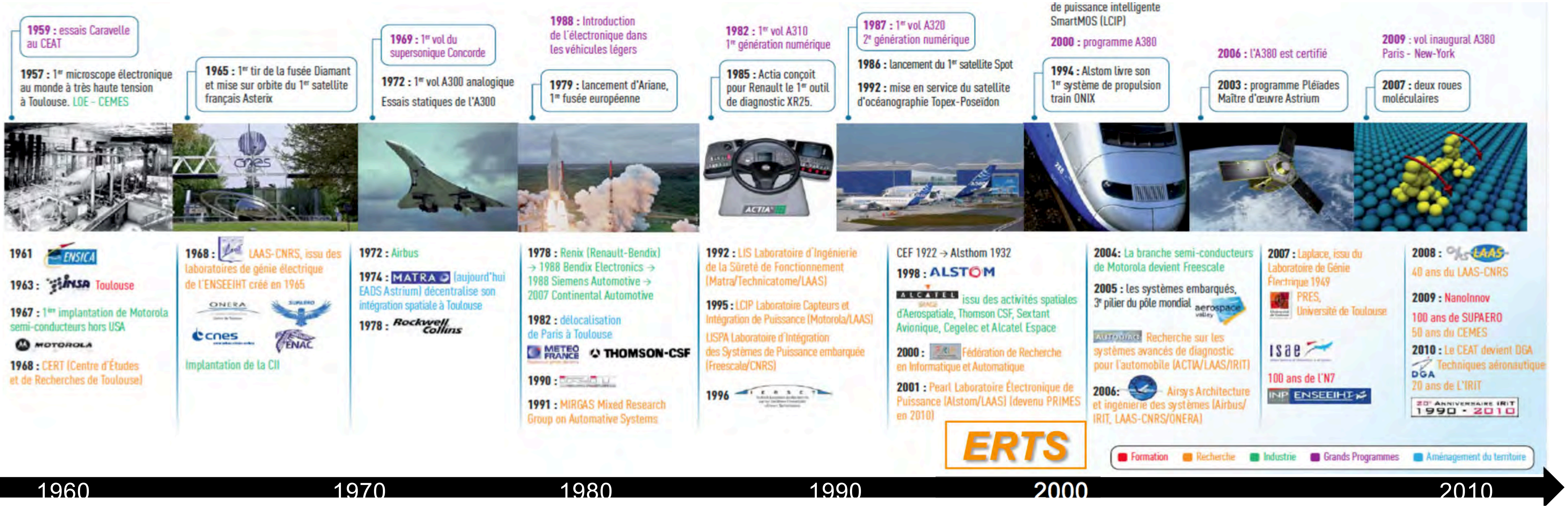
La Région Occitanie Pyrénées - Méditerranée

toulouse métropole
COMMUNAUTÉ URBAINE

Opportunities

Toulouse and The Region: A Leading Role in the Emergence and Development of Embedded Systems

Some Milestones:



1959 : essais Caravelle au CEAT

1957 : 1er microscope électronique au monde à très haute tension à Toulouse. LOE - CEMES

1965 : 1er tir de la fusée Diamant et mise sur orbite du 1er satellite français Asterix

1969 : 1er vol du supersonique Concorde

1972 : 1er vol A300 analogique

Essais statiques de l'A300

1988 : Introduction de l'électronique dans les véhicules légers

1979 : lancement d'Ariane, 1re fusée européenne

1982 : 1er vol A310 1re génération numérique

1985 : Actia conçoit pour Renault le 1er outil de diagnostic XR25.

1987 : 1er vol A320 2e génération numérique

1986 : lancement du 1er satellite Spot

1992 : mise en service du satellite d'océanographie Topex-Poseïdon

de puissance intelligente SmartMOS (LCIP)

2000 : programme A380

1994 : Alstom livre son 1er système de propulsion train ONIX

2006 : L'A380 est certifié

2003 : programme Pléiades Maître d'œuvre Astrium

2009 : vol inaugural A380 Paris - New-York

2007 : deux roues moléculaires

1961 ENSICA

1963 : INSA Toulouse

1967 : 1er implantation de Motorola semi-conducteurs hors USA

MOTOROLA

1968 : CERT (Centre d'Études et de Recherches de Toulouse)

1968 : LAAS-CNRS, issu des laboratoires de génie électrique de l'ENSEEIHT créé en 1965

ONERA SUPAERO cnes ENAC

Implantation de la CII

1972 : Airbus

1974 : MATRA (aujourd'hui EADS Astrium) décentralise son intégration spatiale à Toulouse

1978 : Rockwell Collins

1978 : Renix (Renault-Bendix) → 1988 Bendix Electronics → 1988 Siemens Automotive → 2007 Continental Automotive

1982 : délocalisation de Paris à Toulouse

METEO FRANCE THOMSON-CSF

1990 :

1991 : MIRGAS Mixed Research Group on Automative Systems

1992 : LIS Laboratoire d'Ingénierie de la Sûreté de Fonctionnement (Matra/Technicatome/LAAS)

1995 : LCIP Laboratoire Capteurs et Intégration de Puissance (Motorola/LAAS)

LISPA Laboratoire d'Intégration des Systèmes de Puissance embarquée (Freescale/CNRS)

1996 IERSET

CEF 1922 → Alsthom 1932

1998 : ALSTOM

ALCATEL issu des activités spatiales d'Aerospatiale, Thomson CSF, Sextant Avionique, Cegelec et Alcatel Espace

2000 : Fédération de Recherche en Informatique et Automatique

2001 : Pearl Laboratoire Électronique de Puissance (Alstom/LAAS) (devenu PRIMES en 2010)

2004: La branche semi-conducteurs de Motorola devient Freescale

2005 : les systèmes embarqués, 3e pilier du pôle mondial aerospace valley

AUTODIAG Recherche sur les systèmes avancés de diagnostic pour l'automobile (ACTIA/LAAS/IRIT)

2006: Airsys Architecture et ingénierie des systèmes (Airbus/IRIT, LAAS-CNRS/ONERA)

2007 : Laplace, issu du Laboratoire de Génie Électrique 1949

PRES, Université de Toulouse

ISAE

100 ans de l'N7

INP ENSEEIHT

2008 : LAAS

40 ans du LAAS-CNRS

2009 : NanoInnov

100 ans de SUPAERO

50 ans du CEMES

2010 : Le CEAT devient DGA Techniques aéronautique

20 ans de L'IRIT

20e ANNIVERSAIRE IRIT 1990 - 2010

ERTS

🟥 Formation 🟧 Recherche 🟩 Industrie 🟪 Grands Programmes 🟦 Aménagement du territoire

Some Recent Achievements & Breakthroughs

- **Strengths and Roadmap Developed in the White Paper on Intelligent Terrestrial Transportation (Automotech, Mipirail, Primus *Défense & Sécurité*, Robotics Place)**
- **Major Projects: Hyperloop, eHorizon, Attol, Electric flight, OneWeb, EGNOS V3**, etc.
- **Infrastructures and Support for R & I**: **ADREAM** Building, **B612** Building, **Francazal** Site, **Toulouse Tech Transfer**, etc.
- **Emerging Key Players: SigFox** (IoT Communication), **Delair** (Drones), **Naïo** (Agriculture Robots), **EasyMile** (Driverless), etc.
- **18 Dec 2019**: **Take off of an Airbus A350 without human intervention**
- **19 Jan. 2020**: **Test of Hyperloop in Francazal Site**

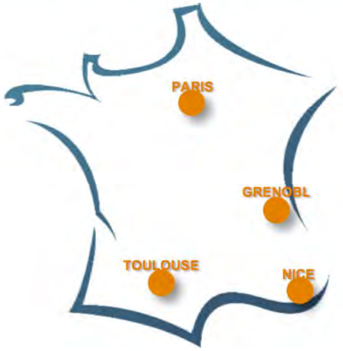
The New Frontier and the Way Forward

Embedding (Artificial) Intelligence into the Systems of the Future

- ❖ Developing Public Awareness of Innovative Technologies
- ❖ Enhancing Skills for Digital System Design & Assesement
- ❖ Funding Research and Innovation on Resilient Digital Technologies, Data Science & Artificial Intelligence
- ❖ Conducting Comprehensive Experimentation and Valuation of the Candidate Approaches/Solutions

ANITI
ARTIFICIAL & NATURAL INTELLIGENCE TOULOUSE INSTITUTE

Artificial & Natural Intelligence Toulouse Institute


PARIS
GRENOBL
TOULOUSE
NICE

Develop a Hybrid Approach Mixing Model-based and Data-based IA, To Address the Challenges at Stake:

Acceptability, Explainability, Fairness, Flexibility, Resilience, Scalability

- ❖ **Pillars: Education, Research, Innovation => Foster Economic Development**
- ❖ **Key Local Players Involved ===>**
- ❖ **Openness to Talents and Collaborations**

ACTIA
AIRBUS
altran
Atos
BRAINKEY
CAISSE D'EPARGNE DE MIDI-PYRENEES
Capgemini
CERFACS
CLS
Continental
EDF
BRL
CGI
IBM
IRT
IVADO
LATÉCOÈRE
LIEBHERR
LINAGORA
NXP
Pierre Fabre
aerospace valley
Quantmetry
Qwant
GROUPE RENAULT
SCALIAN
SIEMENS Healthineers
sopra steria
syngenta
terraNIS
THALES
Hôpitaux de Toulouse
cnes
cnrs
ENAC
icam
IMT Mines Albi-Carmaux
INRA
INSA
Inserm
UC Champollion
IRD
isae SUPAERO
METEO FRANCE
ONERA
tbs
INP
INP ENIT
Université Toulouse Jean Jaurès
UNIVERSITÉ TOULOUSE III PAUL SABATIER
toulouse métropole
TOULOUSE TECH TRANSFER

The Alan Turing Institute

www.turing.ac.uk

- **The UK National Institute for Data Science (2015) and Artificial Intelligence (2017)**
  - **Advance world-class research and apply it to real-world problems, generating the creation of new businesses, services, and jobs**
  - **Train the leaders of the future with the necessary breadth and depth of technical and ethical skills to match the UK's growing industrial and societal needs**
  - **Lead the public conversation: encompassing research priorities, public engagement and expert technical advice, to develop new solutions significantly impacting industry, government, regulation, or societal views**

- **Major UK Universities Are Involved**
  - **Cambridge, Edinburgh, Oxford, UCL, Warwick** (2015)
  - + **Leeds, Manchester, Newcastle, Queen Mary University of London, Birmingham, Exeter, Bristol, Southampton** (2018)

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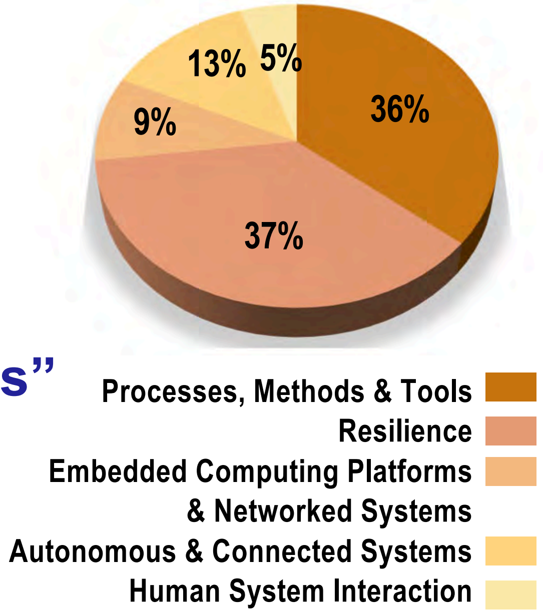
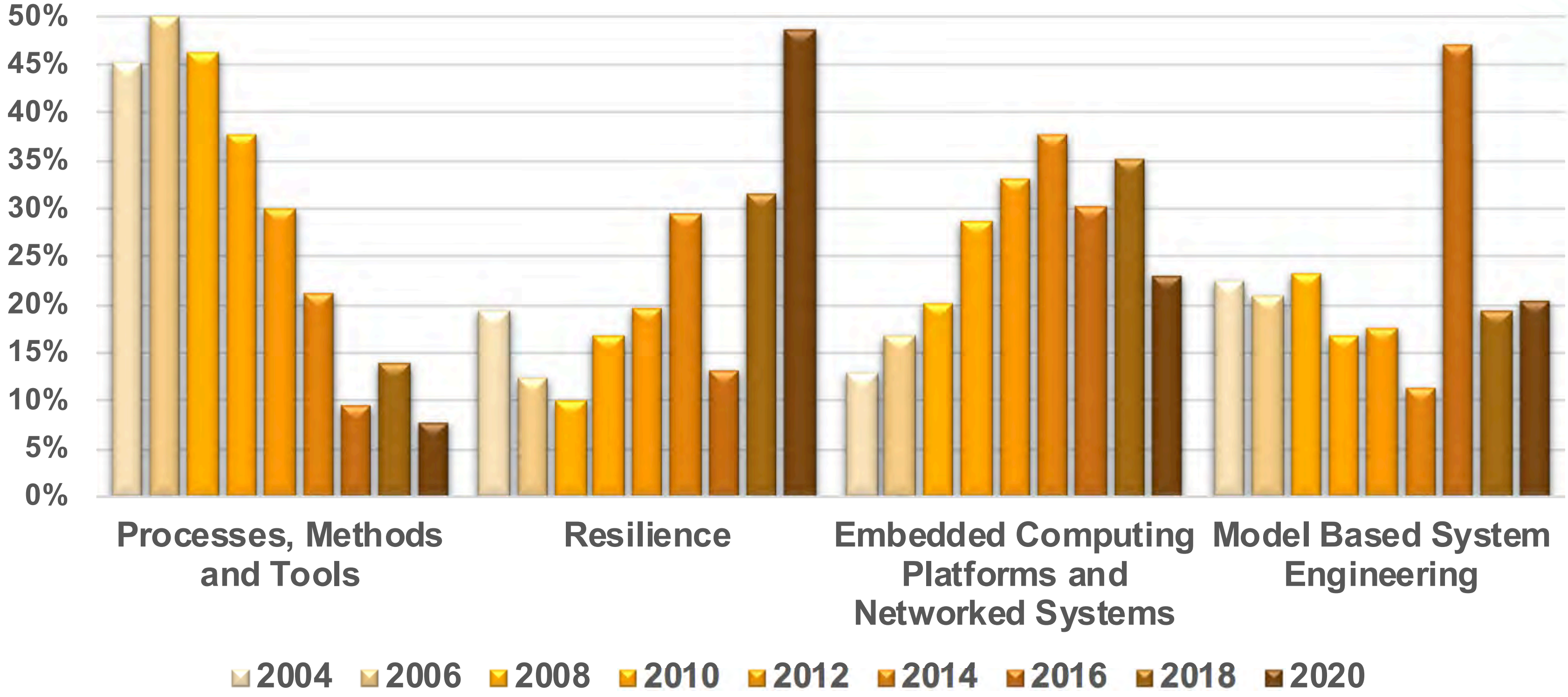
Paper Submission and Selection Process

- Call for Contributions
  - Submitted papers: 105 => Regular: 87 and Short: 18
- Reviewer Assignment & Evaluation
- Monitoring & Reviews Consolidation by "Super-reviewers"
- Program Committee Meeting
  - Accepted papers: 67 => Regular: 56 and Short: 11
- Shepherding Process

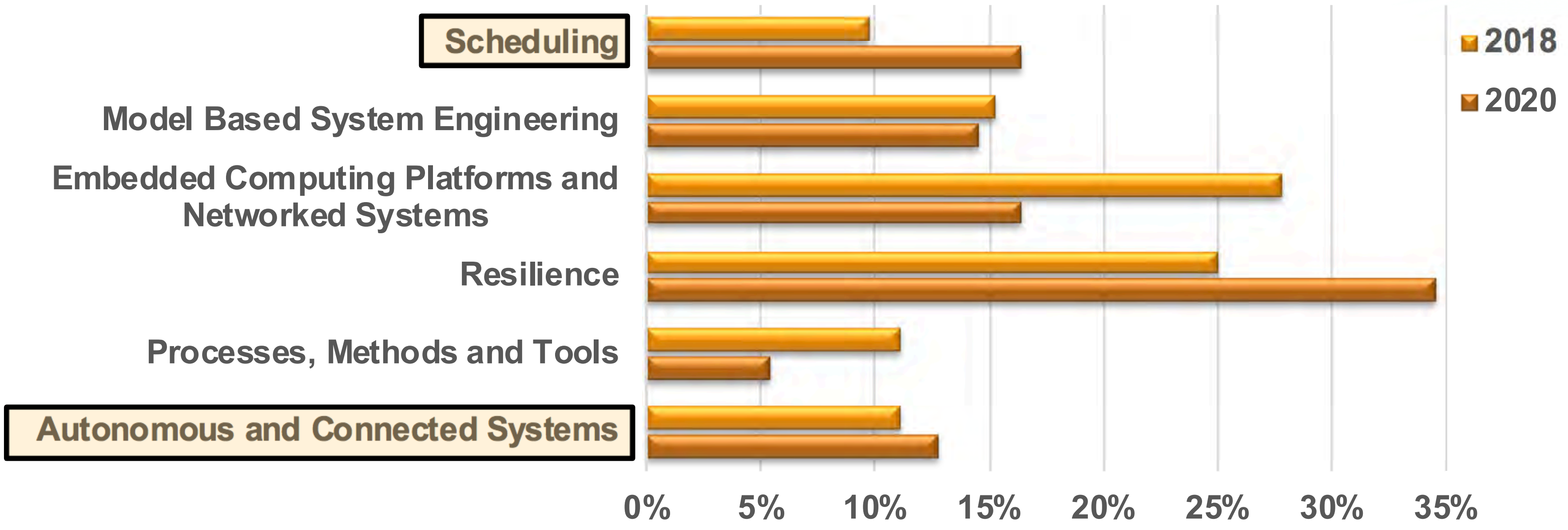
  => Final contributions: 64
    - Regular Paper + Presentation: 55
    - Short Paper + Poster: 9



Evolution of Continuous Topics (≈ ¾ papers)



Evolution since 2018 (Including New Topics)



About the Technical Programme

❖ Paper Presentations

Organized by Sessions According to **Six Major Topics**

Autonomous and Connected Systems	3
Processes, Methods and Tools	1
Resilience	8
Embedded Computing Platforms and Networked Systems	4
Model Based System Engineering	3
Scheduling	3

Keynote Addresses

Marta Kwiatkowska [Wednesday - 11:30]

Professor, Computing Systems, University of Oxford, UK

Safety Verification for Deep Neural Networks with Provable Guarantees

Jean-David Malo [Wednesday - 13:45]

Director Open Science and Innovation
DG Research and Innovation, European Commission

EU Funding for Innovation

Marc Mortureux [Thursday - 9:00]

General Manager of the National Automotive & Mobility Platform (PFA)

The Challenges of the Automotive Industry

Panels

Certification of Machine Learning for Safety Critical Applications: Probable, Plausible or Impratical?

[Thursday - 16:00]

Chair: Claire Pagetti, Onera/ENSEEITH, ANITI Chair on CertifAI, FR

Panelists: **Christophe Gabreau**, Airbus, FR; **George Romanski**, FAA, US;
Guillaume Soudain, EASA, DE, **François Terrier**, CEA & INSTN, FR;
Hugues Bonnin, Continental Digital Service, FR

Challenges for Robotics and Autonomous Systems With Human Interaction: A Multi Domain Perspective

[Friday - 11:30]

Chairs: Hélène Gaspard-Boulinc, DSNA/DTI, FR
Philippe Palanque, IRIT – FR

Panelists: **Medical**: **Jean-Loup Chrétien,** Tietronix, FR; **Marc Garbey**, Houston Methodist, US;
Agriculture: **Hélène Waeselynck**, LAAS-CNRS, FR;
Air traffic control: **Stéphane Chatty**, DGAC, FR; **Flight control**: Christine Gris, Airbus, FR

Special Focus Session

Building the Future Today: A Certification Path for Hyperloop Technology

[Thursday - 18:00]

Mohamed Kaâniche, LAAS-CNRS, FR

Panelists

Benjamin Pasquier, RAMS Engineering Director, Virgin Hyperloop One, US

Jean-Louis Boulanger, Lead Assessor Leader, Certifer, FR

And also…

- **Coffee Break “Busy Programme”**

  Posters, Exhibition, Networking, etc.

- **Poster Overview Session** [Thursday - 9:45]

  Philippe Cuenot, Continental Automotive SAS, FR

Industrial Co-Chairs Addresses

[Wednesday - 11:00]

Alexandre Corjon

Alliance (Renault-Nissan) Global Vice President,
Electrics, Electronics and Systems - France

Evolutions of Automotive EE & SW Technology

Charles Champion

Chairman of the Toulouse-Blagnac Airport
Supervisory Board

A Perspective on Embedded Real Time Software in Commercial Aviation

Thanks to

- The Congress Main Architect and Craftman: **Louis-Claude Vrignaud**
- The Scientific Coordinators: **Jean-Paul Blanquart, Philippe Cuenot, Kevin Delmas, Hervé Delseny, Adrien Gauffriau, Christophe Grand, Mohamed Kaâniche, Claire Pagetti**
- The Organizing Societies: **Francis Guimera, Dominique Mary**
- The Industrial Co-Chairs: **Alexandre Corjon, Charles Champion**
- The Members of the International Programme Committee (see the Programme)
- The Sponsors and the Partners (see the Programme)
- The The Many People Involved in the Organization
- The Keynote Speakers, the Panelists, the Contributors and the Audience!

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