Airbus Autonomy Roadmap

CSDM – Towards smarter and more autonomous systems
Paris December 12-13, 2017

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13 December 2017
Airbus Autonomy – Global Megatrends

*Transformative, global forces that define the future of the world with impact on businesses, societies, economies, cultures, and personal lives*

- Technological Breakthroughs
- Demographic & Social trends
- Climate Change & Resource Scarcity
- Rapid Urbanization
- Shift in Global Economic Power
## Airbus Autonomy – World Megatrends

### Megatrends

#### Technological Breakthroughs

Technology is disrupting all areas of enterprise, driving a myriad of opportunities and challenges.

#### Demographic & Social trends

Population growth, Gen Y/Z, aging population and the rise of the middle-class are set to transform the cultural values and practices in society.

### Data and Facts

- **10s of Billions of Investment a year.**
  - Digital transformation is changing business and revenue models.
  - Proliferation of data are changing the business-customer relationship.

- **Commercial aviation traffic is expected to double in the next 15 years.**
  - By 2030:
    - 60% middle class
    - 80% developing regions
  - Today:
    - 8% 65+
    - 13% 65+

### Airbus Autonomy Roadmap – CSDM - Towards smarter and more autonomous systems
### Climate Change & Resource Scarcity

Growing demand and shifting supply are driving innovation in the energy and resources space.

#### Facts & Figures

- By 2025, by 2030
- By 2030: the share of electricity generated by renewable energy could reach 50%

### Rapid Urbanization

The number and scale of cities continues to grow across the globe, driven by rapid urbanization.

#### Facts & Figures

- By 2025: there will be 40 cities with a population over 10 million
- US$9 trillion/Yr. infrastructure spending by 2025

- 50 years of supply left in proven oil reserves
- 50% more energy
- 40% more water
- 35% more food
**Shift in Global Economic Power**

Economic power continues to shift east and south, driving new patterns of trade and investment.

**Facts & Figures**

By 2030, emerging markets will comprise 63% of global GDP to US$223t

- Global GDP of rapid-growth markets
- 38% in 2010, 63% in 2020
- US$223t

- China and India will become the world’s largest investors.

- Airbus in Bangalore, Beijing and now Shenzhen innovation Centre (≈A3 in SanJose)

Two-thirds of the global middle class will be Asia-Pacific residents by 2030.
Airbus Autonomy – Autonomy = ?

**A system starts to be autonomous when it takes decisions that do not need crew acknowledge or initiation.**

<table>
<thead>
<tr>
<th>SAE level of driving automation</th>
<th>Informal definition derived from SAE J3016</th>
<th>What it could mean for aerospace (tentative)</th>
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</thead>
<tbody>
<tr>
<td>Automation</td>
<td></td>
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<tr>
<td>0</td>
<td>Warning</td>
<td>Stick shaker</td>
</tr>
<tr>
<td>1</td>
<td>Hands-on</td>
<td>Yaw damper (automatic damping of limited oscillations)</td>
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<tr>
<td>2</td>
<td>Hands-off</td>
<td>Auto-pilot, flight management system</td>
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<td>Autonomy</td>
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<tr>
<td>3</td>
<td>Eyes-off</td>
<td>Flight envelope protections, failure reconfiguration</td>
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<tr>
<td>4</td>
<td>Mind-off</td>
<td>To Be Defined 😊 Human for strategic decisions only</td>
</tr>
<tr>
<td>5</td>
<td>Cockpit-off</td>
<td>To Be Defined 😊 No human involved, neither in flight nor on ground</td>
</tr>
</tbody>
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Airbus Autonomy Applications – ISR, Cargo

Autonomous Mission Management
Autonomous Coordination of Vehicles
Airbus Autonomy Applications – Urban Air Mobility

**Urban Air Mobility**
Total System,
from customer to vehicle,
traffic management
Airbus Autonomy Applications – Single Pilot Operations

Human as the Strategic Decision Maker
Focus on Crew Workload and Awareness
Humans are and will remain essential to ensure safety of operations
How to be confident in algorithms that have “learned” or even would continue learning after their entry into service?
What about the non-prescript cases
The “unknown-unknown” ?
Airbus Autonomy - Conclusions

• Anticipating the competences of operators by mid-century
• Trusting systems that have not been designed in a classical way but by learning
• Trusting systems that are continuously learning
• What to do with unprescript cases, the unknown unknown?

• Social acceptance
• Time, Cost and Quality
• ....

Airbus is interested in cooperating with the CSDM community to solve autonomy challenges to systems engineering

https://www.youtube.com/watch?v=frRUfpMsQYM&index=1&list=PLJltpHUetWvGDMY-5Uu1Csxi-MliI9O3t
Thank you