



# Man4Gen

## Manual Operations of 4<sup>th</sup> Generation Airliners

Arjan Lemmers – Project Coordinator

Alicia final presentation event, Rome, 30 July 2014



# Contents

What is the situation?

What are we aiming for?

What are we doing?

Where are we now?



# What is the situation?

- Aviation is extremely safe...
  - 4 accidents per million departures
  - 30+ million flights per year
  - Advanced 4<sup>th</sup> generation aircraft
  - However...
    - ...*what about when the systems fail?*
    - ...*what if something unexpected happens?*
    - ...*we rely on the **pilot.***
- ***Is the pilot ready to take control?***



# What is the situation?

The pilot's task is changing from flying by means of manual control, to increased automation managers and monitoring of cockpit  
→ **change in tasks, roles and cognitive demands in the cockpit**



Advanced systems increase reliability, reduce variations, minimise faults and disturbances in normal operation  
→ **crews get little exposure to variability during normal flight**

Most training programs focus on anticipated faults and pre-determined responses  
→ **provide little opportunity to prepare for unexpected and unforeseen events**

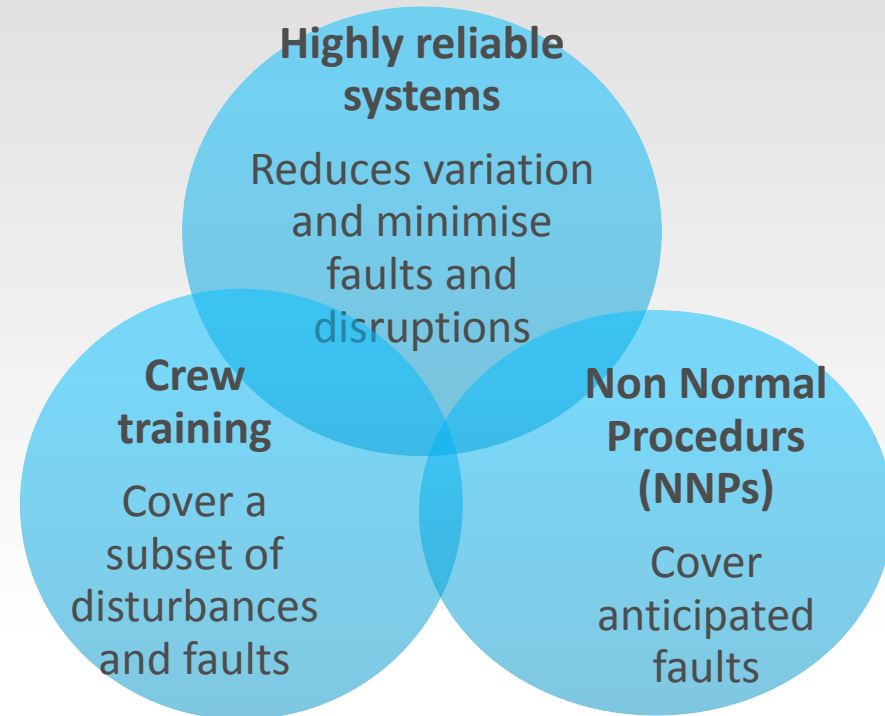
# What is the situation?

...what about unexpected and unforeseen events that fall outside textbook and trained scenarios?

...what about coping with ambiguity and conflicting information?

Is the crew prepared to be unprepared?

- **US Airways A320:** Ditching in Hudson River following bird strike
- **Quantas A380:** Engine explosion leading to series of events and faults





# EU 7<sup>th</sup> FP defines the goals

- Reduce the accident rate by 80%
- Substantial improvement in the elimination of and recovery from human error
- Advanced concepts & techniques to support human behaviour...  
...with special consideration of abnormal situations and crisis management.
- International cooperation on topics related to safety
- Advanced concepts to enable improved human centred design of cockpit displays, training of crews and flight control systems
- Methods and techniques for improved understanding of the human factor:
  - human machine interaction
  - crew performance in the cockpit
  - crew behaviour when managing information from different ends





# Man4Gen acts

- Identify the effects that the 4<sup>th</sup> generation automated system have on the pilot-aircraft system and investigate the cognitive processes that prevent pilots responding quickly and effectively,
- Develop methods to understand cognitive performance in crew-aircraft systems, and identify techniques to assist pilots in understanding and responding to unexpected events,
- Identify recommendations for improved procedures, training and design in 4<sup>th</sup> generation automated systems



# Man4Gen approach



What is the problem?

Where does this come from?

What can we do about it?





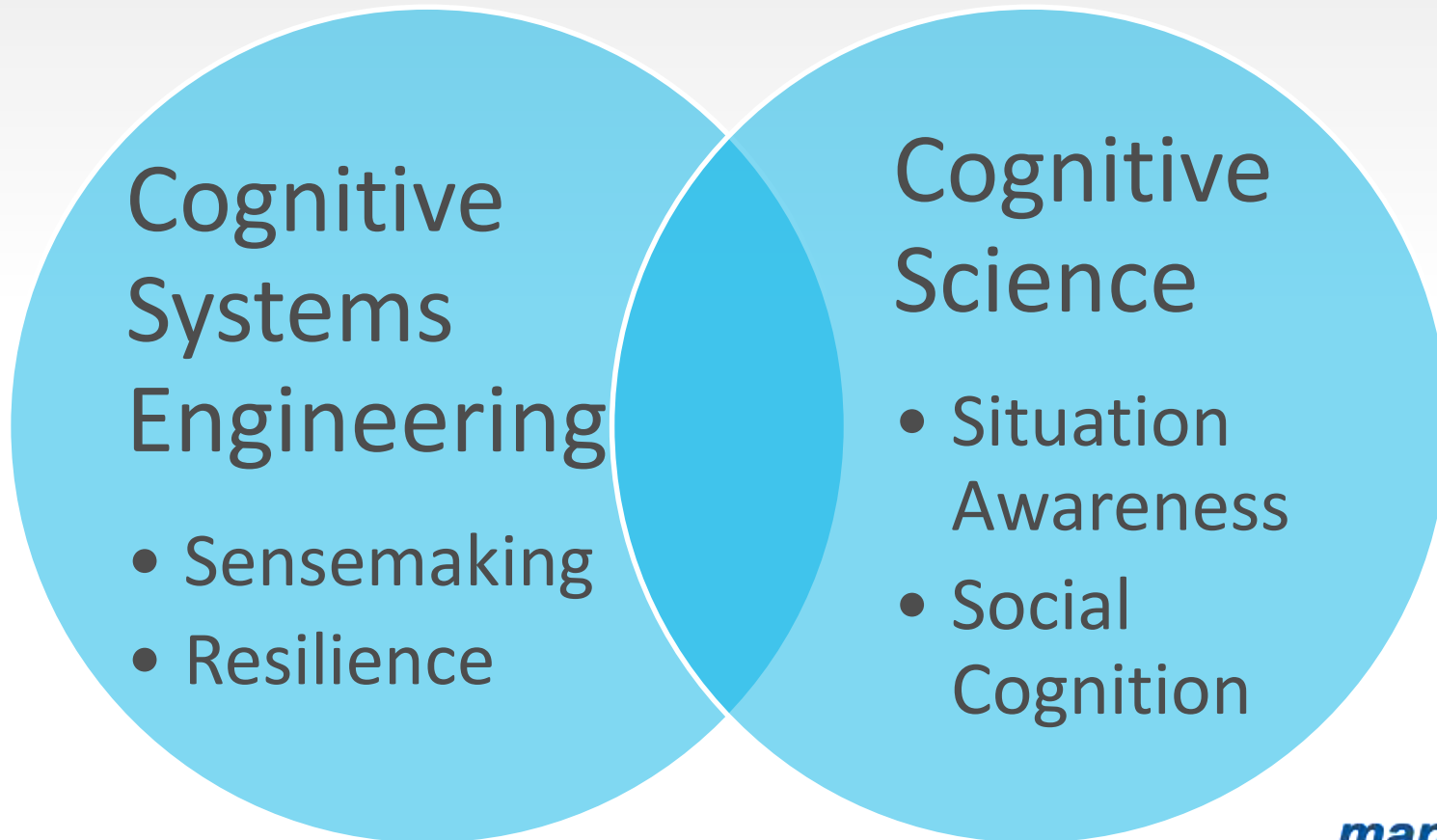
# What have we done so far?

- Analysis of existing studies
- Analysis of automation in the cockpit
- Problem statement
  - *Despite the substantial and proven safety benefits of automation systems in 3<sup>rd</sup> and 4<sup>th</sup> generation aircraft, evidence indicates that pilots sometimes have difficulties in appropriately responding to unexpected situations which require a rapid transition from monitoring very reliable systems to active and authoritative decision-making and exercising control of the aircraft.*



# How are we examining the problem?

Two research perspectives



# How are we examining the problem?

- Experimental Scenario

*Despite the substantial and proven safety benefits of automation systems in 3rd and 4th generation aircraft, evidence indicates that when faced with **unexpected** and **challenging** situations, pilots sometimes have difficulties in **quickly responding** to situations which require a **rapid transition** in their activity from monitors of very reliable systems, to **active and authoritative decision-makers** exercising **manual control** of the aircraft.*



# How are we examining the problem?



Experimental  
Analysis



Approach  
Scenario



Go-Around



Events...



# Our experiment environments



B747 Simulator



A320 Simulator



fMRI

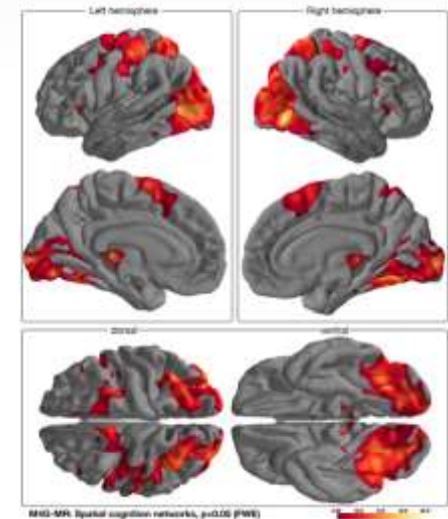
# What are we investigating?

- Investigating crew behaviour
  - From an operational perspective
    - Understanding what is going on?
  - From a research perspective
    - Understanding why does the crew do this?



# What are we investigating?

- Core competencies
  - Application of procedures
  - Communication
  - Flight path management – automation
  - Flight path management - manual
  - Knowledge
  - Leadership and teamwork
  - Problem solving and decision making
  - Situational awareness
  - Workload management
- Identifying expected behaviour
- Non-verbal communication



# Summary

## Where are we?

- Completed the initial analysis
- Identified the operational problem area
- Identified research applications
- Executed explorative simulator experiments

## What is going on now?

- Analysis of simulator and fMRI experiment data

## What is the next step?

- Applying the results
  - Confirming the problem operationally
  - Explaining the underlying theory
  - Identifying the potential solutions





# Man4Gen Partners:



This research is funded as part of the FP7 2012 Aeronautics and Air Transport programme under EC contract ACP2-GA-2012-314765-Man4Gen

<http://man4gen.eu>