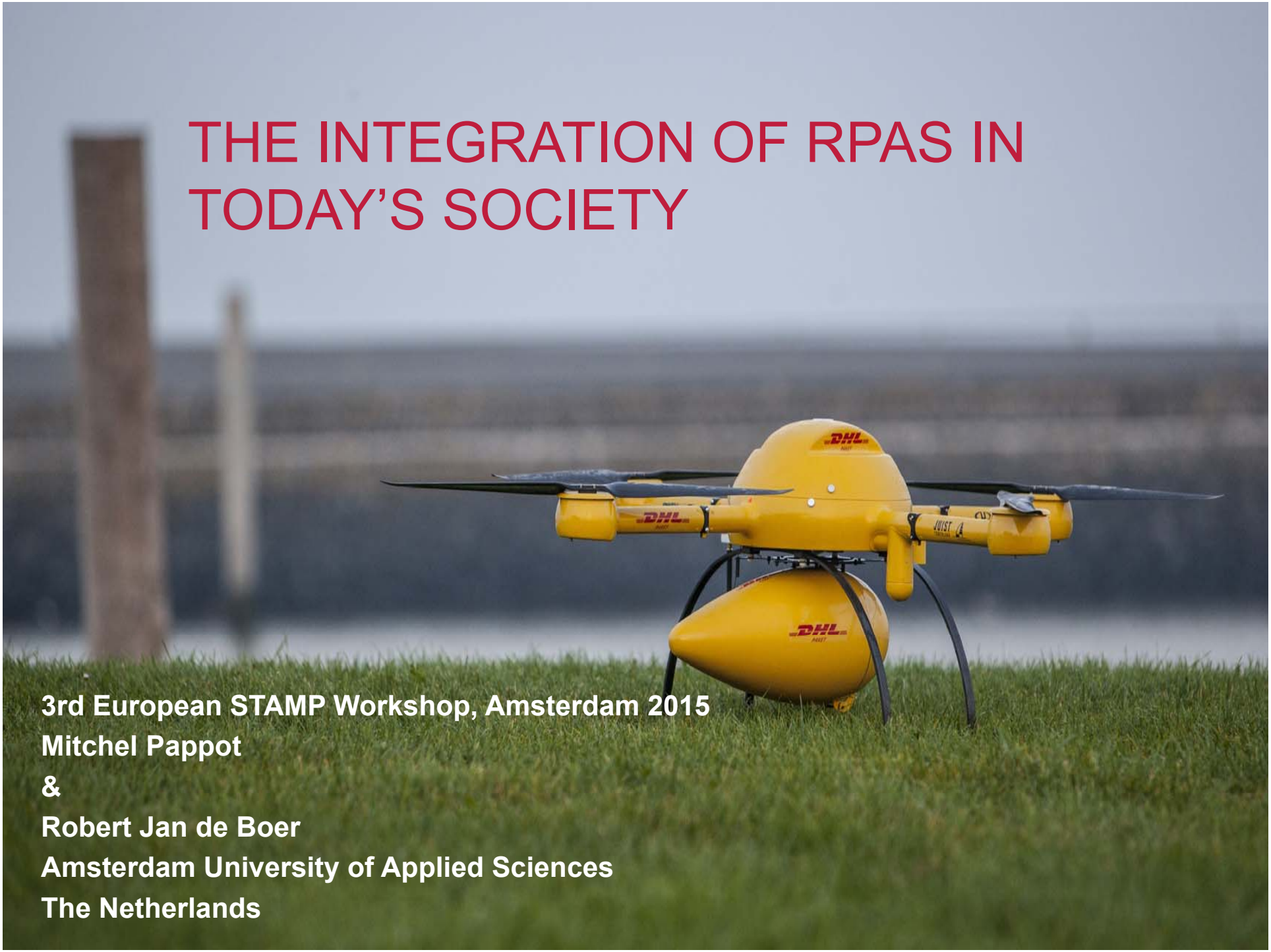
THE INTEGRATION OF RPAS IN TODAY'S SOCIETY



3rd European STAMP Workshop, Amsterdam 2015
Mitchel Pappot
&
Robert Jan de Boer
Amsterdam University of Applied Sciences
The Netherlands

RPAS FOR AGRICULTURE INVESTIGATION


RPAS WITH AED

Drone Crash in California Injures Baby

LEGAL NEWS *September 28, 2015 by Jason Reagan - No comments*

A drone crash injured a baby in Pasadena, prompting the FAA to step in to investigate.

On Sept. 12, a DJI Inspire 1 plummeted to the ground after its operator lost control, police said and the debris cut and bruised an 11-month-old girl. She was treated and released at an area hospital.

Police claim the unidentified pilot flew outside visual range, losing track of the
Although he was not charged by Pasadena Police, the incident was turned ove
Field Standards District Office.

FAA spokesman Ian Gregor told the Pasadena Star-News that the incident illus
growing trend of careless flying. "The FAA is concerned with the growing numb
about unsafe operations and is stepping up both its education and enforcemer
said. "Anyone who flies carelessly or recklessly can face fines from $1,000 to $2
depending on the seriousness of the violation."

Near miss between drone and Air NZ flight

Posted on September 26, 2015 by The Drone News

4

The Civil Aviation Authority (CAA) is investigating after a near miss between a drone and commercial plane near Christchurch.

MOTIVATION

- Remotely Piloted Aircraft Systems (RPAS) are rapidly appearing
  - businesses now see potential for using professional civil RPAS.

- New regulations
  - Easier access to flying permits

- including the phased integration of RPAS
  - Ability to fly above building and near people (Class 2 operations)

ADDED VALUE

- The traditional safety assessment method (Risk matrices)
  - May not fulfil the requirements set to analyse the safety of advanced professional RPAS operations
  - Adapted from the light aviation safety management system manual
  - Not optimized for RPAS operations (JARUS, 2014)

- Need for a new safety analysis methodology!

GOAL OF THE STUDY

- To investigate whether system theoretic process analysis (STPA) is a more fitting method for determining the safety of professional light RPAS during class 2 operation

Approach:

- Case studies

Hogeschool van Amsterdam
Techniek

GENERIC MODEL FOR RPAS

CASE STUDY OVERVIEW

- Case information
  - Goal
  - Type of operation / operational requirements
  - Complexity level
  - Context

- Cases:
  1. Aiding ship docking in the Harbour of Amsterdam
  2. Crowd management during (large) events
  3. Search and rescue operations
  4. Semi-Automated flight air quality management industrial plant

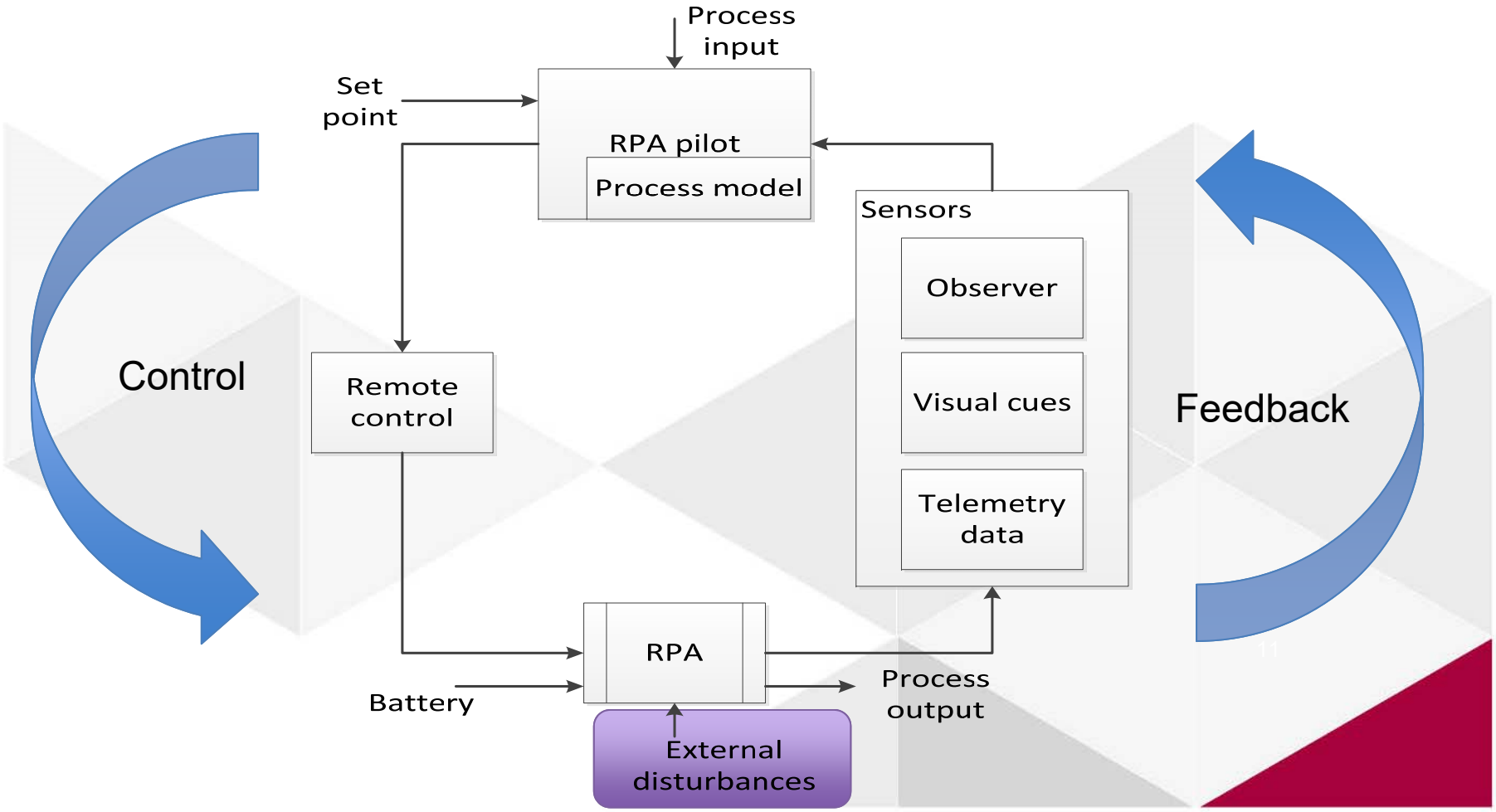
STPA FOUNDATION

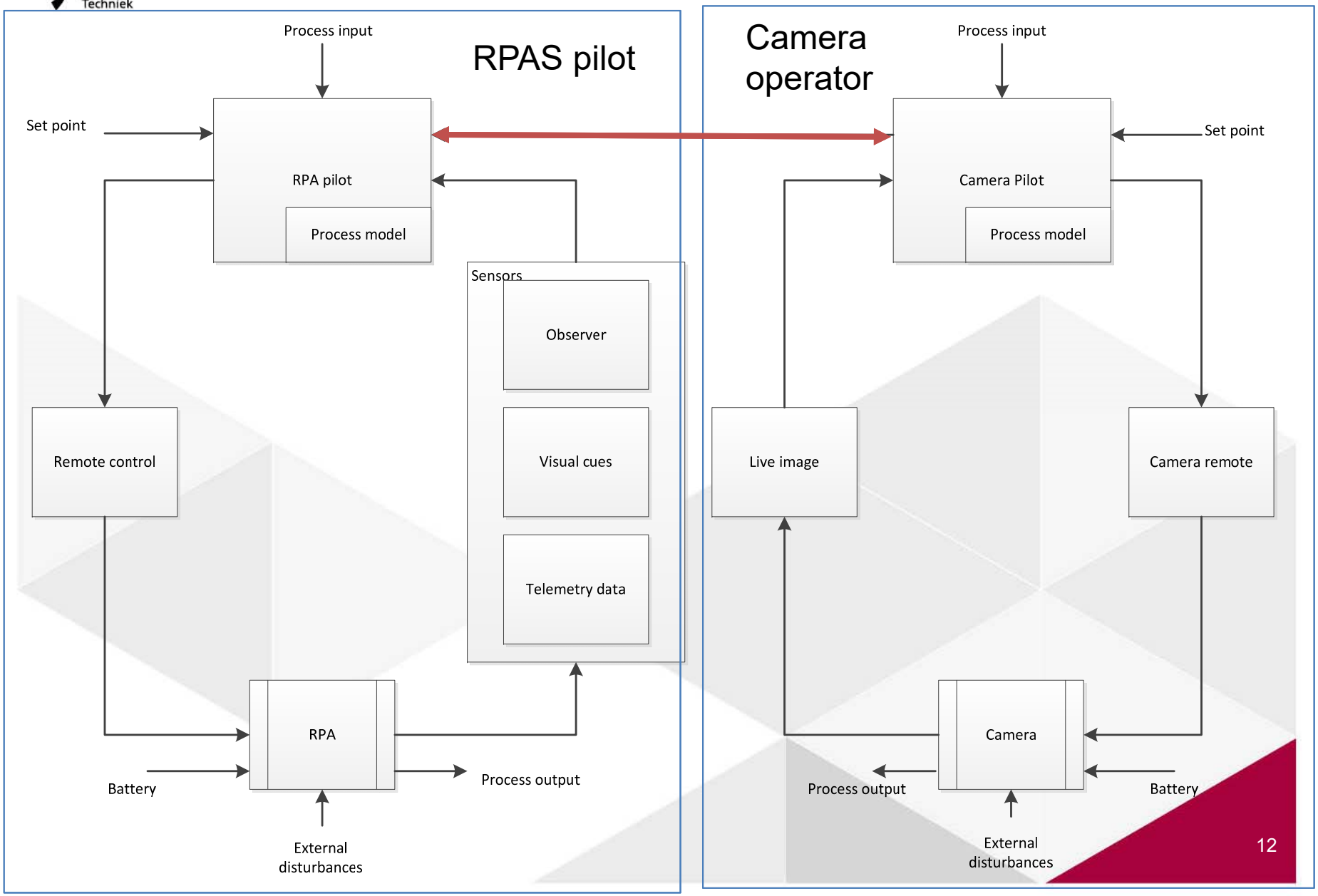
Accidents:

1. RPAS collides with object, ground or person,
2. RPAS collides with aircraft
3. RPAS objective failed.

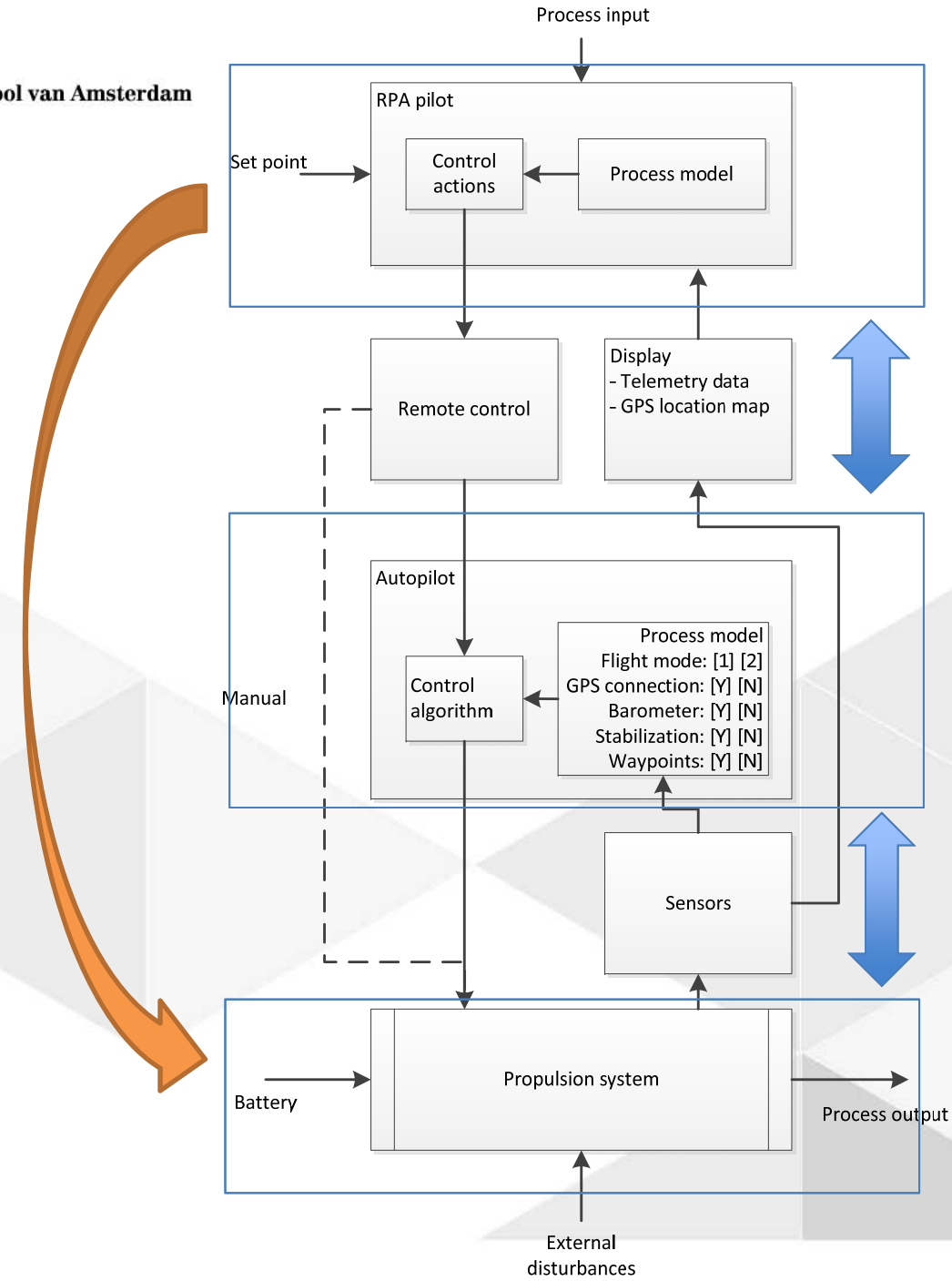
ID	Description	Links to accidents
H1	RPAS collides with terrain due to control actions (controlled flight)	A1, A3
H2	RPAS control is entirely lost	A1, A2, A3
H3	RPAS / camera data connection is lost or not recorded	A3
H4	RPAS is launched or remains flying without permission	A1, A2
H5	RPAS violates the safety separation limits	A1, A2
H6	RPAS damages surroundings, causes injury to humans, or is damaged during take-off or landing	A1, A2, A3

SYSTEM FOUNDATION




RPAS pilot
Process input
Set point
RPA pilot
Process model
Sensors
Observer
Visual cues
Telemetry data
Remote control
RPA
Battery
Process output
External disturbances
Camera operator
Process input
Set point
Camera Pilot
Process model
Live image
Camera remote
Camera
Process output
Battery
External disturbances

Hogeschool van Amsterdam
Techniek



RPAS pilot

Automated controller

Propulsion systems

RESULTS STPA STEP 1

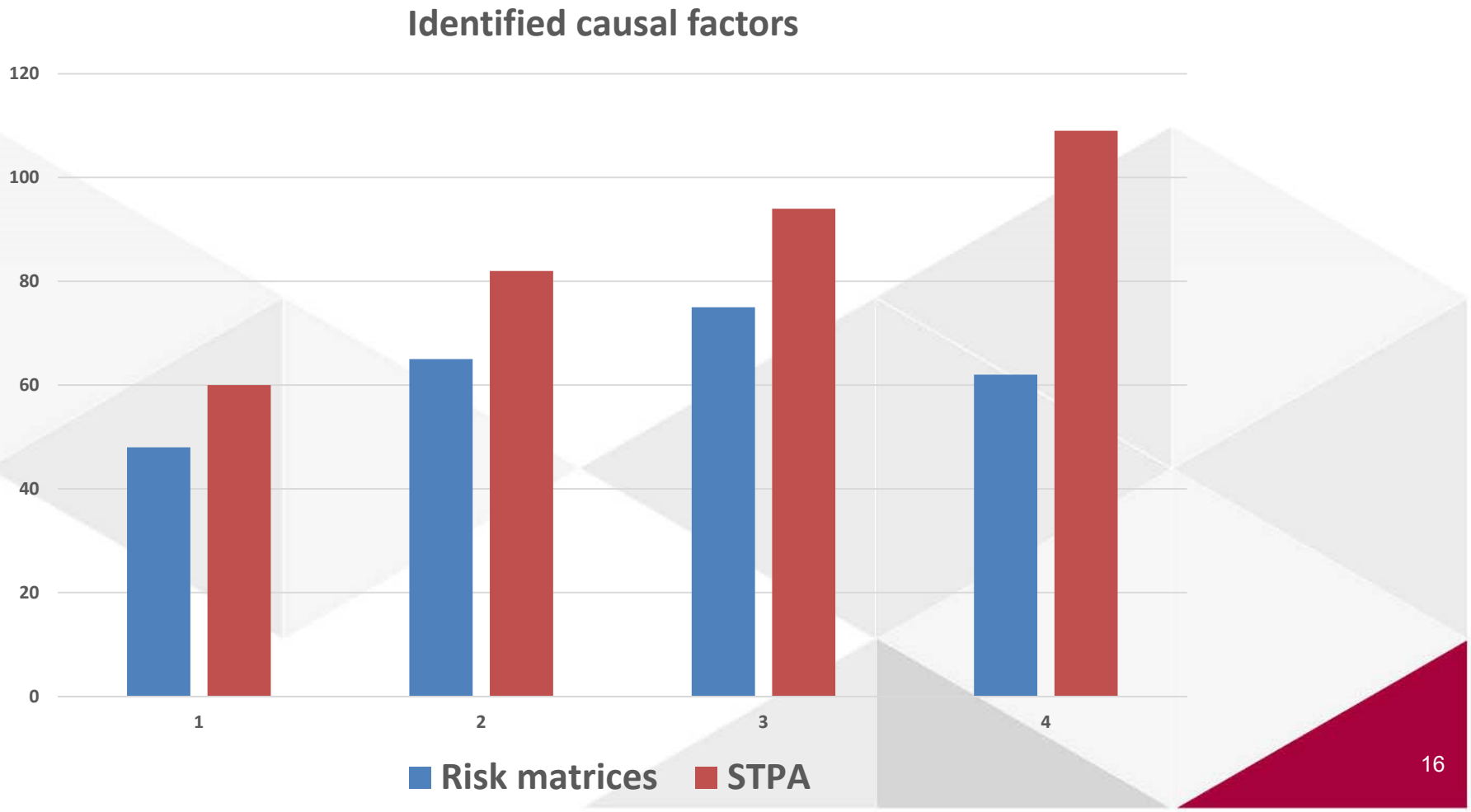
- Determine unsafe control actions (UCA)
  - PRAS pilot 8 control actions
  - Camera Pilot 4 control actions
- Use of context tables to specify context and controller
  - 27 – 32 unsafe control actions
- Link similar UCA's to hazardous control states
  - 10 – 14 Hazardous control states

RESULTS STPA STEP 2

- 19 – 28 unique scenarios
  - 60 – 104 unique causal factors
    - Including design / software
    - Missing feedback to and from management / government

- Common vulnerabilities
  - Signal jamming / hacking
  - Delays between input and execution and, feedback
  - Inconsistent feedback resulting in inadequate process model

5. RESULTS


Identified causal factors
120
100
80
60
40
20
0
1
2
3
4
Risk matrices
STPA

COMPARING THE RESULTS

Risk matrices

- External disturbances
- Component failures
- Inadequate operation of components

STPA

- Ineffective control input
- Inconsistent process model
- Missing feedback between crew members
- Inadequate control due to delays in the system
- Missing information and from higher levels in the organisation

DIFFERENCES IN APPROACH

STPA

- Based upon the identification of inadequate control within the system
- Identifies how inadequate control arises within the system
- Step-by-step process

Risk matrices

- Based upon the identification classification of hazards (expert interpretation)
- Identifies the consequences of hazards and failure modes
- Iterative process without clear end point

ISSUES

Hazard identification and risk matrices

- Not able to identify the frequency of most hazards
- Stopping the iterative process of identifying hazards

STPA

- Less guidance for the identification of mitigation measures
- When to stop identifying causal factors and scenarios

CONCLUSION AND FUTURE WORK

- Proof of concept
- The approach of the STPA methodology provides options to prevent accidents
- Provides more guidance to the analyst
- *STPA is useful to identify safety constraint for RPAS design and RPAS operations*

Next step:

- Apply to ‘real’ operation with professional operator
- Multiple controller STPA model