

TEM as an Analytical Tool

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Presentation Overview

- Brief introduction to Threat and Error Management (TEM)
- Case Study: occurrence at Schiphol
 - How to determine which countermeasure is the most effective one?
- Conclusion



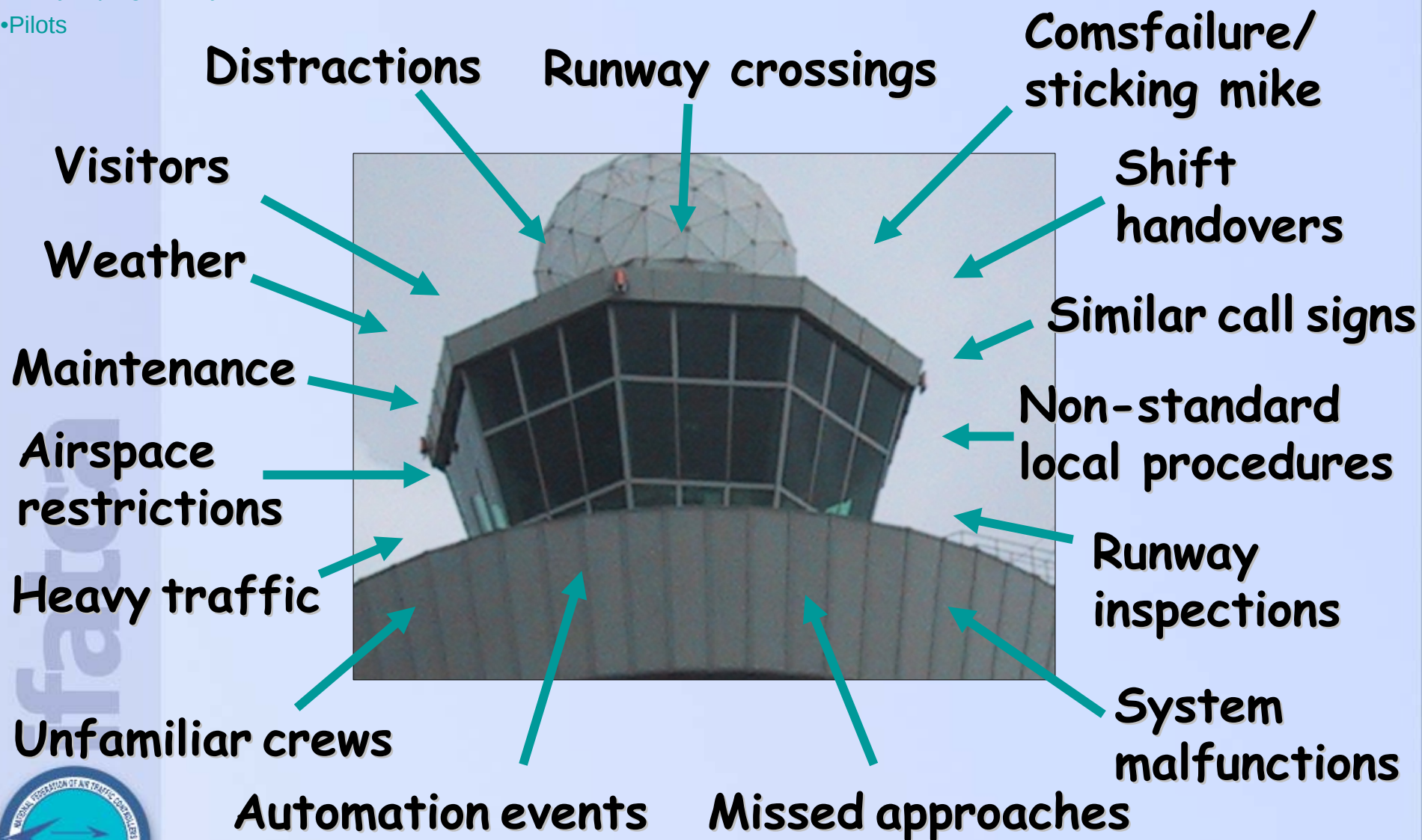
TEM Terminology for ATC

- **Threats**: Events or errors that occur beyond the influence of the air traffic controller, increase operational complexity, and which must be managed to maintain the margins of safety
- **Errors**: Actions or inactions by the air traffic controller that lead to deviations from organisational or controller intentions or expectations
- **Undesired States**: operational conditions where an unintended traffic situation results in a reduction in margins of safety

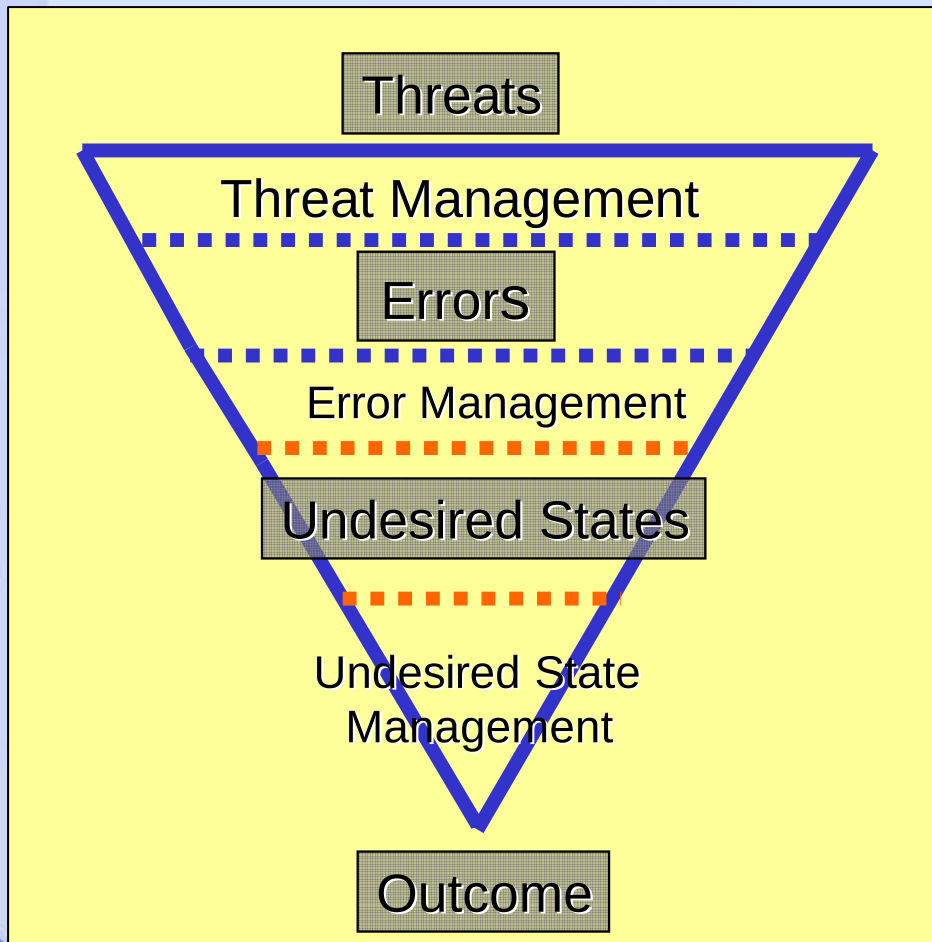


- VFR traffic
- Military activities
- Photoflights
- Parajumping activity
- Pilots

Threats (Aerodrome Environment)

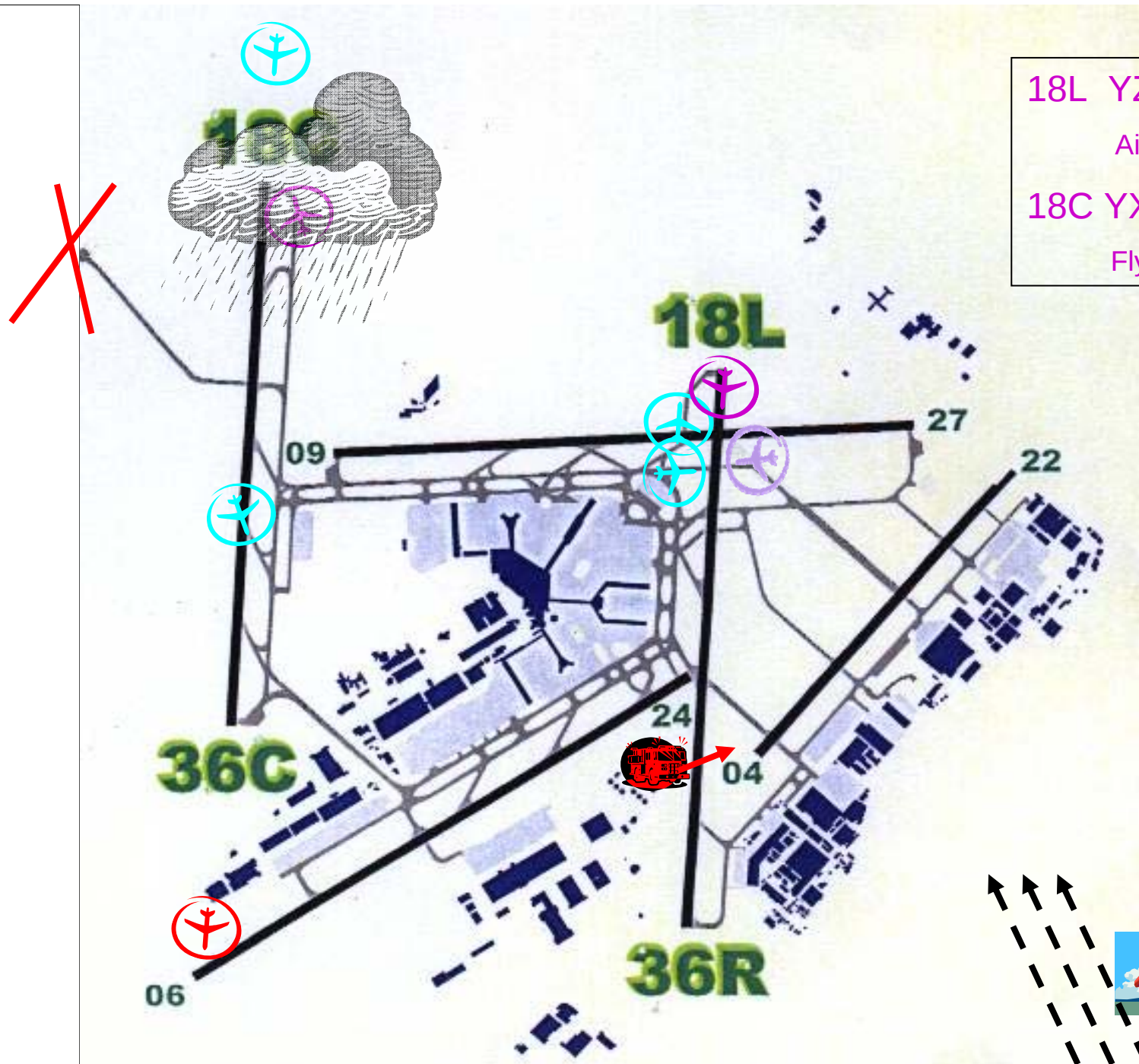


TEM Framework



- Incorrect readback (pilot)
- Hearback Error (ATC)
- Aircraft climbing/ descending to other altitude than expected
- Loss of separation





18L YZS158

Airline 158

18C YXS148

Flyfine 148

Potential Countermeasures

- Dedicated Supervisor
- Deconflicting of callsigns
- Two runway controllers active
-

How effective are those countermeasures?



Threats

1. Strong, gusty wind
2. Only one landing runway available
3. Several earlier go-arounds because of Wx
4. Combined role Runway Controller and Supervisor
5. Departure from non-standard runway
6. No extra marking on strip (non-standard runway)
7. No remark from GC about non-standard runway
8. Occasional departure between landing traffic
9. Occasional departure from non-standard holding point
10. Runway crossing by RFFS vehicles because of emergency
11. Similar company identifiers on strips outbound traffic (YXS and YZS)
12. Company identifiers do not resemble callsign (Flyfine/Airline)
13. Similar flight numbers (148 and 158)
14. Acceptance and confirmation of clearance for incorrect runway by YXS148
15. YZS158 does not challenge take-off clearance 18L for other flight
16. Holding point 18C obscured because of rainshower



Errors

1. Didn't notice YXS148 was at holding point 18C
2. Incorrect information ("several departures in front") to YXS148 *[result of E1]*
3. Use of incorrect callsign/ flight number/ runway combination with t/o clearance
4. Didn't notice readback was by YXS148



Undesired States

1. YXS148 departs from runway 18C on take off clearance intended for YZS158 on runway 18L
2. YZS158 remains stationary on 18L

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Threats Linked to Errors 1 - 2

4. Combined role Runway Controller and Supervisor
5. Departure from non-standard runway
6. No extra marking on strip (non-standard runway)
7. No remark from GC about non-standard runway
8. Occasional departure between landing traffic
16. Holding point 18C obscured because of rainshower

Those Threats were not managed. Result: Errors 1 and 2:

1. Didn't notice YXS148 was at holding point 18C
2. Incorrect information ("several departures in front") to YXS148 *[result of E1]*



Threats Linked to Error 3

11. Similar company identifiers on strips outbound traffic (YXS and YZS)
12. Company identifiers do not resemble callsign (Flyfine/Airline)
13. Similar flight numbers (148 and 158)

Those Threats were not managed. Result: Error 3:

3. Use of incorrect callsign/ flight number/ runway combination with take off clearance



Threats Linked to Error 4

14. Acceptance and confirmation of clearance for incorrect runway by YXS148

This Threat wasn't managed. Result: Error 4:

4. Didn't notice readback was by YXS148



Remaining Threats

1. Strong, gusty wind
2. Only one landing runway available
3. Several earlier go-arounds because of Wx
9. Occasional departure from non-standard holding point
10. Runway crossing by RFFS vehicles because of emergency

Those Threats were managed or inconsequential



Error Management

1. Didn't notice YXS148 was at holding point 18C
2. Incorrect information ("several departures in front") to YXS148 *[result of E1]*
3. Use of incorrect callsign/ flight number/ runway combination with take off clearance
4. Didn't notice readback was by YXS148

E1 Not noticed, not managed → E2

E2 Not noticed, not managed → inconsequential

E3 Not noticed (except by YZS158), not managed → T15 → US2

E4 Not noticed, not managed → US1, US2



Undesired State Management

1. YXS148 departs from runway 18C on take off clearance intended for YZS158 on runway 18L
2. YZS158 remains stationary on 18L

US1 Noticed afterwards by ATCO
Not managed.

Outcome: take off from incorrect runway

US2 Noticed by ATCO
Managed

Inconsequential



Countermeasures – effectiveness (1)

- Dedicated Supervisor
 - 4. Combined role Runway Controller and Supervisor
- Deconflicting of callsigns
 - 11. Similar company identifiers on strips outbound traffic (YXS and YZS)
 - 12. Company identifiers do not resemble callsign (Flyfine/Airline)
 - 13. Similar flight numbers (148 and 158)
 - 14. Acceptance and confirmation clearance for incorrect runway by YXS148

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Countermeasures – effectiveness (2)

- Two runway controllers active

5. Departure from non-standard runway
6. No extra marking on strip (non-standard runway)
7. No remark from GC about non-standard runway
8. Occasional departure between landing traffic
11. Similar company identifiers on strips outbound traffic (YXS and YZS)
12. Company identifiers do not resemble callsign (Flyfine/Airline)
13. Similar flight numbers (148 and 158)
14. Acceptance and confirmation of clearance for incorrect runway by YXS148
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Potential Countermeasures

- Dedicated Supervisor
- Deconflicting of callsigns
- Two runway controllers active
- ...

Most effective countermeasure:
**With mixed mode operations use a
dedicated runway controller**



Conclusion

- The TEM framework can potentially be applied in incident and accident investigation by quantifying elements in the context of air traffic control operations and by providing an understanding of the relationships between those elements
- Application of the TEM framework can assist in validating countermeasures that are proposed in investigation reports



Conclusion

- Controllers, pilots and other aviation professionals have intuitively been familiar with Threats (and Errors, and Undesired States) throughout their careers – the TEM framework provides a structured way to look at them
- The TEM framework adds a valuable dimension to the analysis of safety data

