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Preventing Runway Incursion: How to Design a Safe Conflicting ATC Clearance System (CATC system)
From traditional to augmented approach to safety assessment of changes

**Traditional**
Safety receiving a design & trying to “crack” it

**Next...**
Safety encapsulating System thinking & promoting a Teaming Concept (SAF ∈ Design)
Detection of Conflicting ATC Clearances

...Cleared to Line-Up...

...Cleared to Land...

Conflicting ATC Clearances ALERT
Embed safety within design

What is acceptably safe for the operational concept

What need to be delivered at operational level to satisfy SAC

High-Level design requirements to satisfy SO

SAC

Safety Criteria
Risk Modelling

Safety Objectives
VALIDATION EXERCISE
Safety Validation Objectives

Safety Requirements
VALIDATION EXERCISE
Safety Validation Objectives
Setting Safety Criteria (SAC) for CATC

SESAR Safety Validation Target

No increase in the number of accident due to ATM despite traffic growth

Airport Safety Net Safety Validation Target

A least 4.8% decrease of runway collision per year

The number of Runway Conflict shall be reduced by 5% when ATC is supported by the conflicting ATC clearance Tool.
Setting Safety Objectives (SO) for CATC

**SO in normal operations**

→ Detect all possible conflicting clearances considering:
  * Aircraft and Vehicles traffic
  * Airport layout
→ Alert timely Controllers to solve the potential runway conflict
→ Detection rate, nuisance rate to be acceptable

**SO considering failure conditions (Hazards)**

→ failure to detect conflicting clearances when using the system
→ failure to solve the conflicting situation following a correct system detection
Deriving Safety Requirements (SR) for CATC

**SR Functionality & Performance**
- All clearances to be keyed in the ATC system in a timely manner
- Alert to be provided in case of potential runway conflict
- Controller shall take corrective actions when needed
- CATC detection rate and nuisance rate is specified
- Interface with the ATCO is specified (type of info displayed, type of alert, audio, …)
- Alert priority between different alerting system is proposed
- …

**SR Integrity/reliability**
- Max probability for the undetected loss of the system
- Max probability for miss-detection by the system
- …

→ If these requirements are correctly implemented “the number of Runway Conflicts will be reduced by 5% (Safety Criteria)”
Embed safety within CATC design
Issue#1 Timing aspect and reaction to alert

- **SR Functionality & Performance**
  - ATCO input clearances in the EFS *as soon as practicable and within less than 3 seconds*
  - When alerted ATCO shall issue corrective clearance *as soon as practicable and at least within 3 seconds*

**Initial Design**

1. Enter Clearances
2. CATC Alert
3. ATCO corrective action
4. Pilot/VD correction

**Updated Design**

1. Predictive Indication
   - Provide clearance considering indication
   - Provide clearance disregarding indication
2. No Conflict
3. No CATC Alert
4. Potential conflict
   - CATC Alert
   - ATCO corrective action
5. Pilot/VD correction

Design not fully satisfactory in order to solve timely any conflict.
Embed safety within CATC design

Issue #2 Nuisance alert

- **SR Functionality & Performance**
  - CATC Alert when clearances are given to two A/C which might lead to runway conflict
  - Case of Land versus Line-up conflicting clearances
  - Possible nuisance alerts if A/C has already landed and a lining up clearance is given
  - **Answer:** use of SURV and routing function to minimize nuisance alerts

*Alert* before the landing a/c has touched down on the runway

With SURV **No Alert** because A/C has touched down on the runway
Conclusion

- A broader approach addressing not only the effect of failure, but addressing ATM’s positive contribution to aviation safety (a success approach).

- The approach embed Safety within the Design

- The approach ensures the system will deliver the safety required

- The process leads to the identification of a complete and effective set of Safety Requirements for the ATM change in order to satisfy the Safety Criteria (Target)