A new Safety net for Tower Runway Controllers. Preliminary Results from a SESAR exercise at Hamburg Airport in the detection of Conflicting ATC Clearances

Karsten Straube and Marcus Biella
DLR, Germany

S. Loth (DLR), H. Lafferton (DFS), S. Straub (DFS), B. Weiß (DFS), F. Schmitt (DFS), P. Diestelkamp (DFS), R. Lane (EUROCONTROL), S. Dubuisson (EUROCONTROL)

Keywords: ATC Clearances, Runway Controller, Runway incursions, Hamburg Airport

Abstract

The "Single European Sky ATM Research" (SESAR) is the collaborative project that is intended to completely modernise the European airspace and its Air Traffic Management. It represents the technological dimension of the Single European Sky initiative launched by the European Commission. The total estimated cost of its development phase is € 2.1 billion, to be shared equally between the European Community, EUROCONTROL and industry. One high-level goal to be met is the improvement of safety by a factor of 10. The increase of runway safety is amongst these topics. In this context runway incursions shall be reduced. They are defined by ICAO Doc 9870 as "any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and Take Off of aircraft."

According to the German Air Navigation Service Provider (ANSP) DFS Deutsche Flugsicherung GmbH, 66 runway incursions occurred in Germany in 2011 of which 12% were caused by Air Traffic Controllers (ATCOs). In order to prevent incidents or accidents in this particular cause, an additional new safety net was created.

Currently the only safety net available to Tower Runway Controllers is the Runway Incursion Monitoring System (RIMS). It uses Advanced Surface Movement Guidance and Control System (A-SMGCS) Surveillance data to detect dangerous situations within the runway protected area. Detections and subsequent alerts to controllers are provided at the very last moment and require immediate reaction.

The "Conflicting ATC Clearances Safety Net will detect conflicting ATC clearances much earlier – when the ATCO inputs clearances into the Electronic Flight Strips (EFS), which are already in operational use in many control towers. Therefore, it will perform crosschecks with the clearances input on the EFS, and in most cases the aircraft position, to see if the given inputs violate the rules and procedures at the concerned airport, which could lead to a hazardous situation. The new safety net will not replace the existing RIMS but is intended as an additional layer of safety.

In the framework of SESAR, and co-financed by the European Community and EUROCONTROL, a validation exercise studying Conflicting ATC Clearances was performed by DFS at Hamburg Airport between the 26th and 30th November 2012. Industrial prototypes were integrated and used in the Airport Research Facility in order to provide the appropriate validation platform. The prototypes were developed by DFS, and after a period of off-site testing the necessary equipment was successfully installed and used for the validation.

The developed “Conflicting ATC Clearances safety net” for Hamburg Airport takes particular operational characteristics of the airport (i.e. crossing runway layout) into account. Furthermore DFS considered recommendations from V2 validation trials 2011 in Luxembourg. It was recommended here, that the detection of Take Off versus Line Up and Line Up versus Take Off should be fine-tuned so that the system takes into account the line-up point of the taxiing aircraft and not the actual position of the aircraft. This would prevent the false alarm that is triggered when the aircraft that was due to line up would be still taxiing on the taxiway parallel to the runway but is in front of the aircraft taking off, but the line-up point is behind the aircraft taking off.
An additional routing function by DFS was integrated in the validation platform. The conflicting ATC clearance function bases on this routing function. Another suggestion from V2 Trials was a predictive indication. This was also integrated in the Industry Based Platform

The main aim was to evaluate the Conflicting ATC Clearance concept in a realistic environment using operational ATCOs. This was achieved by using six active and one retired ATCOs from Hamburg (HAM) airport in Germany, and one active ATCO each from XFW (Hamburg Finkenwerder, Germany), LEJ (Leipzig, Germany), KLU (Klagenfurt, Austria) and SUF (Lamezia Terme, Italy). The ATCOs performed three shadow mode trials per day. In each trial they assessed different situations where the ATCOs entered Conflicting ATC Clearances into the Electronic Flight Strips.

An example of a Conflicting ATC Clearance is when the ATCO gives clearances to two or more aircraft at the same time and for the same runway.
The figure 1 below shows a line up versus land conflict.

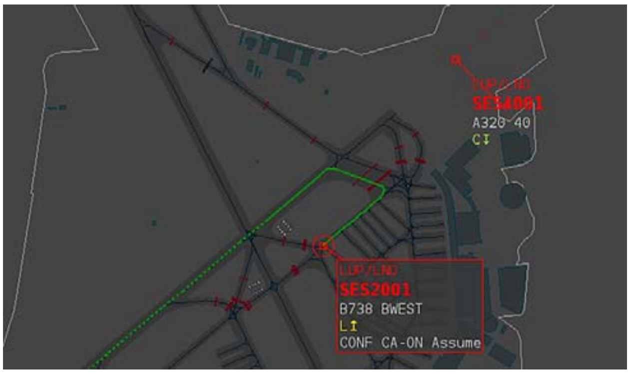

Figure 1 Land vs. Line up Conflict

In this case, the ATCO cleared the taxiing aircraft (SES 2001) for line up and the approaching aircraft (SES 4001) for landing.

This paper focuses on the validation supported by DLR, DFS and EUROCONTROL. First of all operational feasibility had to be validated in order to clarify in which situations the system helps at its best. At the same time it was checked if certain conflicting ATC clearances alerts can be regarded as nuisance alerts, e.g. in case of conditional clearances.

The validation was located outside the control tower environment so as not to interfere or disturb the active controllers and pilots at the time.

ATCOs had to follow the real traffic with no intervention but acting as if they were in charge of the traffic. Additional synthetic traffic was used to create pre-conditions for conflicting clearance. Another reason for the synthetic traffic was that it was not always possible to use real traffic for different situations e.g. there was not enough real traffic. On the ATCOs’ HMI there was no difference between real or synthetic traffic.

The ATCOs inserted clearances via the EFS, e.g. a landing clearance. On request of the validation team the ATCO then was asked to input a 'conflicting' clearance, e.g. a line-up clearance for a synthetic aircraft, to check the feasibility and functionality of this dedicated alert.

Evaluation methods included data logging, questionnaires and debriefings after each session and at the end of the day. Both the system's response times in situations with conflicting clearances and the ATCOs' response to the systems alerts were logged. Furthermore it was assessed whether the correct type of alert was triggered by the system and if false alerts were kept to an acceptable level.
A specific questionnaire was designed to assess operational feasibility according to the ATCOs after their use of the Conflicting ATC Clearances System during the shadow mode trials.
Debriefing sessions with ATCOs, operational experts, and developers were conducted to analyse which alarms were a nuisance for the ATCO and which alarms were perceived as being a useful safety net.

Binomial tests were performed to show statistically significant ATCO feed-back in the questionnaire.

We will present results from the questionnaires to reveal the degree of the ATCOs' acceptance and usability for different types of alerts. In conclusion, response times of the users and the system will be presented. These results are the key to fine tune the new safety net for operational use.

Our report will conclude presenting a set of future safety nets, starting with the conflicting ATC clearances safety net, the inclusion of an additional conformance monitoring system, completed with the Runway Incursion Monitoring System.