Mind the gap...
Keeping aircraft operations safe during runway construction works

by Gaël Le Bris

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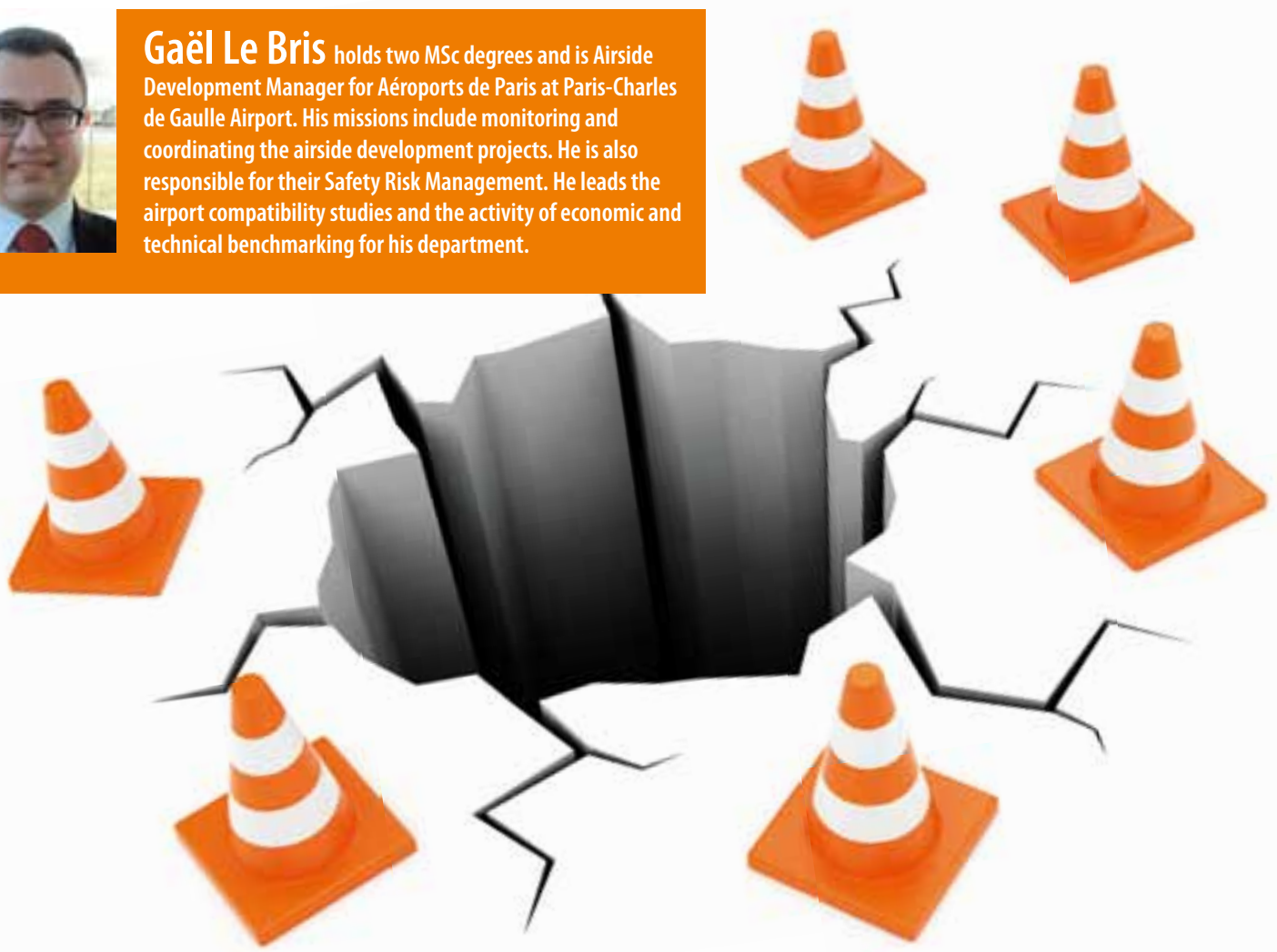

Construction works on the movement area are quite a sensitive matter. Airfield closures modify the usual ground routeings. A taxiway can be closed or forbidden to the widest aircraft if constructions are carried out within the limits of the taxiway strip. But construction works in the vicinity or within the borders of the runway strip and its protection surfaces are the most critical, because they involve modifying or degrading the operating conditions of an area where aircraft land and takeoff.

Temporarily shortened runways, especially if the threshold is displaced may avoid the closure of the runway. This concept is used at airports of all volumes of traffic, fleet mix, and location. They have been deployed equally at general aviation, civilian/military, and commercial airports.

However, accident and incident records show that events have happened on shortened runways, and sometimes even on closed runways. Consequently, the airport operators, in cooperation with the Air Navigation Service Provider (ANSP) and the airlines, must carefully prepare for the operation of runway restrictions or closures. To succeed in this, they should apply the techniques and tools of Safety Risk Management (SRM) as part of an Airport Safety Management System (A-SMS).

The right path

One of the main hazards during the temporary displacement of a runway threshold is an aircraft landing before the new threshold. In 1997 at Porto airport, a Saab 340 landed near the normal threshold then encountered a trench and lost its landing gear[1]. In Perth, in 2005[2] and then again in 2008[3], flights touched down or interrupted the final approach before the displaced threshold. When the lengths of a runway are reduced, the pilots usual environment may be significantly modified and become more complex. Also, the level of service in terms of infrastructure (NAVAIDS, markings, etc.) may be reduced during construction works, when they might paradoxically be especially useful at their existing standard.

Displacing a threshold means that the Instrument Landing System (ILS) Glide Path (GP) is no longer available. Since the ILS localiser (LOC) is usually still operative, the LOC/DME is often the most popular alternative. A temporarily relocated PAPI can be an affordable means of providing a visual indication on aircraft position on the modified vertical profile. Finally, inapplicable markings must be properly removed or masked and it is vital that the new temporary markings are clear and comprehensive.

At Paris-CDG, such a configuration was used when the threshold of runway 08L was displaced for two months during the summer of 2012 with equivalent infrastructure, but with only a non- precision approach. All the runway threshold and related markings moved approximately 700 metres along the runway and the normal markings were fully masked and replaced with white crosses or displaced threshold arrows.

Caution: runway closed ahead

Hazards remain even if a runway is completely closed, especially when its threshold is near to that of another (parallel or crossing) runway. In ICAO Annex 14, the required marking for a closed runway[4] is a 36 m-long white cross every 300 m. But again, being compliant is necessary but not always sufficient to avoid incidents. In 2011 in Menorca, Spain a CRJ200 landed on a runway (RWY01R) that was properly closed with ten painted crosses all along. The investigation[5] found that despite requesting and flying a visual approach, the crew input the procedure for the closed parallel runway they were used to landing on (RWY01L) into their FMS and then proceeded to fly it.

When Paris CDG completed a Safety Risk Assessment for resurfacing RWY08R/26L (the preferential runway for landing on the southern runway pair) during summer 2014, it was decided to replace the normal white colour of three of the ten white crosses with a luminous orange. This trial was inspired by the standards in the United States, where the crosses for closed runways are yellow[6].

1- See the report in Portuguese language only via a link from: http://www.gpiaa.gov.pt?cr=9600
2- See: http://www.skybrary.aero/index.php/A342,_Perth_Australia,_2005_(RE_HF_GND)
3- See: http://www.skybrary.aero/index.php/B738,_Perth_Australia,_2008_(RE_HF)
4- Annex 14, Aerodromes, Vol. I Aerodrome Design and Operations, 6th edition, ICAO, July 2013, p. 7-2.
5- http://www.skybrary.aero/index.php/CRJ2,_Menorca_Spain,_2011_(RE_HF)
6- http://www.skybrary.aero/bookshelf/books/2714.pdf

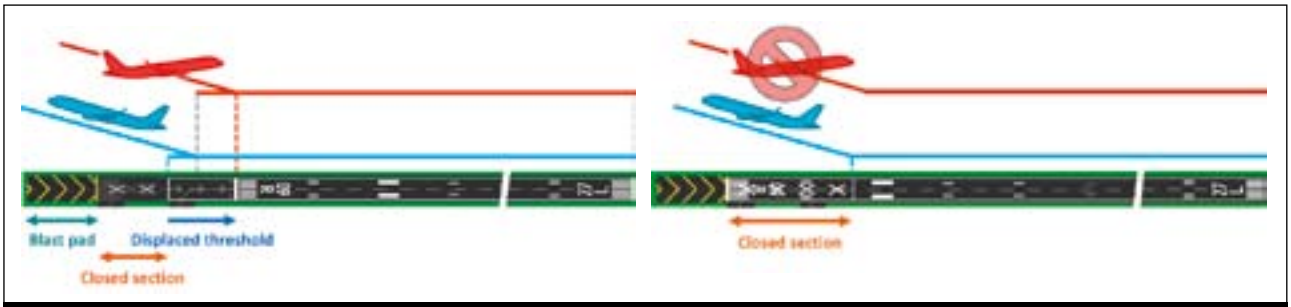

Fig. 1 – An example of shortened runway (left) and a typical displaced threshold (right)

Mind the gap...
Keeping aircraft operations safe during runway construction works (cont'd)

The main goal is highlighting the runway status by breaking the habit of pilots of seeing white markings on active runways. In addition, white crosses are readily visible on asphalt runway surfaces, but they stand out far less well on recent concrete runway surfaces. Since RWY08R/26L has a cement concrete construction which will be eventually be overlaid with an asphalt concrete layer, the use of the two colours ensures adequate visibility of the closure markings during interim state of the runway.

What is happening to my runway?

Providing crews with proper information is a key issue in the prevention of most accidents. For instance, in an undershoot at Porto Airport (1997) and two near-collisions with construction works at Paris-CDG (2008)[7] and at Prague (2012)[8], lack of awareness and information on the part of the flight crew was considered to be the primary cause.

A reduction in the length of a runway is announced by a NOTAM or an AIP Supplement. They specify the reductions in the declared distances and changes to available NAVAIDS and procedures. A NOTAM can take a dozen lines to describe such modifications of the operating conditions. In a context where the number of NOTAMs can be significant, AIP Supplements represent a real value added for safety. Indeed, unlike NOTAMs, they provide accurate descriptions and charts on a separate document. A short simple Trigger NOTAM announces the publication of an AIP Supplement.
Since missing the aeronautical information happens, it is important to reinforce it locally. Paris-CDG publishes a regular bulletin of airside works, displaying week-by-week the airside closures for the coming year. In Europe, the A-CDM (Airport Collaborative Decision Making) websites are a good medium to make these materials available on a large scale to the airside community. In the United States, the Federal Aviation Administration published illustrated construction works notices, available on the National Flight Data Center (NFDC) website[9].

LAL 11/035 LAL TWY A1, A2, A3, P1, P2, TWY A WEST OF TWY H, TWY P WEST OF TWY S CLSD 1311192028-1403282100
LAL 11/034 LAL RWY 27 DECLARED DISTANCES: TORA 4734 TODA 4734 ASDA 4734 LDA 4734. 1311192029-1403282100
LAL 11/033 LAL RWY 9 THR DISPLACED 3766FT NOT STD MARKING. DECLARED DISTANCES: TORA 5734 TODA 5734 ASDA 5734 LDA 4734. 1311192029-1403282100
LAL 11/021 LAL NAV ILS RWY 9 GP OUT OF SERVICE 1311181200-1403182359EST
LAL 11/020 LAL RWY 9 PAPI OUT OF SERVICE 1311181200-1403182359EST
LAL 11/019 LAL RWY 9 ALS OUT OF SERVICE 1311181200-1403182359
LAL 11/013 LAL RWY 27 ALL DISTANCE REMAINING SIGNS MISSING 1311082156-1403312200
LAL 11/012 LAL RWY 9 ALL DISTANCE REMAINING SIGNS MISSING 1311082154-1403312200

Fig. 3 – An example of a temporary DTHR described by NOTAMs

Ultimate safety nets

However, despite the efforts of the airport operators and the ANSP to communicate beyond the minimum mandatory actions, accidents due to lack of awareness in the flight deck still happen. In the 2008 incident at Paris-CDG, a Boeing 737 took off towards work in progress at the far end if the runway without taking into account the reduced declared distances. As a result, it subsequently crossed plastic barricades 100 m after the end of the reduced TORA and then flew low over blast fences. The investigation[10] concluded the crew was not aware that the available distances were reduced. In the 2012 incident in Prague, the Captain determined the V-speeds based on the full runway lengths. The crew attributed their error to fatigue and low awareness.

Airport operators and ANSPs can work together to provide innovative solutions which will increase pilot awareness. At Mumbai in 2009, the temporarily reduced-length runway 27 was designated runway 27A. At Paris-CDG in 2012, the single access taxiway to the threshold of runway 26R during the works was temporarily named R1

7- http://www.skybrary.aero/index.php/B738,_Paris_CDG_France,_2008_(RE_HF)
8- http://www.aaib.gov.uk/cms_resources.cfm?file=/Airbus%20A319-111%20G-EZDN%2002-13.pdf
9- https://nfdc.faa.gov/xwiki/bin/view/NFDC/Construction+Notices
10- http://www.skybrary.aero/index.php/B738,_Paris_CDG_France,_2008_(RE_HF)

Oh, him? He's part of the awareness campaign about the reduced RWY length...

"WORKS".

Landing and taking off towards or away from construction works requires quasi re-designing the runway. Facing this complexity, SRM is the "right stuff" and the only tool to address this challenge in a comprehensive and efficient way.

But the last barrier against an accident is the air traffic controller. Indeed, he is the only one able to prevent an accident in real time. In the accident at Perth in 2008, the air traffic controller played a key role in helping the crew for initiating a second go-around and for identifying the temporary threshold[11]. At Paris-CDG in 2012, three attempted incursions onto runway 26R using closed taxiways were stopped as a result of intervention by air traffic controllers. The controller is also the pilots' last source of information in case they are not aware of the aeronautical information and so the way in which phraseology is used can be critical (see HindSight 15 of May 2012[12]).

Working together to improve safety

Safety Risk Management (SRM) is a formal approach to assessing the impacts of any modification at an airport on aviation safety and to mitigating their effects by appropriate measures. It is part of the Airport Safety Management System (A-SMS) which is mandatory for certified airports in Europe under the provisions of Regulation EC N°139/2014[13]. On the other side of the Atlantic, the FAA is in the process of adding provisions for such an A-SMS to its equivalent regulation (Part 139).

Landing and taking off towards or away from construction works requires quasi re-designing the runway. Facing this complexity, SRM is the "right stuff" and the only tool to address this challenge in a comprehensive and efficient way. In a SRM process, all airfield project and airside operations stakeholders must work together to deliver the appropriate level of safety under both the usual operation of an airport and temporary variations from it using their respective competencies and experiences.

Also, it is important to bear in mind past accidents when conducting a SRM process. But since no one airport can claim to have experienced the entire range of accidents and incidents possible, it is relevant to look for learning from events occurring at other airports. Although both the FAA and Transport Canada provide public online access to their safety occurrence databases (ASIAS[14] and CADORS[15]). Such a systematic data sharing does not exist in Europe.

But the most direct information is always the most valuable, and so the best value comes from airports, ANSPs and airlines directly sharing their experience and best management practices in order to enhance the level of safety of the air transportation system, especially when it concerns runway construction works.

11- http://www.skybrary.aero/index.php/B738,_Perth_Australia,_2008_(RE_HF)
12- http://www.skybrary.aero/bookshelf/books/1792.pdf
13- http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2014:044:0001:0034:EN:PDF
14- http://www.asias.faa.gov
15- http://wwwapps.tc.gc.ca/saf-sec-sur/2/cadors-screaq/