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Multiple remote tower for Single European Sky: The evolution from initial operational concept to regulatory approved implementation

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ABSTRACT

The European Union project of Single European Sky initiated a reorganization of European airspace and proposed additional measures for air traffic management to achieve the key objectives of improving efficiency and capacity while at the same time enhancing safety. The concept of multiple remote tower operation is that air traffic controllers (ATCOs) can control several airfields from a distant virtual control centre. The control of multiple airfields can be centralised to a virtual centre permitting the more efficient use of ATCO resources. This research was sponsored by the Single European Sky ATM Research Program and the ATM Operations Division of the Irish Aviation Authority. A safety case was developed for migration of multiple remote tower services to live operations. This research conducted 50 large scale demonstration trials of remote tower operations from single tower operations to multiple tower operations for safety assessment by air navigation safety regulators in 2016. A dedicated team of air traffic controllers and technology experts successfully completed the safety assessment of multiple remote tower operations in real time. The implementation of this innovative technology requires a careful balance between cost-efficiency and the safety of the air traffic control in terms of capacity and human performance. The live trial exercises demonstrated that the air traffic services provided by the remote tower for a single airport and two medium airports by a single ATCO with 'in sequence' and 'simultaneous' aircraft operation was at least as safe as provided by the local towers at Cork and Shannon aerodromes. No safety occurrence was reported nor did any operational safety issue arise during the conduct of the fifty live trial exercises.

1. Introduction

The initial concept of remote tower operations was started by the research proposal of Virtual Control Tower over 20 years ago (Kraiss and Kuhlen, 1996). The paradigm of remote tower operation will allow air traffic services (ATS) be delivered remotely without direct observation from a local tower. The emerging technology of remote towers developed slowly during the early stages but in recent times has taken a leap forward with some single airport virtual tower operations. SeaRidge technologies in partnership with HungaroControl have secured certification for the provision of remote tower live operations without restrictions; SAAB has provided London City airport with its digital tower platform to begin its landmark replacement of the conventional tower with remote solution. Norway's air navigation service provider Avinor has collaborated with Indra, Navia and Kongsberg to implement remote tower provision at up to fifteen low density airports from one central location (Otsby, 2016). Italian air navigation services providers ENAV successfully tested "Remote Airport Concept of Operation" (RACOON) which validated multiple mode operations at Milan

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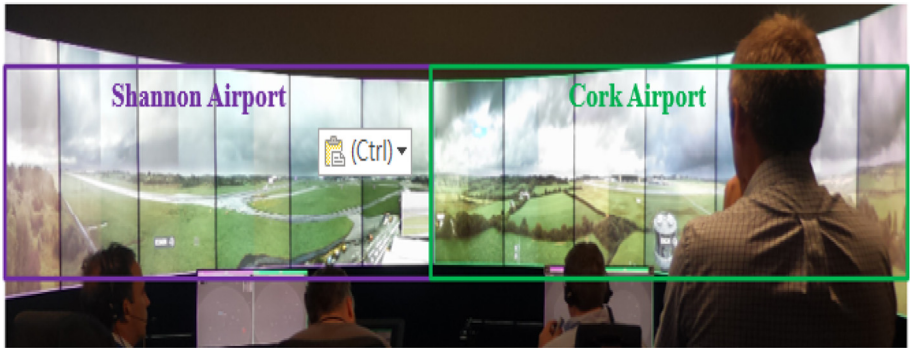

Fig. 1. The Remote Tower Centre located at Dublin Airport in excess of 100 miles away provided air traffic services for both Cork and Shannon airports.

Linate airport from Milan Malpensa (SESAR, 2016). Additionally, remote tower operations to medium size aerodromes were demonstrated by DFS at Saarbrücken Airport and by LVNL for Eelde Airport in active as well as in passive shadow mode based on operational procedures used in their respective conventional towers (SESAR, 2015a).

The development of Augmented Vision Video-panorama technologies has increased the monitoring capabilities of remote tower operations (RTO). Both monitoring and communication are important tasks of ATCOs, the concept of MRTO raised a safety concern of human performance in higher traffic environments (Papenfuss and Friedrich, 2016). The identification of visual properties used by ATCOs to monitor aircraft for landing and manoeuvring at airports are critical to aviation safety. ATCO's use Out the Window visualisation (OTW) supported by radar data processing (RDP), electronic flight strips (EFS) and a communications network (TEL) to provide air traffic services in the airfield environment (Ellis and Liston, 2016). The concept of distributed cognition seeks to understand the structure of cognitive system and extends the application to encompass interactions between resources and information in the operational environment (Hollan et al., 2000). Based on the concept of remote tower operations, multiple remote tower operations (MRTO) offer further solutions for cost efficiency of air traffic services for small and medium size of airports. The new technology will allow one air traffic controller (ATCO) control two or more airports at the same time during low traffic volumes. The feasibility of controlling two airports simultaneously was demonstrated successfully with a special focus on the visual attention of ATCOs and the controller working position design (CWP) related to ATS task (Moehlenbrink and Papenfuss, 2011). The objective of this research is to conduct safety assessment of MRTO in order to secure regulatory approval for implementations.

2. Background of policy and practice

This Multiple Remote Towers research was sponsored by the Single European Sky ATM Research Program (SESAR) and the ATM Operations Division of the Irish Aviation Authority. The Remote Tower Centre (RTC) was located at Dublin Air Traffic Services Unit in excess of 100 nautical miles away from the two airports at Shannon and Cork where the services were provided simultaneously (Fig. 1). Cork airport is a H24 international airport with aircraft types up to medium weight category such as Boeing 737 and Airbus 320. Total movements in 2016 were 50,242. Shannon is a H24 international airport with aircraft types up to the heavy weight category such as Airbus A330, it handled 25,059 movements in 2016. This research will contribute to the objectives for in sequence and simultaneous remote provision of ATS for multiple aerodromes as outlined in the Operational Improvement Step (OIS) SDM-0205 linked to SESAR Work Package (WP) 06.09.03 of the EU ATM Master Plan.

2.1. The evolution of remote tower operation

Air traffic in Europe has consistent increased since the 1990s. The Single European Sky (SES) initiated a reorganization of European airspace based on traffic flows instead of national boundaries and proposed additional measures for air traffic management to achieve key objectives of enhanced efficiency and capacity while improving safety performance. SES regulations focussed on efficiency, capacity and safety have increased cost pressure on air navigation service providers and require them to be more innovative in their approach to the provision of air traffic management services. Many air navigation service providers (ANSPs) have developed automated systems using video-panorama cameras for synthetic outside view, to increase capacity at airports and to improve cost efficiency by minimising personnel to meet cost efficiency targets (Leitner and Oehme, 2016). This has seen increased attention in remote tower research over the last 20 years. The concept of remote tower operations is that an ATCO can control any airfield from a distant virtual control centre. The view of the airfield under control is displayed in real time on screens and air traffic movements can be controlled. This concept is predominantly appropriate for the lower volume airports. Therefore, the control of multiple airfields can be centralised permitting capital and operational costs savings. Consequently, the visual features of cues and objects which ATCOs must identify for safe operations are significant influencers of the requirements for surveillance cameras, data-communication links and display systems in a remote tower centre (Van Schaik et al., 2016). The concept of an advanced remote tower was developed for airports with fewer than 25 movements at the mean busy hours with a mix of visual flight rules and