HADTUDOMÁNYI SZEMLE

2018. XI. évfolyam 4. szám

JÁNOS CSENGERI[1]

Remote Towers III.

Távoli toronyirányítás III.

Abstract

In the last part of the research period on the one hand it has been examined how a remote tower centre might be composed of and on the other hand it is studied that how the remote tower technology can affect the training methods of air traffic control.

In the first main chapter of the present paper the author describes which elements may build up a remote tower centre. The second main chapter examines the ATC training of our days in order to provide a global understanding on how ATC trainings are being built up and being able to see the similarities and universality of them. After that the author shares his experiences, impressions and ideas on how the proliferation of rTWR technology might affect the training and education of air traffic control.

Keywords: remote tower control; remote tower centre; air traffic control training

Absztrakt

A kutatás utolsó szakaszában egyfelől a távoli irányítótorony lehetséges felépítése, szervezeti elemei kerültek vizsgálatra, másrészt pedig, hogy a távoli toronyirányítási technológia milyen hatással lehet a légiforgalmi irányító képzésre, annak módszereire.

Az esszé első fő fejezetében a szerző azt részletezi, hogy milyen szervezeti elemekből épülhet fel egy távoli irányítótorony. A második fő fejezet első része napjaink légiforgalmi irányító képzését mutatja be annak érdekében, hogy egy általános képet kapjon az olvasó a képzési programok tartalmáról, illetve szemléltesse azok egyetemességét. Mindezek után a szerző megosztja tapasztalatait,

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benyomásait és gondolatait arra vonatkozóan, hogy milyen ahtással bírhat a távoli toronyiráynítási technológia a légiforgalmi irányító képzésre és oktatásra.

Kulcsszavak: távoli toronyirányítás, távoli irányítótorony, légiforgalmi irányító képzés

INTRODUCTION

It is the air traffic/airport remote controlling that seems to be the main direction in the air traffic controlling sector, which determines the interests of the sector and carries promising innovative possibilities. Air traffic control, as a kind of service, and military air traffic control, within the defence public service sector, are facing a wide range spread of technology which represents significant added values concerning the topic. In the present series of articles, consisting of three parts, I have examined this kind of technology, namely the Remote Towers (rTWR), and its connections to other areas.

In the first part[2] I represented the development and use of remote control technology, furthermore, I dealt with remote sensing and other related background topics also. I specifically emphasized the development, spread, abilities and opportunities of services and technology of remote airport tower control. I also represented the solutions of atypical air traffic control towers, the mobile air traffic control tower, as well as the remote virtual control tower itself.

In the second part of the series of papers, I have demonstrated the process leading to the present technological concept and solution, and I outlined the architecture of the system. As a matter of course, the advantageous features and added values along with the weaknesses and threats of the system have also been presented, compared to the traditional tower control through a SWOT analysis. I have mentioned the experiences reached on international fields so far, the availability of research and development activity in our country, and the possible places to apply the solution.

In the third part of this research I examine the possible utilization of the technology in practice. Consulting experts, I analyse the general organizational architecture applied so far, and demonstrate the set-up of the air traffic control centre (in some possible general outlines). As the widespread use of this technology is „round the corner" and because possibly in the middle term future the rTWR technology will take place (at least a certain degree) of ordinary tower air traffic control, it is essential to search its possible implementation in air traffic controller training. First of all, the differences shall be identified between conventional air traffic controller training/education (and possible application of general pedagogical methods[3]), furthermore the overall impact of rTWR technology should be examined on air traffic controller training.

[2] János Csengeri: Remote Towers I. In: Hadtudományi Szemle, X/3. 2017. pp.8-25.
[3] Szelei Ildikó, Bárdos László: Általános és katonapedagógia. ZMNE, Budapest, 2006.

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1. SOME POSSIBLE ARCHITECTURES FOR REMOTE TOWER CENTRES (RTC)

As I examined this topic already in my second paper related remote towers, the real benefit of the technology is the centralisation of different services which are involved into air traffic management (ATM). To this end I have determined the services which can be moved from the airports into remote tower centres. By the application of the rTWR technology the air navigation service provider is able to reduce the number of necessary personnel and also able to create an extendable remote control facility at whichever location that fits the needs, requirements and possibilities.

After studying the literature, searching the internet and consulting with experts from Hungary and abroad, I recognised that architectures for remote tower centres cannot be found. This is the reason this paper intends to draw a provisionary architecture of a remote tower centre.

Some paper says that "A remote tower centre is a building where ATS [air traffic services] are located to serve one or more airports. It usually includes several RTMs [remote tower modules]."[4] So the term remote tower centre is mentioned and even defined, but this definition refers only on the air traffic control service and perhaps on ground control and clearance delivery. Beyond these, other services which are also involved into ATM might be placed in a remote tower centre (see Figure 1.) leaning further the fix costs of an airport. These additional services can be the Aeronautical Information Service (AIS), the ATS Reporting Office (ARO) and the aeronautical metrology service.

The AIS has one of the least known and most vital roles in support of international civil aviation: to ensure the flow of information/data necessary for the safety, regularity and efficiency of international air navigation. To ensure this it collects and disseminates aeronautical information required by all categories of flights. This documentation can either be urgent/temporary (NOTAM – Notice to Airmen; SNOWTAM – a report regarding snow and ice on airport airside surfaces) or permanent (AIP – Aeronautical Information Publication). Updating these documents is an integral part of the work of AIS officers. Their task also comprises the management of the flight movements database for billing and statistical purposes and billing of terminal and airport charges.[5]

The ARO is responsible for the reception, verification, change and distribution of flight plans and associated messages, (e.g. departure and arrival messages). Flight plans can be filed via fax, e-mail, telephone or in person. A second responsibility is the briefing of pilots using a PIB (Pre-flight Information Bulletin), which gives necessary information for the proper execution of flights. Another obligation lies within air traffic flow and capacity management by providing pilots information on the regulation of air traffic and by indicating the delays that some flights might experience due to these specific regulations (e.g. strike, weather conditions). A last important responsibility consists in alerting the appropriate or-

[4] Frequentis AG: Whitepaper: Introduction to remote virtual tower. Vienna, 2016. p.4.
[5] International Civil Aviation Organization: Aeronautical Information Services Manual (Doc 8126 AN/872). Montreal, 2004.

ganisations regarding aircraft in need of search and rescue services and to assist such organisations as required.[6]

The aeronautical meteorological service aims to provide aviation weather services to contribute to safety improvement, regularity, and efficiency of air navigation. The provision of services includes the observation of wind direction, wind speed, the Runway Visual Range (RVR), temperature, air pressure, precipitation, etc. The service analyses aviation observation elements and then conducts various observation activities, such as METAR, local MET Report, SPECI, and local SPECIAL in order to produce and provide weather information necessary for flight safety. Based on aviation weather observation data, various numerical forecast data, and international preliminary data produces and provides TAF, landing and take-off forecasts, area forecast, SIGMET, AIRMET etc.[7]

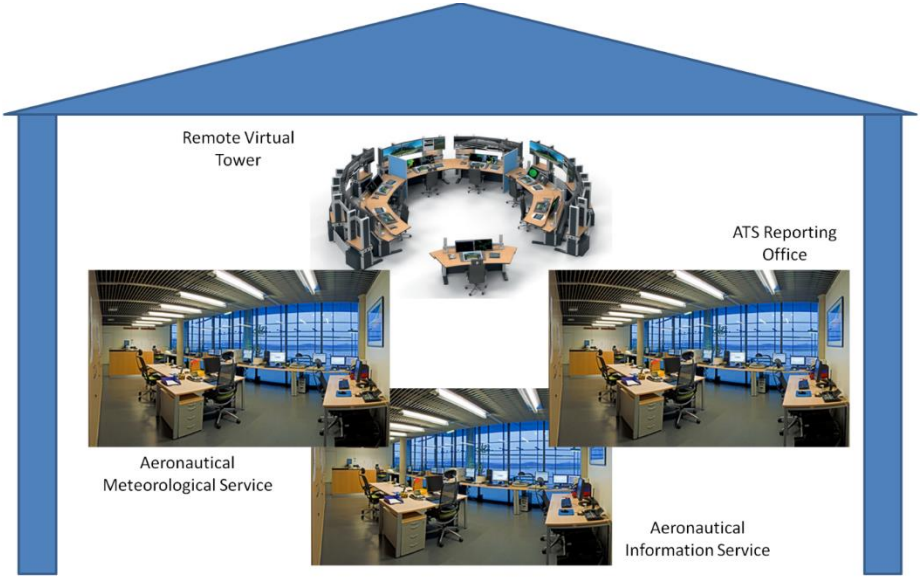

Figure 1.: Basic possible architecture of a Remote Tower Centre (Source: own edition of the author)

In the organisation of remote tower centre, beyond the virtual remote tower and within that the remote tower modules (also known as: controller working positions), the aeronautical information service, ATS reporting office and aeronautical meteorological service there might or should be other auxiliary elements as well. This can be a civil engineer team which

[6] Air Navigation Administration Luxemburg: Aeronautical Information Services https://ana.public.lu/en/administration/organisation/soa/index.html (downloaded on 06.21.2018.)
[7] Korean Meteorological Administration: Aeronautical Meteorological services https://web.kma.go.kr/eng/biz/aviation_01.jsp (downloaded on 06.21.2018.)

is responsible for the maintenance of the visualization in the RTC and at the airports which are linked to the given RTC, the cameras, the data link, the video walls, the power supply, etc. An auxiliary element can also be an IT cell of which task is to provide computer expertise, monitor the proper operation of softwares and computers and perhaps realise the needs and requirements of ATCOs (air traffic controller officers) and other personnel if these are manageable. Security also required, which element is supposed to provide the security checking of persons and vehicles at the entries of the RTC, the surveillance of the surrounding area of the remote tower centre, prevent any unauthorised entries and also managing access level among the personnel of the RTC, etc. A facility management cell is required too, which is tasked to manage all the issues related to the building and its surrounding area itself where the installation of remote tower centre takes place.

After all, a remote tower centre might be consisted of the above mentioned elements. For a better understanding see the figure below (Figure 2.) as an assessment:

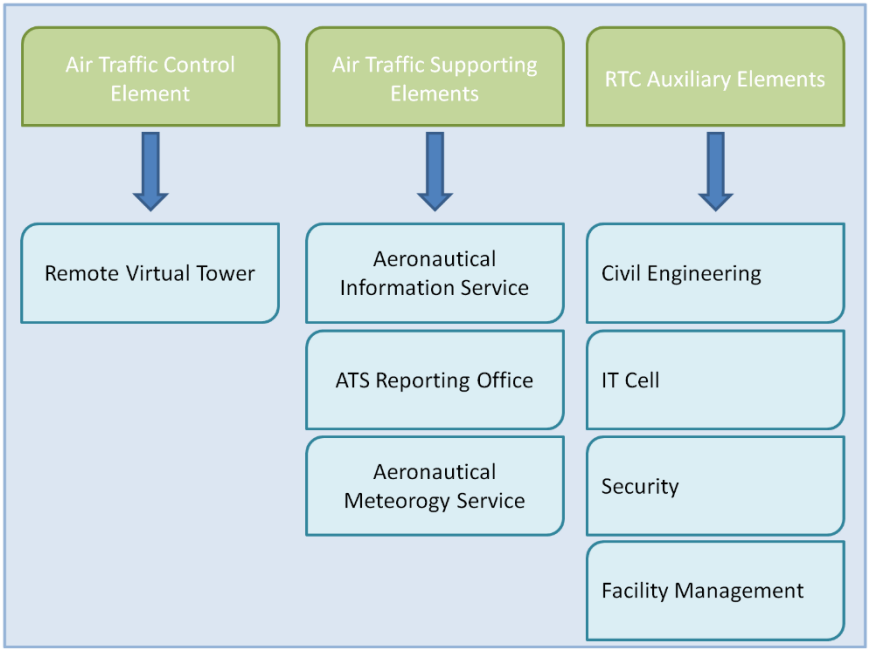

Figure 2.: Possible elements of a remote tower centre, Source: own edition of the author

Remote virtual tower technology can control airport traffic from remote locations (Figure 2.). This allows remote tower centres to be placed in populated or attractive places (e.g. larger cities, emerging regions). It is easier to find skilled and educated people in such areas,

simplifying staffing and recruiting. This also provides a long-term perspective for people in their jobs and high flexibility of resources.

Another factor for deploying remote virtual tower technology is security. A control tower at an airport is an obvious target and could be subject to bombing or other attack. The remote virtual tower approach keeps personnel at a safe, secure and protected location.[8] Additional technology (e.g. infrared-based night vision cameras, video-based object detection) can be used as an enhancement for the remote virtual tower for infrastructure protection and monitoring.

Instead of resources at each airport, which may be under-utilised due to little air traffic, centralised resources can handle several airports and can employ a steady workload. Examples include: Combining resource for multiple airports (time shifting): A controller can use time between scheduled traffic at one airport for other tasks, such as handling services for another airport, training or preparation work. Combining activities from several airports: At small airports, there are still two controllers to manage traffic and provide support functions. With RVT, functions such as clearance delivery or flight information tasks of multiple airports can be assigned to one person. As a result, one controller could focus on tactical operation and service air movement and ground movement in a combined way.

During night shifts with low traffic, one controller can monitor multiple airports, resulting in a saving of two ATCOs, or 66% per night shift. A tower is normally equipped with at least one ATCO for air movement, one ATCO for ground movement and one supervisor. In an RTC environment, one supervisor can handle three airports, resulting in a saving of two supervisors or 66% per shift.[9]

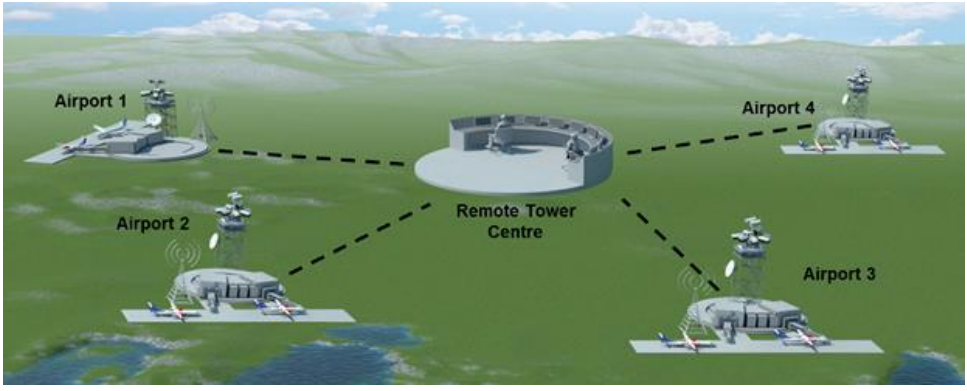

Figure 2.: Remote tower centre with the connected airports Source: Frequentis AG: Whitepaper: Introduction to remote virtual tower. Vienna, 2016. p.3.

[8] Vas Tímea: NDAB (NATO Deployable Airbase) sajátosságai a nemzetközi polgári és katonai szabványok tükrében. In: Repüléstudományi Közlemények (1997-TŐL) XXIX/2. 2017. pp. 211-227.
[9] Frequentis AG: Whitepaper: Introduction to remote virtual tower. Vienna, 2016. p.6.

2. THE PROSPECTIVE IMPACT OF REMOTE TOWER TECHNOLOGY ON AIR TRAFFIC CONTROLLER TRAINING

First of all, the present ATC (Air Traffic Controller) training curriculums should be examined and after a review of these programs, it will be possible to add the elements that the rTWR technology demands or to conduct the proper adjustments in the training method. I have conducted several interviews with experts from SAAB[10], DSF[11] at World ATM Congress 2018, which was held in Madrid, Spain on 06-08. March 2018. I have also visited the headquarters of Hungarocontrol Pte.Ltd. in Budapest, Hungary and I have participated at a Hungarian ATM (Air Traffic Management) conference on 10. April 2018. as well. At each occasions I was able to talk with very high qualified people. During the paragraphs below I share my experiences and knowledge which I collected during the last third of my research and I also present some curriculums of ATC training programs. Finally, I describe in which way rTWR technology might influence the course of ATC training methods.

2.1. THE ATC TRAINING OF TODAY

Air traffic controller training programs generally follow a very complex and thorough schedule. The whole program is usually consisted of three major fields, as: basic theoretical program, simulator aided program and on the job training. There are two approaches in training programs, one is the program of air navigation service providers (ANSPs) and specialised air traffic service schools like Entry Point North[12] in different countries as Sweden, Denmark, Spain, Ireland and Belgium; and in Hungary Entry Point North cofounded an ATS academy with Hungarocontrol Pte.Ltd. of which name is Entry Point Central. The other approach is the gradual education where in the framework of university education students are able to apply for air traffic controller education as a major. In Hungary the latter one is available at Faculty of Military Sciences and Officer Training of National University of Public Service.

The basic theoretical program provides the elementary air traffic management and aviation knowledge. A number of the basic ATC course's theoretical components are similar to the requirements for pilot training because of the close inter relationship within the aviation environment. During course students will learn:[13]

- navigation;
- meteorology;
- rules of the air;

[10] SAAB Remote Tower https://saab.com/security/air-traffic-management/digital-tower-solutions/remote-tower/ (06.27.2018.)
[11] DFS (Deutsche Flugsicherung GmbH) homepage https://www.dfs.de/dfs_homepage/en/ (06.27.2018.)
[12] Entry Point North homepage https://www.entrypointnorth.com/ (06.28.2018.)
[13] Entry Point North, Basic ATC course https://www.entrypointnorth.com/training/air-traffic-controller-basic-course/ (07.02.2018.)

- human factors,
- military aviation;
- equipment and systems;
- airspace management;
- environmental protection;
- security;
- airspace users,
- regulator role,
- ATC licensing;
- safety management systems,
- international organisations;
- alerting services.

At National University of Public Service, Hungary air traffic controller officers are educated for the armed forces in order to solve the manning of military ATC towers and NATO subordinated Control and Reporting Centre (CRC) in the town of Veszprém. At the University one half of the cadets receive a basic ATC training for ordinary tower workplaces and the other half of cadets utilize radar instruments in order to become an air defence controller. In the following table (Table 1.) I summarise only their professional subjects. Of course there are subject which are part of the cadet's curriculum due to the university gradual education, but these subject are not part of a training of an ANSP or ATM training centre and I also do not intend to indicate them.

Subjects	4. semester	5. semester	6. semester	7. semester	8. semester
	Aviation safety II.	Basics of aviation I.	Theory of aviation	Radio communication procedures	Air Force tactics III.
	Aviation psychology	Basics of aviation II.	Aviation meteorology	Human factor and its limits in aviation	Practice of air traffic control II.
	Air Force tactics II.	Rules of the air	Aviation law and ATC procedures	ATC procedures	Simulation of contingency situations
	Air traffic systems	Aircraft systems	Navigation	Practice of air traffic control I.	ICAO English IV.
	Use of airspace	Types of aircraft	Radar control procedures	ICAO English III.	6 weeks of exercise at a specific military aerodrome

Subjects	4. semester	5. semester	6. semester	7. semester	8. semester
	Aviation practice	Basics of air advisory service	ATC rules and procedures		
	3 weeks of exercise at a specific military aerodrome	ICAO English I.	ICAO English II.		
			4 weeks of exercise at a specific military aerodrome		

Table 1.: Education syllabus of military ATCOs, Source: official syllabus provided by Military Aviation Institute, NUPS, Hungary

It can be seen that the cadets also receive all the necessary knowledge which is essential for an ATCO candidate just like in the case of the Entry Point North training. The major subjects for regular ATCOs are the 'Practice of air traffic control I. and II.' which subjects are taught through 120 and 195 lectures in the 7th and 8th semesters. The syllabus of air defence controllers is quite similar except for the major subjects which are 'Practice of radar control I. and II.' also in the 7th and 8th semesters, through 120 and 195 lectures as well. The syllabus from which the information is extracted is a novel one, the education according to this one will be started in September 2018. The former syllabus is similar, but from the next academic year (2018/2019) on the cadets will be knowing from the very first semester their specialty will be air traffic controller. At the present moment cadets choose their speciality after the 4th semester. The newcomers will have the advantage that they will be able to familiarize with aviation and their future expertise since the 2nd semester.

Analysing further the subjects it can be seen professional English language is essential, and the cadets are provided by all the aviation and air traffic management essential knowledge as well. Practical training is also mandatory. Except for the end of their first year, cadets spend weeks at aerodromes every early summer in order to familiarize with the aerodrome, different services which are related to air traffic management, atmosphere and so on. Furthermore, at the end of 4th academic year (8th semester) every cadet is sent to their future workplace in order to familiarise with their future workplace and to take their final on-the-job exam.

After graduation young 2nd lieutenants start working at different air bases (Szolnok, Kecskemét or Pápa and as for the air defence controllers they start at CRC Veszprém or its supplement Control and Reporting Point Kecskemét). During their ATC or ADC career this phase is the real on-the-job training at a specific venue. Generally, this period lasts for three to six months depending on the profile of aviation at the specific aerodrome and on the personal abilities of the candidates. Passing the on-the-job training lieutenants receive

their licence and after that they are allowed to fulfil the local controller position (the person who controls aircraft on the ground and in the air in the vicinity of the airfield and also controls movement of ground vehicles and auxiliary services like firefighters, ambulance, airfield maintenance, etc.). Broadly, this is how military officer candidates become an air traffic controller which state is just the first entrance into this profession, there are classifying exams during the course of their career, other professional courses, they have the opportunity to become a radar (approach) controller and so on.

After the examination of civil and military basic ATC training and education I continue with the EUROCONTROL Specification for the ATCO Common Core Content Initial Training. This document details the minimum training requirement for the achievement of a Student Air Traffic Controller Licence in accordance with Directive 2006/23/EC of the European Parliament and of the Council of 5 April 2006 on a Community air traffic controller licence, and the minimum training requirement in accordance with EUROCONTROL Safety Regulatory Requirement on ATM Services' Personnel Ed. 2.0. This Specification shall be used by training providers and regulators to ensure that all relevant training objectives have been included in any courses that are intended to be Common Core Content Initial Training compliant. The document also provides the mandatory minimum training requirement to be applied, by all European Civil Aviation Conference (ECAC) Member States[14], during the Initial Training of ATCOs. In addition, for EU Member States, these objectives are referenced in Directive 2006/23/EC of the European Parliament and of the Council of 5 April 2006 on a Community air traffic controller licence, as the minimum training standard to be included in Initial Training of ATCOs.

The syllabi which are incorporated into the document cover training objectives for ATCOs from entry into training, to the issue of a Student Air Traffic Control Licence. This phase of training has become known as Initial Training and includes both Basic and Rating Trainings.[15] The basic training provides the fundamental knowledge, establishes the essential skills and prepares the students to continue the program with the second phase which is the specialisation (rating). The specialisation training in turn is a specialised air traffic control training of which aim is to provide the proper knowledge and skills in an ATS environment in accordance with the requirements of the different specialisations.

In the following figure (Figure 3.) the place of fundamental trainings for ATC licence in the framework of the whole education system of air traffic controllers can be seen.

[14] Albania, Armenia, Austria, Azerbaijan, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, *Hungary*, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia, Turkey, Ukraine and United Kingdom. (Source: European Civil Aviation Conference home page/About ECAC/Member states. https://www.ecac-ceac.org/member-states; downloaded on: 08.06.2018.)

[15] EUROCONTROL-SPEC-113 EUROCONTROL Specification for the ATCO Common Core Content Initial Training. Ed. 1.0. Brussels, 2008. p.1.,6-7.

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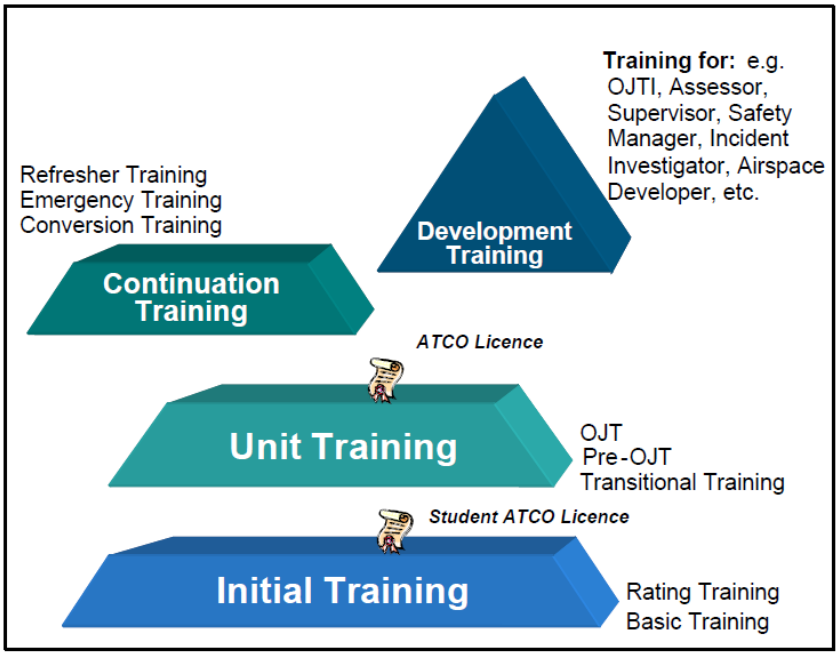

Figure 3.: Progression of ATCO Training, Source: EUROCONTROL-SPEC-113 EUROCONTROL Specification for the ATCO Common Core Content Initial Training. Ed. 1.0. Brussels, 2008. p.10.

Initial Training

Training including theory, part-task practice and simulation. The object of initial training is to prepare an ab initio for training at an Air Traffic Control (ATC) unit. It includes two phases (basic and rating training) leading to a student licence. Rating training might also be provided as training for conversion to another rating.

Basic Training

Training designed to impart fundamental knowledge and skills to enable an ab initio to progress to specialised ATC training.

Rating Training

Specialised ATC training to provide knowledge and skills related to a job category and appropriate to the discipline to be pursued in the ATS environment.

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Unit Training

Training comprising transitional training, pre-OJT and OJT, leading a learner to obtaining an air traffic controller licence, with appropriate rating and with appropriate rating endorsements and unit endorsements.

Transitional Training

Phase following initial training during which site-specific theoretical knowledge and understanding will be transferred to the student air traffic controller and/or trainee air traffic controller using a variety of methods and during which skills will be developed through the use of site-specific simulations.

Pre-On-the-Job Training (Pre-OJT)

Phase of locally based training during which extensive use of simulation using site-specific facilities will enhance the development of previously acquired routines and abilities to an exceptionally high level of achievement.

On-the-Job Training (OJT)

The integration in practice of previously acquired job-related routines and skills under the supervision of a qualified On-the-Job Training Instructor (OJTI) in a live traffic situation.
Continuation Training
Training given to licensed or certificated personnel designed to augment existing knowledge and skills. It includes refresher, emergency and conversion training.

Refresher Training

Refresher training is designed to review, reinforce or upgrade existing knowledge and skills (including team skills).

Emergency Training

Training designed to impart knowledge, skills and behaviour in case of an emergency, unusual or degraded situation. Emergency training that is part of initial training shall be generic, covering the situations common for all disciplines and some specific for the appropriate rating. More details about these situations are given in the respective syllabi. More comprehensive emergency training that may include security measures shall be given to all controllers on a regular basis with the site specific content.

Emergency situation

A serious, unexpected and often dangerous situation requiring immediate actions.

Unusual situation

A set of circumstances which are neither habitually nor commonly experienced for which an ATCO has not developed an automatic know-how. The essential difference with an emergency situation is that the element of danger or serious risk is not necessarily present in an unusual situation.

Degraded situation

A situation that is the result of a technical system failure or malfunction or a set of circumstances arising from human error or violation of rules affecting the quality of the service provided.

Conversion Training

Training designed to provide knowledge and skills appropriate to a change in either job category (rating discipline, rating endorsement or unit endorsement), procedures or system (system upgrade or change).

Development Training

Training designed to provide additional knowledge and skills demanded by a change in job profile, e.g. new licence endorsement (OJTI) or any other career development like assessor, supervisor, safety manager, incident investigator, airspace developer, training manager, traffic flow manager, etc.[16]

The efficient education and training requires various and up-to-date education methods, of which the most frequently applied might be the following:[17]

- lecture;
- exposition;
- narration;
- student presentations;
- discussion;
- debate;
- demonstration;
- project method;
- cooperative education method;
- simulation, roleplay and acting;
- educational excursion;

[16] EUROCONTROL-SPEC-113 EUROCONTROL Specification for the ATCO Common Core Content Initial Training. Ed. 1.0. Brussels, 2008. p.9-11.
[17] Falusi Iván (edited): Didaktika - Elméleti alapok a tanítás tanulásához. Nemzeti Tankönyvkiadó Zrt. Budapest, 2003. p.216-243.

– home work.

After learning the basic rules and procedures students have to improve and practice how to react different anomalous and contingency situations. These are the atypical situations which should be practiced how to react and to be solved during on-the-job training:

– radio connection malfunction;
– transponder failure;
– aircraft technical problem;
– fire and smoke on-board of an aircraft;
– low fuel situation;
– deviation from controller clearance or instruction;
– illegal use of an airspace;
– aborted take-off or approach;
– navigation issues;
– situation of endangering or disturbance of air traffic;
– emergency locator transmitter (ELT) signal;
– aircraft going off from runway;
– disappearance of an aircraft;
– crash down of an aircraft;
– collision of aircraft;
– terrorist attack on-board of an aircraft;
– RENEGADE aircraft;
– contingency procedures.

In order to demonstrate the similarity between military and civil ATCO basic trainings I present the syllabus of basic training according to the Eurocontrol Specification (Table 2.).

Introduction to the Course	Aviation Law	Air Traffic Management	Meteorology	Navigation	Aircraft	Human Factors	Equipment and Systems	Professional Environment
Course management	Introduction	Air traffic management	Introduction	Introduction	Introduction	Introduction to human factors	General	Familiarisation
Introduction to the atc training course	International organisations	Radiotelephony	Atmosphere	The earth	Principles of flight	Human performance	Radio	Airspace users
Introduction to the atco's future	National organisations	Atc clearances and atc instructions	Atmospheric circulation	Maps and aeronautical charts	Aircraft engines	Human error	Other systems and communications	Customer relations

Introduction to the Course	Aviation Law	Air Traffic Management	Meteorology	Navigation	Aircraft	Human Factors	Equipment and Systems	Professional Environment
Conditions of service	Rules and regulations	Coordination	Meteorological phenomena	Navigational basics	Aircraft systems and instruments	Communication	Radar	Environmental protection
Security		Altimetry and level allocation	Meteorological information for aviation	Instrumental navigation	Aircraft categories	The work environment	Automatic dependent surveillance	
		Separations		Area navigation	Factors affecting aircraft performance		Future equipment	
		Airborne collision avoidance systems and ground-based safety nets			Aircraft data		Automation in ats	
		Data display					Working positions	

Table 2.: Syllabus of Basic Training of Eurocontrol, Source: EUROCONTROL-SPEC-113 EUROCONTROL Specification for the ATCO Common Core Content Initial Training. Ed. 1.0. Brussels, 2008. Annex 1. p.7-39.

Reading the lines above and studying the figures and tables, lots of similarities can be recognised between “commercial” and national air traffic control training programs. The framework is the same: basic training, specialisation and on-the-job training until students receive their first ATC licence for a specific aerodrome. Even program elements show a lots of similarities and overlap between each other, however in the syllabus of Eurocontrol several training of modern ATM assets also can be found.

2.2. ATC TRAINING AFTER THE PROLIFERATION OF RTWR TECHNOLOGY

The real aim of the second chapter is to explain the possible influence of remote tower control technology on ATC training programs and methods. To this end I felt essential to

study the basic ATC training programs from different sources. Now, in this second subchapter I will explain the possible effects of rTWR technology on training and education methods of air traffic controllers from different angles.

In advance, it can be said rTWR technology will not pose a radical impact on ATC training, at least it is not a “game-changer” which fact is not disadvantageous at all. As I formerly mentioned I consulted experts at World ATM Congress 2018, and I have also visited the headquarters of Hungarocontrol in Budapest and have met experts and visited the rTWR room as well. Summarizing their opinions and my knowledge, rTWR technology will have effect on ATC training but not in a significant way. It is not necessary to rethink the syllabuses from the bases, but supplementary elements shall be added to them and not just at the time when the technology will be widespread, but training organisations ought to be prepared well in advance.

In our present days, programs of courses which prepare for working in a rTWR environment are rare. Hungarocontrol has already have an interim course for rTWR working positions, but is not available even for research due to secrecy reasons. Because of this fact, I can only report that the experts of Hungarocontrol have told me during the interview.

It has been said ATCOs do not learn any new aviation rules or procedures during the course and they face with the identical ATM systems and equipment that they apply in the ordinary control tower. The emphasis is rather on getting used to the formation of the working positions, the new environment, being closed, losing the opportunity to look out of the window, the camera handling, where to look on the video wall, maintaining the cooperation and on the whole: building the confidence towards the rTWR system. According to the associates of Hungarocontrol great tone has been put on the psychological side. Every participant had the opportunity to express her/his opinions on the new technology, the environment and how she/he feels about the situation in general. Every idea and comment was seriously considered and even built in (if it was feasible and advantageous) in order to ATCOs feel the system even more personalised and “own”.

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Figure 4.: Remote tower room of Hungarocontrol Pte.Ltd. in use, Source: Origo: Új, high-tech terem váltja ki a ferihegyi repülőtér tornyát. 11.17.2017. http://www.origo.hu/auto/20171117-tavvezeresu-torony-lesz-ferihegy-uj-agya.html (07.05.2018.)

So these were the experiences regarding retraining for rTWR system so far. In turn, the duty of researcher is to think further and rise questions which shall be answered or at least think about the issue. In the next few paragraphs I will do this.

One of the major issues is the system degradation, especially the malfunction or failure of visualization which is the greatest difference between rTWR solution and the genuine control tower. Students have to be prepared how to react in case of loss of camera picture in part or entirely of the aerodrome. Proper procedures have to be taught and practiced continuously even after receiving ATC licence.

Also the category of system degradation is the case if one or more system elements other than visualization get out of order. It can be the visualization aid like label of aircraft which contains the call sign, SQUAWK and other information of the certain aircraft which information have to be connected to the proper flight. Another visualization failure can be the loss of contour of runways or taxiways or especially the loss of marking an inoperative part of the aerodrome.

In case of the breakdown of the entire rTWR working station or room contingency procedures also shall be trained and practiced, how a back-up working position or control

room be occupied and how the issues can be bridged without the disturbance of air traffic and along with continuous and safety air traffic control.

The training of supervisors might also be effected because she/he is the person who manages the workflow among working positions and in case of system degradations like above she/he have to orchestrate the transition and the contingency situation. On-the-job training instructor training shall be adopted too because these associates have to be the experts of camera handling, system application, video wall awareness and of course contingency situations as well, etc.

As it can be seen, rTWR technology have already risen a lot of questions, and there will be more during the spreading of the solution. As I have phrased earlier, the fact that the rTWR technology does not mean a radical impact on ATC training is not disadvantageous I reckon now reasonable. Associates at training centres, universities and academies will even face great work during the integration of rTWR solution into the education and training programs.

SUMMARY OF THE PAPER

In the last part of the research period on the one hand I examined how a remote tower centre might be composed of and on the other hand I studied that how the remote tower technology can affect the training methods of air traffic control.

In the first main chapter of the present paper I described which elements may build up a remote tower centre which can be the following: the air traffic control element with the controller working positions; the air traffic supporting element with the aeronautical information service, ATS reporting office and aeronautical meteorological service; and RTC auxiliary element with a civil engineer team, IT cell, security and facility management.

The second main chapter examines the ATC training of our days in order to provide a global understanding on how ATC trainings are being built up and being able to see the similarities and universality of them. After that I shared my experiences, impressions and ideas on how the proliferation of rTWR technology might affect the training and education of air traffic control which effect is not radical, but associates at training centres, universities and academies will even face great work during the integration of rTWR solution into the education and training programs.

SUMMARY OF THE SCHOLARSHIP

Ideological content of r-TWR technology is the following: each air traffic or aerodrome service which is not required to get in direct physical contact with the traffic of the airport, and in case of which the access to necessary information is achievable, should be exported to a remote and centralised station.

This solution is resembling the phenomenon known as outsourcing in the business, but here it is not needed to contract a provider, because the organization being in charge may

carry out such innovation/reorganization considering rationalization. But we may rely on more specific examples:

- application of the technology is reasonable inside state borders if several remote control towers of military or regional airports are replaceable by a control centre;
- in case of a busy international airport such a decision may be reasonable, if the added value of the technology significantly improves the safety and efficiency of air traffic, and improves security of system operation, etc. (in case of Liszt Ferenc International Airport Budapest and Hungarocontrol Pte.Ltd. implementation of the technology possesses demonstrational characteristic as well as Hungarocontrol should prove achievability as a pathfinder of the technology);
- from the operational point of view, the control unit can carry out its tasks from a blockhouse, or in certain cases there is no need to be present at the operational area at all.

Defining the „transferable" services has a great importance from operational angle, because by providing remote services individual safety could be improved a lot regarding armed forces.

In the second term of the research I have shortly outlined the history of remote tower control technology. I demonstrated in detail the architecture of remote tower control systems, the characteristics of certain elements, and I used several pictures as visual aids. I also introduced the conclusions of Hungarocontrol Hungarian Air Navigation Service Provider, concerning rTWR, which allowed to review the main advantageous attributes and added values. Finally, with the help of SWOT analysis, I summarized the strengths, weaknesses, opportunities and threats of the technology in a chart, and I explained all the aspects, confirming the written concepts with examples and with my own experiences.

The basic conclusion of the remote tower demonstration exercises is that the current level of technology is generally capable of providing the background for safe ATS service provision. However, to secure the continuous and safe operation from a remote tower facility, the visualization needs to be carefully fine tuned to the local environment and the well-defined concept of operations.

As the medium size airport environment is considerably different from the small airports where the benefits of the remote tower solution were first validated, the implementation has its special challenges. It should also be kept in consideration that the implementation at medium size airports has other motivations than that of small airports which shifts the emphasis from pure cost-efficiency motives to capacity considerations. Naturally as the size and complexity of the airport environment grows, the implemented solution needs more customization to local characteristics. The implementation is highly dependent of local procedures and safety barriers and the deployed visualization should not be expected to make up for the weaknesses of those. The adaptation process is the key to the acceptance and success of the remote tower solution at this scale.

In the last part of the research period on the one hand I examined how a remote tower centre might be composed of and on the other hand I studied that how the remote tower technology can affect the training methods of air traffic control.

In the first main chapter of the present paper I described which elements may build up a remote tower centre which can be the following: the air traffic control element with the controller working positions; the air traffic supporting element with the aeronautical information service, ATS reporting office and aeronautical meteorological service; and RTC auxiliary element with a civil engineer team, IT cell, security and facility management.

The second main chapter examines the ATC training of our days in order to provide a global understanding on how ATC trainings are being built up and being able to see the similarities and universality of them. After that I shared my experiences, impressions and ideas on how the proliferation of rTWR technology might affect the training and education of air traffic control which effect is not radical, but associates at training centres, universities and academies will even face great work during the integration of rTWR solution into the education and training programs.

Finally, it can be said the remote tower control technology holds a wide scale of beneficial attributes and added values. It may enhance ATCO performance if the system and working position are well adjusted, have a logic and efficient layout, reliable and quality made. Nowadays confidence and acceptance towards rTWR technology are still growing, but the desired level is still far to reach. rTWR solution is reasonable due to two major causes: performance enhancement and cost efficiency.

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