Air Traffic Control

Johnpaul Thankachan

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1 Introduction

Air traffic controllers (ATCs) are people responsible for the coordination of traffic in their assigned airspace. Typically stationed in air traffic control centers or control towers, they monitor the position, speed, and altitude of aircraft and communicate with the pilots via radio. In addition, controllers ensure safe distances between the different aircraft.[2]

The profession is considered to be highly demanding and stressful due to the need for continuous decision-making and adherence to strict safety regulations. Factors such as equipment reliability, traffic volume, weather conditions, the potential consequences of making a mistake, and airspace restrictions can further influence workload and stress levels.[3] Despite these challenges, the role offers competitive salaries and strong job security, which are often cited as key benefits.[2]

2 Origins

Air traffic controlling dates to the early 1920s in the United Kingdom (UK).[4][5] The first control tower was established in 1920 at Croydon Airport, but it wasn't until the 1922 Picardie mid-air collision that air traffic control gained wider attention. Jimmy Jeffs was issued the first Air Traffic Control License. Before 1922 air traffic controllers only provided information to the pilots on the ground.[6] In the United States (US), Archie League is regarded as the first air traffic controller and was hired by the city of St. Louis in 1929 to prevent collisions. The first ATCs used basic visual communication methods such as flags to communicate with pilots.[7][8]

In the USSR, the first air traffic control service was organized in 1929 on the Moscow - Irkutsk air route; in 1930, control areas were defined along all existing air routes[9].

3 Introduction of radar and radio communication

In 1930 Cleveland Airport opened the first tower using two-way radio communication and in 1946 Indianapolis International Airport (then Weir-Cook airport) became the first civilian airport to have radar installed.[7] This allowed controllers to monitor aircraft positions in real-time, even in poor visibility conditions. Together with radio communication with the pilots, this laid the foundation for Ground Control Approaches and later Instrument landing system (ILS).[10] These innovations fundamentally changed the profession of air traffic controllers from guidance and ground controlling to actively guiding planes that are already in the air and making sure they land safely.[10]

4 Developments until today

Since the introduction of radar in the 1950s, the field of air traffic control is still undergoing major innovations; Automatic Dependent Surveillance–Broadcast (ADS-B) technology is being expanded world wide providing even more accurate position information to the controller providing them with more advanced assistance systems.[11]

5 Future prospects

With new technologies such as artificial intelligence emerging, efforts to automate certain tasks of ATCs began.[11]

The focus of the industry is on the development of assisting and predicting artificial intelligence tools as well as the automation of repetitive tasks rather than attempts to replace the controllers.[12][13][14] There is a consensus among developers and airport operators that, in the foreseeable future, air traffic controllers will tend to be more of a system manager overseeing decisions made by automated systems and intervening to resolve unexpected situations, which is currently one of the most difficult tasks for artificial intelligence, making full replacement unlikely.[15][12][16][17] One challenge with partially automated workflows is the potential for skill and knowledge disintegration due to reduced daily practice. One possible solution is the use of computer-based training or simulation technologies to maintain continuous learning and proficiency.[18]

Another approach to modernization is the construction of fully digital remote and virtual towers that can be accessed from anywhere in the world allowing for controllers to work remotely. Developments are already advanced, with the first remote-controlled tower having opened in Sweden in 2015.[19][20]

Another concern is the acceptance or willingness by the controllers to use such technology. In a study with 500 air traffic controllers Bekier et al. found that as soon as the focus of decision-making shifts away from the air traffic controller, support for the technology dramatically decreases.[21]

Roles