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# Air traffic Control (A/S) Department Emergency control remote tower system..... (RTS)

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***Abstract***
*Remote Tower Service (RTS) is a system that allows the provision of airport Air Traffic Control (ATC) or Flight Information Service (FIS) from a location other than the airport, while maintaining a level of operational safety equivalent to that achieved by using a staffed tower at the airport to supervise both air and ground movements.*
*Remote Towers, the latest technology introduced in air traffic control, is transforming the way airports operate worldwide. This unique technology is not only enhancing the safety and security system of airports, but it delivers flexibility and efficiency in providing unmatched air traffic control solutions. The Remote Tower technology replaces traditional control towers with digitally equipped control facilities.*
*Advantages*
*One of the biggest advantages of remote towers is the flexibility it offers to airports and air traffic controllers. It allows customization of towers to meet different expectations and requirements. For instance, a new airport, looking to construct a cutting-edge control facility, can benefit with the installation of digital towers. On the other hand, an existing airport looking to upgrade its tower to handle additional traffic, or to replace an aging tower can save on maintenance costs and can free up valuable space.*
*In addition, the security aspect of airports is greatly benefited with the Remote Tower technology. By installing a Remote Tower system, the airport can move an existing tower or create a contingency facility, ensuring full capacity of airport operations even if the main tower is out of action. This feature is especially useful during emergency situations, as it keeps the airport up and running with minimal downtime.*
*Types*
*The different Remote Tower models are designed to accommodate any airport size, level of complexity, or distinctive needs. These models are equipped with high-tech features to provide enhanced situational awareness ensuring safe, flexible, and efficient air traffic control, making air travel safer.*

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## I. Introduction:

Study topic : emergency control tower system & Libyan air space

1.1: emergency control tower system

Compared to the earlier cost-benefit studies, the air traffic controller (or AFIS officer) no longer needs to be inside the airport control tower. Instead, they work from remote control center and provide air traffic services. The information they use comes from airport cameras and sensors, rather than looking directly out of the tower windows, and these inputs are displayed as reconstructed images.

The ATO also provides air navigation services to private-sector customers, commercial aviation, and the military.

Its operational scope covers 1.76 million km (679.540) square miles of airspace over Libyan territory, as well as parts of the Mediterranean Sea.

Efficient use of human factor (air traffic controllers and aerodrome flight information service staff), particularly by serving multiple airports with medium-to-low traffic levels from a central location.

* ICAO Annex 11
* ICAO Annex 10
* Doc 4444
* EUROCONTROL Remote Tower
NFPA 72
National Fire Alarm and Emergency Communication Code

**1.2Objective**

- Lower infrastructure costs: No need to build or maintain control towers at local airports, reducing construction and operating expenses.
- Better use of human factors: Controllers and staff can serve multiple airports with medium-to-low traffic from a central location.
- Centralized technical systems: Data networks allow consolidation of system, cutting local maintenance costs and sharing expenses, saving up to ($1.3 million) per year for smaller airports.
- Flexible and efficient service: Remote control allows handling flights outside normal hours, unscheduled flights (Like ambulance or rescue helicopter) and night operations at small airports that are usually closed.

1.3:Methodology ::
Collecting documents from: approved aviation information
Sources and analyzing data using qualitative analysis

* According to ICAO (Annex 11), emergency communication systems are essential for airport safety.
* Remote tower systems reduce operating costs (EUROCONTROL, 2020).

## II. Significance of the Study

Aerodrome Air Traffic Service (ATS) from a remote position is facilitated by the streaming in real time of the view from an assembly of fixed and moveable high definition digital video cameras situated at the remotely controlled aerodrome. This encrypted signal is used to replicate a view of the aerodrome and its vicinity onto a 360° LCD screen which is equivalent to reality but arguably better than the sector-limited view which would exist from a Visual Control Room on the aerodrome. Fixed cameras provide the main display and any necessary supplementary ones such as ramp close-ups and there are also one or more moveable cameras which can be directed as required from the RTS position replicating the way binoculars might be used in a conventional Tower. This visual situational awareness for the controller or flight information service operator is supplemented by a range of environmental sensors and microphones capturing sound and meteorological or other operational data. The system also easily facilitates a switch in ATS between ATC and FIS if required.

Whilst the initial focus has been on day VMC operations, night and low-visibility operations can also be supported with the installation of additional sensing equipment and use of infrared or night-vision lenses and three dimensionally-augmented reality overlays. If the circumstances justify it, an A-SMGCS can be installed to complement the RTS visual display available at the RTS location.

Figure:1.1 Remote tower center

Figure: 1.2Remote tower center

## III. Problem Statement

Many regional airports face high costs tor building maintaining conventional control towers, in addition to inefficient use if human factors This affects the safety and efficiency of air traffic, especially at airports with low traffic, and calls for studying alternative solutions such as remote tower operations .

Air Traffic Control Errors and the Impact of Weather:

- Air traffic control errors occur when the separation between aircraft drops below the minimum required, especially during periods of high traffic activity, when controllers may overlook certain conditions or traffic.
- According to the Civil Air Navigation Services Organization (CANSO), over ( 70%) of global air traffic delays are due to adverse weather conditions.
- Weather disruptions cause widespread delays, flight rerouting, and cancellations across continents.
- In 2024, Europe experienced a(40%) increase in weather-related delays compared to 2023

- With worsening weather, CANSO has urged real-time collaboration among all stakeholders to mitigate the impact of weather on flight operations.

Weather Impact & ATC Errors

70% of delays due to weather.

- Europe saw 40% increase in 2024.
- ATC errors rise after heavy traffic periods. •

## IV. Human Factors

- Human performance is critical for safe communication
- Most system failures result from fatigue or loss of alertness.

1.7.1Preparation

The first phase where human factors or experimental psychology comes into play is the definition of simulation hypotheses. Due to its characteristics (i.e. relatively controlled and repeatable) RTS is designed to compare various alternatives of the new concept and/or based on the counterfactual theory of causation, compare the impact of new and current system on operators with each other It is of great importance to agree on hypotheses that are testable with metrics and provide meaning for the management.

By defining the hypotheses the human factors experts and the customer have to have a preliminary plan on the number of variables and scenarios that will be tested. Variables may be Human factors such as fatigue, workload, communication clarity, and situational awareness are critical during emergency operations (ICAO Doc 9683).

## V. Results and Discussion

5.1: Presentation of Results:

- The study results will be presented clearly using tables, charts, and descriptive summaries. Key findings on the benefits, challenges, and effectiveness of fic control systems will be highlighted to provide a clear understanding of the outcomes.

5.2: Discussion of Findings:

- The findings indicate that remote air traffic control systems significantly utilization, and enhance safety improve cost efficiency, optimize Human factor utilization, and enhance safety in medium- and low-traffic airports.
- These results are consistent with previous studies on remote tower operations, highlighting the advantages over conventional control towers. Challenges such as technical limitations and staff adaptation are also noted, providing insights for further improvements and practical implementation strategies.

5.3Scope and Limitations

The scope of this study focuses on evaluating the efficiency, safety, and operational benefits of remote air traffic control systems in medium- and low-traffic airports.
The research examines technological performance
Human factor , faster, and the effectiveness of centralized control operations
However, the study is limited by factors such as restricted access to real operational data, reliance on secondary sources, and variability in remote tower technologies between countries. Additionally, time constraints and the absence of field observations may limit the depth of analysis

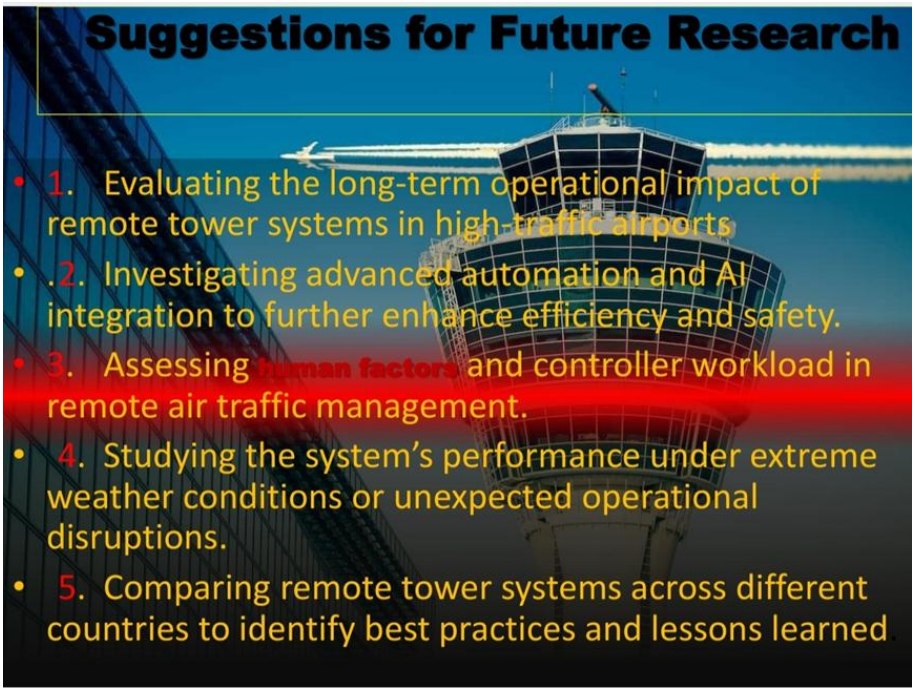
## VI. Conclusion

- This study highlights the growing importance of remote air traffic control systems as a cost-effective and efficient alternative to traditional airport towers.
- The findings show that remote tower operations can significantly reduce infrastructure and staffing costs while Improving the flexibility and availability of air traffic services,
- Despite some limitations related to technology reliability and weather conditions, the evidence suggests that remote ATC solutions can enhance safety, support low-traffic airports, and optimize resource allocation.
- Overall, the study demonstrates that remote tower system represent a viable and modern approach to improving air traffic management.

## VII. Recommendations

1. Expand the implementation of remote tower systems in low-and medium-traffic airports to reduce operational costs and improve service availability.
2. Invest in advanced sensors and high-reliability communication networks to ensure continuous and accurate data transmission.
3. Provide specialized training programs for air traffic controllers to enhance their ability to manage remote tower operations effectively.
4. Strengthen collaboration between aviation authorities and technology providers to improve system performance and address technical limitations.
5. Conduct further research on system reliability during severe weather
conditions and high-traffic scenarios.

## VIII. Suggestions for Future Research

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