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Automatic terminal information service: Key element for increasing safety and efficiency

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Abstract. Determining sector capacity is a fundamental pillar for ensuring safe and effective air traffic management. Sector capacity is usually expressed through the number of aircraft that are allowed to enter a given sector in one hour. Controlling the flow of aircraft and regulating their number in the space ensures that the air traffic controller is able to maintain safe distance between the aircraft and does not exceed the maximum level of permissible workload. Each air navigation services provider is thus looking for ways to increase sector capacity. One of the innovative approaches to optimizing sector capacity is the use of the Automatic Terminal Information Service (ATIS). When comparing the controller availability factor and terminal area capacity with and without ATIS, it was found that the controller availability factor increased by 2.5% after the introduction of ATIS, and the sector capacity increased by 36.2%. This evidence confirms that implementing ATIS has a positive effect on the overall capacity of the Terminal maneuvering area, with a probability greater than 95% that these changes did not arise due to random variation. Such an integrative approach is proving to be a promising path to more efficient and safer air traffic. The reduction in transmission duration means air traffic controllers spend less time communicating ATIS information, allowing more time for traffic control and separation planning. This increased efficiency translates to a higher sector capacity, enabling controllers to manage more aircraft simultaneously.

Keywords: air traffic; Automatic Terminal Information Service; safety; sector capacity; workload

1. Introduction

Air Traffic Management (ATM) primarily prioritizes safety, ensuring that aircraft are guided safely and efficiently both on the ground and in the air (Rydin 2013, Tomaszewska 2023). Components such as Airspace Management (ASM), Air Traffic Flow and Capacity Management (ATFCM), and Air Traffic Control Service (ATCS) play crucial roles in achieving this goal. In recent years, there has been a growing emphasis on managing air traffic in the most fuel-efficient and optimized manner possible (Rydin 2013). Air Traffic Control Service plays a vital role in maintaining orderly air traffic, providing essential information for safe flight operations, and effectively managing emergencies as they arise (Di Mascio 2023).

Air traffic controllers are thus under intense pressure, and it is an effort to regulate the complexity, number of aircraft and generally their workload, so that safety and efficiency are

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always ensured to the highest possible extent (Yazgan *et al.* 2021). The complexity of air traffic can be defined as "*the level of either perceived or actual spatial and time-related interactions between aircraft operating in a given airspace during a given period*" (Pejovic *et al.* 2020). The complexity of air traffic within a particular airspace can be significantly elevated due to the intensity of traffic and its specific patterns of interaction among different traffic flows, as well as among individual aircraft (Pejovic *et al.* 2020).

A particularly high level of complexity is encountered by approach controllers who manage flight traffic in the Terminal Control Area. The Terminal Control Area (TMA) refers to a designated section of airspace where aircraft undergo descent during approach for landing and ascent after takeoff. In this area, aircraft rapidly alter their flight level, direction, and speed within a limited airspace, necessitating continuous monitoring, control, and traffic control to maintain prescribed regulations for aircraft separation (Juricic *et al.* 2011).

Generally speaking, airspace, especially with high-density volumes of aircraft, poses hazards due to the presence of aircraft sharing the same space. Unforeseen events such as weather changes or other unplanned occurrences can lead to deviations from initial flight plans, requiring real-time adjustments to ensure safety while maintaining the necessary system throughput. These adjustments must be made amid uncertainties arising from various circumstances (Radisic *et al.* 2020).

Air traffic controllers thus need to use all means possible to reduce their workload and gain space to solve the situations that arise. The article therefore deals with how important the Automatic Terminal Information Service (ATIS) is for increasing the efficiency and safety in air traffic, as a result of reducing the workload of air traffic controllers. ATIS is the automatic provision of current, routine information to arriving and departing aircraft throughout 24 hours or a specified portion thereof (https://skybrary.aero/articles/automatic-terminal-information-service-atis). The controller does not have to transmit this information individually to all aircraft after the communication has been established.

The objective of the paper is to prove and confirm the positive effect of the use of ATIS on air traffic controllers' workload and sector capacity, thus increasing the safety and efficiency of air traffic.

2. Preliminaries

2.1 Air traffic controller's workload

Air traffic controllers (ATCo's) operate within a complex human-machine environment, facing numerous demands and tasks over time. The workload they experience in response to these demands depends on their capabilities and the actions required to ensure safe and efficient traffic flow. While the workload can be quantified and predicted, it is influenced by a multifaceted interaction of factors, including the airspace conditions, equipment status (including design, reliability, and accuracy), and the controller's individual characteristics (such as age, mood, experience, and decision-making strategies) (Triyanti 2020).

From a human factors point of view, a general definition of workload could be: "*the demand placed on an operator's mental resources used for attention, perception, reasonable decision-making and action*" (Skybrary 2024, Zamarreno *et al.* 2024).

In every ATCo's Operations Manual for a particular sector or aerodrome, all available separations are clearly outlined. These separations are derived from the fundamental regulations specified in the International Civil Aviation Organization's (ICAO) Annexes and Documents. The standard radar separation between aircraft is 5 nautical miles (NM) and/or 1000 feet below Flight Level (FL) 410 (41,000 feet). Within Terminal Maneuvering Areas (TMAs), the typical radar separation is often reduced to 3 nautical miles (NM) (Rydin 2013).

Said separations are one of the most important things that air traffic controllers must observe. With the number of aircraft in the sector, the number of aircraft at one time, between which controllers must maintain a distance, increases. Pejovic *et al.* (2020) observed a robust correlation (R^2=0.9807) between the daily flight count and complexity. Furthermore, notable correlations were identified between safety indicators (with a slightly stronger correlation observed with the number of Potential Loss of Separation incidents) and the overall volume of flights. Similarly, significant correlations were noted between safety indicators and complexity of traffic. These findings suggest that as air traffic increases, complexity of traffic tends to rise, primarily driven by factors such as the frequency of Potential Loss of Separation incidents and conflict risk. Essentially, this implies that the workload of ATCo's is likely to escalate with heightened air traffic, contributing to increased ATCo's workload (Pejovic *et al.* 2020).

2.2 Sector capacity optimal utilization

Aerodromes serve as critical chokepoints within the air traffic control (ATC) system (Wided and Fatima 2022, SESAR 2013). If every aircraft attempted to land at a busy runway according to its preferred schedule, the resulting congestion would pose significant safety risks. Given that a runway can mostly accommodate only one aircraft movement at a time, it is imperative to organize the traffic flow into the aerodrome effectively. This organization is achieved through the application of separation rules. To ensure orderly sequencing of aircraft, sequencing techniques must be implemented further from the aerodrome, alleviating the workload on the Terminal Maneuvering Area (TMA). Just as multiple aircraft cannot simultaneously land on the same runway, the TMA also has limitations on the amount of traffic it can manage called capacity, akin to any sector within the ATC system (Rydin 2013).

Optimal utilization of airspace and airport capacity necessitates a comprehensive systems approach during the planning phase, considering all pertinent elements of the air traffic system. Bottlenecks within the system impede the flow of traffic, and any constraint within the system contributes to capacity limitations. Planning system improvements should not isolate the airport system from the air navigation system (Cary 2024).

Methods to enhance terminal capacity include (Cary 2024):

- assessing flight routes by segment,
- implementing appropriate separation standards for different aircraft types,
- enhancing surveillance capability to support efficient routing,
- exploring opportunities to streamline routes through RNAV (Area Navigation) and RNP SAAAR (Required Navigation Performance Special Aircraft and Aircrew Authorization Required) procedures,
- evaluating the need for additional infrastructure.

The article examines the advantages of one of the approaches for increasing the capacity of the TMA, namely additional infrastructure. Specifically, it deals with the Automatic Terminal Information Service (ATIS) and its effect on increasing the capacity of the sector.

3. Objectives and hypotheses

If the local air traffic control service does not have ATIS, pilots only receive the information necessary for flight operations after establishing contact with air traffic control. The objective of the paper is to prove and confirm the positive effect of the use of ATIS on the safety and efficiency of air traffic.

The following hypotheses were established:

- The introduction of ATIS at the airport reduces the workload of air traffic controllers, thereby increasing the controller availability factor (φ).
- The introduction of ATIS at the airport reduces the mean duration of each message ($\bar{\tau}$) and number of communications for each aircraft in the sector (η).
- The introduction of ATIS at the airport increases the capacity (N) of the sector.

4. Data set and methods

To test the formulated hypotheses, a series of measurements was conducted during regular airport operations. The duration of communication between air traffic controllers and pilots was monitored continuously over a period of 350 days. Anonymity of the airport was ensured as a prerequisite for obtaining permission to conduct the research.

For the case study, an undisclosed airport providing radar services to both IFR (Instrument Flight Rules) and VFR (Visual Flight Rules) traffic was chosen. Over 90% of traffic during the measurement test fell into the medium category (designation of an aircraft type with a maximum approved take-off weight of less than 136,000 kg but greater than 7,000 kg). The airport is equipped with a single runway (RWY) and has recorded an average annual traffic volume of 11,796 aircraft movements since 2016. The air traffic controllers employed at the airport have held their licenses for an average duration of five years.

The study involved 20 air traffic controllers stationed at the airport, who worked in shifts managing traffic within the Terminal Controlled Area (TMA). The volume of traffic during shifts was affected by several factors such as weather, time of year, day of the week, etc. During the data collection process, the values specified in Eqs. (1), (2), and (3) were measured using the voice communication system's built-in clock function utilized by the air traffic controllers. Depending on the volume of air traffic, each shift was staffed by two to five air traffic controllers.

All shifts were conducted without the Automatic Terminal Information Service (ATIS) present, requiring air traffic controllers to relay information which is normally included in ATIS.

Eqs. (2) and (4) are based on the study by Jaurena – Guide for the Application of a Common Methodology to estimate Airport and ATS Sector Capacity for the SAM Region (Jaurena 2009). For the case study, the calculation of the controller availability factor φ_i for the i-th aircraft was defined as follows

$$\varphi_i = \frac{t_i - T_i}{t_i}, \quad i = 1,2, \dots, n, \tag{1}$$

where t_i is the flight time of the i-th aircraft in the sector, and T_i is the total time of transmissions between the controller and all the pilots in the sector of responsibility during the time t_i. The time T_i for the i-th aircraft can thus be influenced by another aircraft in the area of responsibility that has already established contact with the controller. The time T_i is thus the sum of all messages that the controller sent and received for the flight time of the i-th aircraft in the sector (t_i).

The controller availability factor represents the duration during which the controller is not actively engaged in transmitting or receiving communication on the frequency, allowing them to dedicate their full attention to planning aircraft spacing. It is calculated as the proportion of time between individual transmissions relative to the total duration of the flights. This includes the time after the controller receives and verifies pilot readback before initiating the next transmission, regardless of whether it was initiated by the pilot or the controller. Multiplying this result by 100 yields the percentage of time available for planning aircraft separation procedures.

To determine the sector capacity without an installed ATIS, let's denote the total number of messages between the controller and the i-th aircraft by the symbol η_i, and the average length of the messages of the controller to the i-th aircraft by the symbol τ_i. The calculation for determining the sector capacity for the i-th aircraft without ATIS is as follows

$$N_i = \frac{\varphi_i \cdot t_i}{\eta_i \cdot \tau_i} = \frac{t_i - T_i}{\sigma_i}, \tag{2}$$

where

$$\sigma_i = \eta_i \cdot \tau_i, \quad i = 1,2,\ldots,n \tag{3}$$

is the exact time of the controller's communication with the i-th aircraft (the sum of the dispatcher's communication times with the i-th aircraft);

T_i: total time of transmissions between the controller and all the pilots in the sector without ATIS;

t_i: flight time of the i-th aircraft in the sector.

The mean sector capacity ($\bar{N}$), mean controller availability factor ($\bar{\varphi}$). and mean communication time of the controller ($\bar{\sigma}$) without ATIS are defined as follows

$$\bar{N} = \left\lfloor \frac{1}{n}\sum_i N_i \right\rfloor, \quad \bar{\varphi} = \frac{1}{n}\sum_i \varphi_i, \quad \bar{\sigma} = \frac{1}{n}\sum_i \sigma_i \tag{4}$$

The symbol $\lfloor \cdot \rfloor$ means lower integer part of a real number, meaning that the sector capacity value will always be rounded down to the nearest whole number. For instance, if the result is 10.8, the capacity will be established as 10 aircraft. This approach ensures that the capacity remains within the control of the air traffic controller, preventing situations where the capacity exceeds manageable levels.

To determine the sector capacity with ATIS installed at the airport, the number of messages η_i transmitted by the controller to the i-th aircraft is reduced by one. Additionally, when calculating the average duration of each message, the transmission of an ATIS message during a shift is excluded from consideration. Therefore, the adjusted number of messages transmitted by the controller to the i-th aircraft is η_i-1. One transmission is eliminated because the controller does not have to repeat to the pilot the information that is already included in ATIS after the introduction of the service, so he has to make one less transmission. The calculation for determining the sector capacity with ATIS is as follows

$$N_i^A = \frac{\varphi_i^A \cdot t_i}{\eta_i^A \cdot \tau_i^A} = \frac{t_i - T_i^A}{\sigma_i^A}, \tag{5}$$

where $\eta_i^A = \eta_i - 1$ and

Table 1 Sample of measured and calculated values

Measurment	without ATIS						with ATIS				
	t_i	φ_i	η_i	τ_i	σ_i	N_i	φ_i^A	η_i^A	τ_i^A	σ_i^A	N_i^A
1	780	0.78	6	6.00	36	16.90	0.79	5	4.60	23	26.79
2	713	0.86	8	4.75	38	16.14	0.88	7	3.86	27	23.24
3	874	0.79	11	5.73	63	10.96	0.82	10	4.50	45	15.93
4	932	0.79	9	4.44	40	18.41	0.8	8	3.75	30	24.85
5	821	0.79	11	6.00	66	9.83	0.82	10	4.80	48	14.03
6	786	0.8	8	5.63	45	13.97	0.81	7	3.86	27	23.58
7	974	0.77	13	4.38	57	13.16	0.78	12	3.50	42	18.09
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
Mean	716.28	0.82	11.06	4.67	51.17	11.70	0.84	10.06	3.91	39.21	15.94
Median	681	0.81	11	4.56	52.50	14.06	0.82	10	3.82	41.50	19.50

$$\sigma_i^A = \eta_i^A \tau_i^A \;, \quad i = 1,2,\dots,n, \tag{6}$$

is the exact time of communication between the controller and the i-th aircraft with the ATIS system; i.e., reduced by the time of transmission of this information.

T_i^A: total time of transmissions between the controller and all the pilots in the sector with ATIS;

φ_i^A: controller availability factor for the i-th aircraft after the introduction of ATIS;

t_i: flight time of the i-th aircraft in the sector;

τ_i^A: mean duration of each message after the introduction of ATIS.

By analogy with Eq. (3), the mean sector capacity with ATIS is calculated as follows

$$\overline{N}^A = \left\lfloor \frac{1}{n} \sum_i N_i^A \right\rfloor \tag{7}$$

5. Preliminary data analysis

In Table 1, a part of the measured and calculated values is shown for illustration. The full dataset is available from the authors. The values of σ_i and σ_i^A were calculated according to Eqs. (3) and (6); the values of N_i and N_i^A were determined using Eqs. (2) and (5).

Let us recall that according to Eqs. (4) and (7) the mean sector capacity is calculated as $\overline{N} = \lfloor 11.70 \rfloor = 11$ and $\overline{N}^A = \lfloor 15.94 \rfloor = 15$.

The aim of this article is to find out whether the values of the parameters φ_i, σ_i, N_i before the introduction of the ATIS system and the values of the same parameters $\varphi_i^A, \sigma_i^A, N_i^A$ after the introduction of the ATIS system have changed statistically significantly. It is important to note that pre- and post-ATIS data are interdependent. This dependency is due to the fact that some of the communication between the pilot and the tower is the same regardless of whether the ATIS system is in place or not. Subsequently, there is another part of communication that is significantly reduced after the introduction of the ATIS system. For statistical analysis of this data dependence, it is advisable to use one of the so-called paired tests. When performing a test of this type, the

Table 2 Sample of measured and calculated values

Measurment	$\hat{\varphi}_i = \varphi_i - \varphi_i^A$	$\hat{\sigma}_i = \sigma_i - \sigma_i^A$	$\hat{N}_i = N_i - N_i^A$
1	-0,01	13	-9,89
2	-0,02	11	-7,10
3	-0,03	18	-4,97
⋮	⋮	⋮	⋮
mean	-0.02	11.93	-4.24
median	-0.02	12.0	-3.74
variance	0.00006	6.0668	3.9591

Table 3 Differences of measured data with and without the ATIS system

$i = 1,2,\dots,n$	p - value	H_0
$\hat{\varphi}_i$	0	rejected
$\hat{\sigma}_i$	0.02	rejected
$\hat{N}_i$	0.07	not rejected

difference of the measured data when using and not using ATIS in each individual flight is first calculated (see Table 3). The values obtained in this way are then tested with a one-sample test, whether they are statistically "on average" significantly different from zero. Thus, it will be tested whether the differences $\hat{\varphi}_i = \varphi_i - \varphi_i^A$, $\hat{\sigma}_i = \sigma_i - \sigma_i^A$ and $\hat{N}_i = N_i - N_i^A$ are statistically different from zero. The values of $\hat{\varphi}_i, \hat{\sigma}_i$ and $\hat{N}_i$ are shown in Table 2. The last three rows of Table 2 show the averages, medians, and variances of the values of the respective column.

Before we proceed to test whether the values $\hat{\sigma}_i, \hat{\varphi}_i, \hat{N}_i$, listed in the columns of Table 2, are significantly different from zero, we will test the hypothesis for each column of Table 2 using the Kolmogor-Smirnov test at the $\alpha = 0.05$ significance level:

- H_0: the data come from a random sample from a normal distribution, compared to the hypothesis
- H_1: the data do not come from a random sample from a normal distribution.

The test results are shown in Table 3.

We will therefore further assume that the data $\hat{\varphi}_i, \hat{\sigma}_i, i = 1,2,\dots,n$ do not come from a random selection from a normal distribution, while the data $\hat{N}_i, i = 1,2,\dots,n$ do come from a random selection from a normal distribution.

The data from Table 3 lead to the finding that the "typical value" of the data $\hat{\varphi}_i, \hat{\sigma}_i$, $i = 1,2,\dots,n$ is best characterized by the median. Therefore, we denote the theoretical medians of the given sets by the symbols $\mathrm{med}_{\hat{\varphi}}, \mathrm{med}_{\hat{\sigma}}$. Similarly, the "typical value" of the data $\hat{N}_i, i = 1,2,\dots,n$ is best characterized by the mean value. Therefore, we denote by the symbol $\mu_{\hat{N}}$ the theoretical mean value of the set of values $\hat{N}_i, i = 1,2,\dots,n$. The analysis of the theoretical values of $\mathrm{med}_{\hat{\varphi}}, \mathrm{med}_{\hat{\sigma}}$ and $\mu_{\hat{N}}$ using the data presented in Table 3 will be the main subject of research in the following two chapters.

Table 4 Wilcoxon signed-rank test of hypotheses H1 and H2

tested file	p – value	H_0
$\hat{\varphi}_i, i = 1,2,\dots,n$	0	Rejected
$\hat{\sigma}_i, i = 1,2,\dots,n$	0	Rejected

6. Formulation of tested hypotheses and results

Let us not first, that according to Table 1, the following inequalities hold:

- $0.81 < 0.82$, i.e., $\text{median}(\varphi_1,\dots,\varphi_n) < \text{median}(\varphi_1^A,\dots,\varphi_n^A)$, that is the median of the "controller availability factor" increased with the introduction of the ATIS system.
- $52.50 > 41.50$, i.e., $\text{median}(\sigma_1,\dots,\sigma_n) > \text{median}(\sigma_1^A,\dots,\sigma_n^A)$, that is the median "duration of the entire communication with ATIS" decreased with the introduction of the ATIS system.
- $11.70 < 15.94, \text{mean}(N_1,\dots,N_n) < \text{mean}(N_1^A,\dots,N_n^A)$, meaning that the mean value of the "sector capacity" parameter increased with the introduction of the ATIS system.

Using Table 2, we can reformulate the inequalities from the previous list into the following form

$$\begin{gathered}\text{median}(\hat{\varphi}_1,\dots,\hat{\varphi}_n) = -0.02 < 0,\\ \text{median}(\hat{\sigma}_1,\dots,\hat{\sigma}_n) = 12.0 > 0,\\ \text{mean}\big(\hat{N}_1,\dots,\hat{N}_n\big) = -4.24 < 0.\end{gathered} \tag{9}$$

The question now arises whether the inequalities (9) are statistically significant, and the introduction of the ATIS system really led to the changes above. This test will be performed against the alternative possibility that the inequalities (9) arose only due to random deviations and the next testing of the ATIS system could turn out differently.

We will therefore test the following three hypotheses regarding the theoretical characteristics of $\text{med}_{\hat{\varphi}}, \text{med}_{\hat{\sigma}}, \mu_{\hat{N}}$ files listed in Table 2:

H1) $\text{med}_{\hat{\varphi}} < 0$ i.e., the theoretical value of the median "controller availability factor" increased with the introduction of the ATIS system.

H2) $\text{med}_{\hat{\sigma}} > 0$ i.e., the theoretical value of the median "duration of the entire communication" decreased with the introduction of the ATIS system.

H3) $\mu_{\hat{N}} < 0$ i.e., the theoretical mean value of the "sector capacity" parameter increased with the introduction of the ATIS system.

The stated hypotheses are a statistical expression of the hypotheses presented in chapter 2. Now the statistical tests will be used to determine whether these hypotheses are valid or not.

The hypothesis H3 (the data set $\hat{N}_i, i = 1,2,\dots,n$, listed in the last column of Table 2) was tested with a one-sample t −test at the standard level of significance α=0.05:

- H_0: $\mu_{\hat{N}} = 0$ i.e., the mean value is equal to zero, compared to the hypothesis
- H_1: $\mu_{\hat{N}} \neq 0$ i.e., the mean value is non-zero.

The interval estimates of the mean value is $\langle -4.6346; -3.845\rangle$, p=0, H_0 rejected, therefore assume that hypothesis H3 is valid.

Hypotheses H1 and H2 at the significance level $\alpha = 0.05$ was tested by the Wilcoxon signed rank test as the data from the first two columns of Table 2 do not have a normal distribution.

- H_0: $\text{med}_{\hat{\varphi}} = 0$, i.e., the medians of both sets are equal,
- H_0: $\text{med}_{\hat{\sigma}} = 0$, i.e., the medians of both sets are equal.

The resulting values of this test are shown in Table 4 and we do not reject the hypotheses H1) and H2), thus with a probability greater than 95% the changes in controller availability factor and mean duration of each transmission did not arise due to random deviations.

7. Discussion

The result of the introduction of ATIS is that the mean duration of each transmission ($\bar{\tau}_i^A$) after the introduction of the system was reduced by 16.27%. The controller availability factor ($\bar{\varphi}^A$) after the introduction of ATIS was increased by 2.5%. The sector capacity with ATIS ($\bar{N}^A$) was increased by 36.2%, if we consider the values $\bar{N}$ =11.7 and $\bar{N}^A$=15.94. If we calculate the increase with rounded values, i.e., the real expression of the capacity, the resulting increase is 36.36%.

Hypotheses H1 to H3 were accepted with the understanding that the results are statistically significant and that with a probability greater than 95% they did not arise due to random deviation. It can therefore be said with certainty that the use of ATIS positively affects the controller availability factor, i.e., that this factor is increased due to its influence. At the same time, the mean duration of each message ($\bar{\tau}_i^A$) is reduced by the fact that the air traffic controller does not have to transmit the information contained in ATIS. The air traffic controller thus spends less time talking on the frequency and has more time for separation planning and overall traffic control. From a human factor point of view and general definition of workload by Skybrary (2024), Zamarreno *et al.* (2024), the introduction of ATIS reduces the mental resources used for attention, perception, reasonable decision-making, and action. Because of that, the sector capacity was also increased by more than a third. The air traffic controller is thus able to handle a larger number of aircraft in the same unit of time. The introduction of the ATIS system has a significantly positive impact on air traffic efficiency and provides solution to improve safety and reduce congestion (Behl and Charulatha 2024).

Ensuring a high level of safety remains a fundamental requirement in civil aviation. Continuous efforts must be directed toward minimizing the occurrence of accidents and incidents, thereby maintaining operational reliability and passenger comfort (Mikula *et al.* 2021, Korecki *et al.* 2021). As air traffic volumes steadily increase, air traffic controllers are subjected to progressively higher workload demands, which may adversely affect both the safety and efficiency of air traffic operations (Bauer and Kalvoda 2020). In this context, the results presented above clearly indicate that the implementation of ATIS represents a significant step forward in enhancing air traffic management performance.

8. Conclusions

In this article, one of the possibilities for achieving the main contemporary goals of aviation thanks to the reduction of the controllers' workload was tested.

The research conducted clearly proved that with reduced mean duration of each message and increased controller availability factor, ATIS enhances the capacity of the sector by over a third and controller availability factor after the introduction of ATIS was increased by 2.5%.

One of the primary safety benefits of the ATIS system is its ability to minimize distractions for air traffic controllers. With reduced mean duration of each message, controllers can focus more intently on critical tasks, such as monitoring aircraft trajectories and detecting potential conflicts. This undivided attention to operational responsibilities is paramount in mitigating the risk of human error, a leading cause of aviation incidents.

Additionally, the 36% increase in sector capacity brought about by ATIS translates into improved safety outcomes. With the ability to manage a larger volume of aircraft within the same time frame, controllers can better accommodate workload in air traffic demand without compromising safety margins. This flexibility is particularly valuable during peak traffic periods or unforeseen disruptions such as emergencies, where the ability to efficiently manage airspace congestion is paramount for maintaining safety.

In essence, the implementation of the ATIS system not only optimizes operational efficiency but also fosters a safer airspace environment by reducing controller workload and improving capacity management. These safety enhancements play a pivotal role in achieving the goals of civil aviation, which prioritize the safety.

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