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# Entry Count vs Occupancy Count to assess sector capacity with Fast Time Simulation

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**Abstract**

An air traffic controller should manage aircraft movements per hour to ensure the safety and efficiency of the traffic system. This study proposed an innovative methodology to estimate the air traffic controllers' workload through sector occupancy. Starting with a model for the workload of sector controllers designed by Eurocontrol for tower controllers, the authors defined a taskload model from real audio that occurred in an examined Terminal Control Area (TMA). Moreover, trombones have been implemented to sequence arrival flows in the simulated TMA. Therefore, an airside model has been reproduced using Fast Time Simulation software, and its capacity has been calculated in terms of occupancy due to approaching movements. The results permit to evaluate the impact of infrastructural and operative modifications on the sector capacity in terms of hourly entry count and occupancy. Total and maximum occupancy values have been deepened to identify the best predictive factor of controllers' workload and to manage the airspace configuration.

*Keywords:* entry count; occupancy count; trombones; sector capacity; fast time simulation; workload.

## 1. Introduction

Air traffic control service (ATCS) aims to achieve a high level of flight safety by implementing national and international rules that make safe, fast, and orderly the movement of aircraft in flight and on the ground (Morgan, 1960). The main objectives to pursue are to prevent collision of aircraft in flight and aircraft collision with each other and other obstacles in the areas of airport operation (Di Mascio and Loprencipe, 2016; Moretti et al., 2017). Therefore, ATCS provides the orderly and regular maintenance of air traffic in all flight phases over time, distributes information for efficient and safe flight conduct, and ensures the prompt and effective management of emergencies. ATCS is composed of three categories (Histon et al., 2010):

- the area control is provided by an ACC (Area Control Centre): it guides and assists the navigation of the planes during the cruise phase (i.e., at high altitudes). The ACC controllers (ATCO) operate in the radar rooms, where they manage the traffic of the Flight Information Region (FIR), in the terminal control areas (TMA), and on the Air Traffic Service (ATS) navigation routes (Chevalier et al., 2019). ACCs manage much of the national airspace that is divided into sectors to facilitate operations;
- the approach control service is provided by the control tower or an area control centre: it relates to traffic management near an airport, within a 30 NM radius and up to 10,000 ft from the surface. Approach controllers guide the planes from the en-route flight phase until the last approach phase, and they take the planes en-route immediately after take-off;
- the control tower provides the airport landing and take-off control: it manages the traffic of planes in the airport maneuver area. The tower controllers usually work on sight, while they are also using secondary surveillance radars for aircraft in flight and, especially in large airports, there is increasing use of ground motion radar for taxiing ground control. On landing, the ACC controller delivers the flight to the APP controller about 40-50 NM from the airport, and the APP controller delivers the flight to the tower controller between 10 and 3 NM from the airport. The opposite happens after take-off.

According to the International Civil Aviation Organization (ICAO) (International Civil Aviation Organization, 2018), ATCS operates in different spaces and areas: FIR is the largest airspace defined by ICAO where Flight Information Service and Alerting Service services are ensured; the Control zone (CTR) is a volume of controlled airspace within a FIR and contains the portions of the instrumental routes of departure and arrival placed in a FIR or a TMA; the Aerodrome Traffic Zone (ATZ) affords protection to aircraft within the immediate vicinity of aerodromes open to civil traffic; TMA is airspace controlled by its Area Control Center (ACC). Traffic needs and orography define the boundaries of a TMA, which is horizontally and vertically divided into several sectors manageable by controllers.

ATCS is based on the ability of pilots and controllers to collect and communicate ground-to-ground and air-to-ground information. It operates according to procedures (International Civil Aviation Organization, 1992, 2004) that affect the airspace capacity (ATC en-route), the maximum number of aircraft entering an airspace sector in a given period. Studies on ATC en-route can be at different scales and focus on capacity drivers (i.e., elements affecting the ATC capacity balancing conflicting goals of system efficiency, safety, and controllers' workload (Dmochowski et al., 2017; Metzger and Parasuraman, 2001). They are staff (e.g., number of controllers, staff roster, controller flexibility) (Zhang et al., 2018), systems (e.g., flexibility, reliability, procedures to manage flights within ACC or between ACCs within the same air navigation service provider (Hansen et al., 2002), design of routes (e.g. route geometry to avoid conflict points, route deviation to avoid climb/descent lanes, minimization of areas of non-separation) (Alharbi et al., 2022; Díaz et al., 2019; Favennec et al., 2018), design of sectors (Granberg et al., 2019), international agreements between civil and military aviation (Jönsson, 1981).

This study focuses on a central Europe TMA (herein not disclosed for privacy reasons) that includes 5 airports that moved more than 50 million passengers and 700,000 t of cargo in 2019 (the year before the pandemic crisis). The TMA is composed of six sectors where tromboning procedures are implemented; its capacity has been assessed using the FTS software NEST (NEtwork Strategic Tool) (Eurocontrol, 2022) and AirTOp (Air Traffic Optimization) (AirtopSoft, 2022): the former allows traffic assignment and analysis at a Macroscopic level and the network estimation of TMA sector capacity, the latter allows gate-to-gate fast continuous-time simulation of movements. An innovative approach analysis identified different relationships between sector occupancy in terms of the maximum and total number of aircraft in the sector during the given period and ATCO overload thresholds. In addition, this study give a new contribution to the evaluation of the controllers' workloads when the trombones are considered in the TMA.

## 2. Data and methods

The examined TMA is composed of six sectors whose traffic volume on 17 July 2019 was 1441 total movements: their boundaries and architecture have been implemented in the NEST model. NEST software allowed modelling the dynamics of the airspace network to assess entries and crossing times of each flight (Ivanov et al., 2017). Traffic mix composition has been maintained in the AirTOp Fast Time Simulator (FTS), while the traffic volume has been increased to reach and overcome the overload threshold at different simulation steps (Di Mascio et al., 2020) (Figure 1).

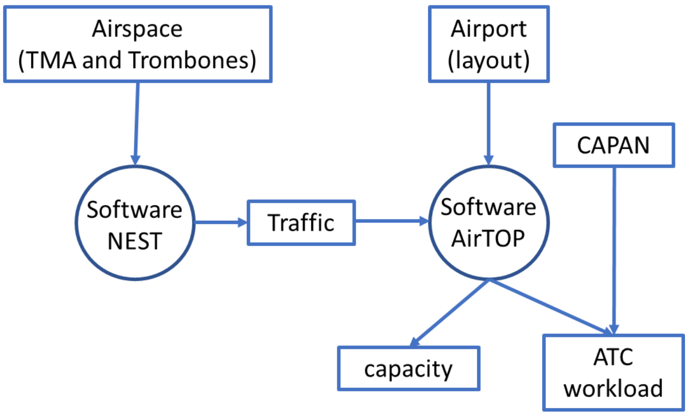


Figure 1: Methods.

AirTOp FTS is a rule-based gate-to-gate fast-time simulator that allows realistic simulations in a 4D environment (3D + Time) that models both airport and air spaces (Di Mascio et al., 2021a): the model in AirTOp derives from aeronautical information publication of each airport in the examined TMA (e.g. runway data, arrival and departure procedures, radar controller of each sector). Performance Based Navigation (PBN) operations have been implemented within TMA and CTR. The final approach procedures leading to the high-traffic international airport in the TMA (more than 30 million yearly passengers) were modelled considering trombone-shaped routes. PBN instrumental procedures are based on navigation system performance requirements related to crew and aircraft. In this study, the area navigation specifications were applied for departure and arrival routes in the busiest airport. Tromboning procedures (Trombones) are adopted for sequencing arrival flows (Saez et al., 2020). Even in high-traffic loads without radar vectoring (Ivanescu et al., 2009), they provide benefits in terms of predictability, spacing, and flexibility during approach sequencing. Trombones (Figure 2) are composed of linear segments with orthogonal turns. At the beginning of the procedure, airplanes fly outbound of the airport (downwind /extended downwind), then according to the number in the sequence they are instructed to start a first turn (base) and a second one (final) to be aligned with the runway centerline.

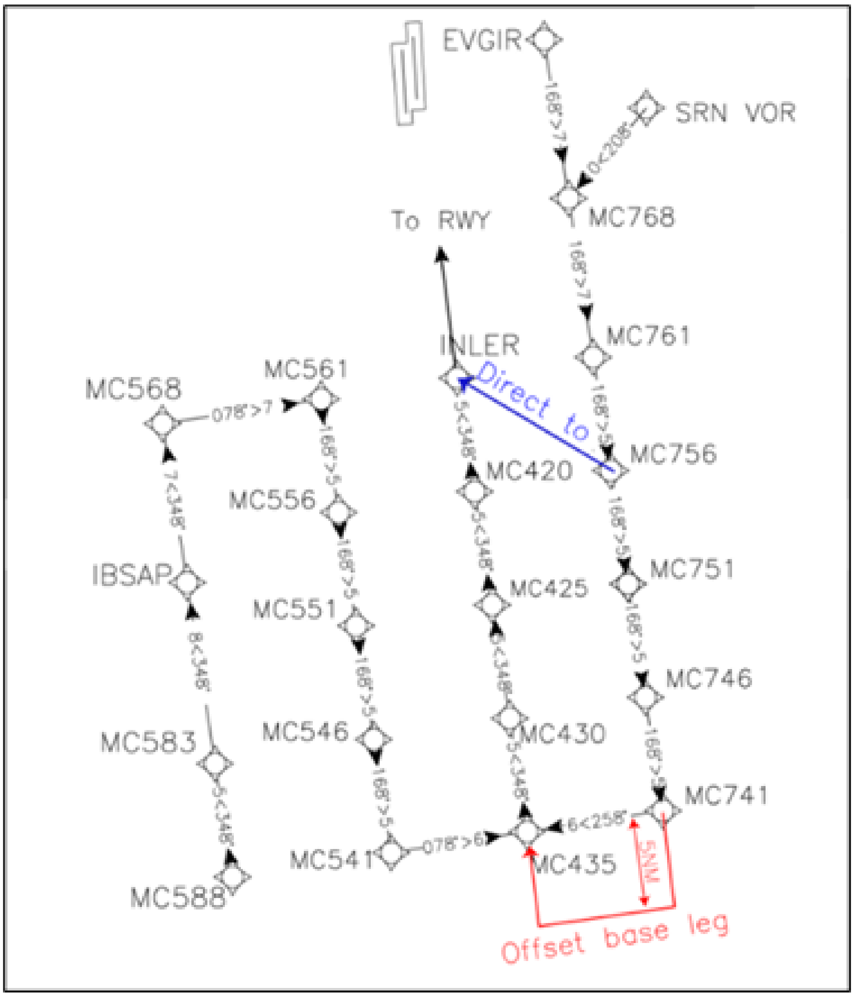


Figure 2: Simplified layout of a tromboning procedure.

Depending on the operational and environmental constraints, and the design choice made, the expected benefits are the simplification of controller tasks, reduction of communications and workload, better pilot and controller situational awareness, the orderly flows of traffic with a better view of arrival sequences, and the improved containment of flown trajectories. It leads to better trajectory prediction, allowing for flight efficiency and standardization of operations, and better airspace management.

Table 1 lists the taskload model of the ATCO executive (EXE) for the approach sector (APP) adopted in this study (International Civil Aviation Organization, 2009). The model derives from interviews with controllers and real audio recordings from the examined TMA where tromboning procedures were adopted: different task types were identified (Flynn et al., 2003). Overall, it takes into account 20 approaching tasks and 2 supplementary approaching tasks: each action identifies the responsibilities of the pilot (P) or ATC (C) during the APP phases. The automated procedures of the model allow overlooking some procedures to simplify and faster the controller’s activities.

Table 1: Taskload model.

| | *ATCO exe taskload model - APP* |
|---|---|
| Communication default tasks | First pilot (P) calling to ATC (C) |
| | First contact between P and C |
| | First hear-back contact |
| | Single instruction (route, direct routing, heading, speed) |
| | Hear-back single instruction (route, direct routing, heading, speed) |
| | Flight level instruction |
| | Hear-back flight-level instruction |
| | Clearance of the procedure |
| | Hear-back of clearance |
| | Instruction to establish the RWY/final procedure |
| | Hear-back of instruction to establish the RWY/final procedure |
| | Request to report established the aircraft and runway in sight |
| | Hear back of the request to report established the aircraft and runway in sight |
| | Request to report established the aircraft |
| | Hear-back of request to report established the aircraft |
| | Last pilot calling C |
| | Last hear-back contact |
| Coordination tasks | Transmission of automatic radar coordination between ATS of the same TMA |
| | Hear-back of radar coordination |
| Conflict solving tasks | Identification and solution of potential conflicts between two or more aircraft |
| Supplementary tasks | Instruction for approaching/vectoring |
| | Hear-back of instruction for approaching/vectoring |

Each task has a duration obtained from direct measurement of ATCOs listening and speaking time: the greater the number of tasks the higher the complexity of the event to be managed, and the longer the workload time.

The ATCO workload has been assessed according to the ATC Capacity Analyser (CAPAN) method by Eurocontrol (2003). Five categories contribute to collecting input data for CAPAN: environment data (e.g., route network, airspace structure, sectors), traffic data (e.g., flight plans, aircraft performances), simulation parameters (e.g., conflict detection/resolution, procedures, separation minima's), ATC tasks, and sector manning (Eurocontrol, 2016). The simulated controller position in ACC has a workload to be compared to the overload threshold of ATC (i.e., the theoretical sector capacity), which occurs when the time spent by ATC in predefined tasks reaches 70% of the absolute working time (i.e., 42 min during 1 hour) (Loft et al., 2007; Di Mascio et al., 2021b, 2021c).

Moreover, the sector entries and occupancy have been considered for each sector. Sector entries account for the number of flights entering the ATC in a given period (entry counting period), assumed equal to 1 hour in this study: the Hourly Entry Count (HEC) is the assessed variable (Eurocontrol, 2019). On the other hand, sector occupancy takes into account the number of flights in the sector in a given period (occupancy counting period): the Occupancy Count (OCC) is the assessed variable (Eurocontrol, 2019). The relationship between those variables is oriented and non-symmetric (Figure 3):

- the relationship HEC→OCC gives a set of OCC values for a single HEC value;
- the relationship OCC→HEC gives a set of HEC values for a single OCC value.

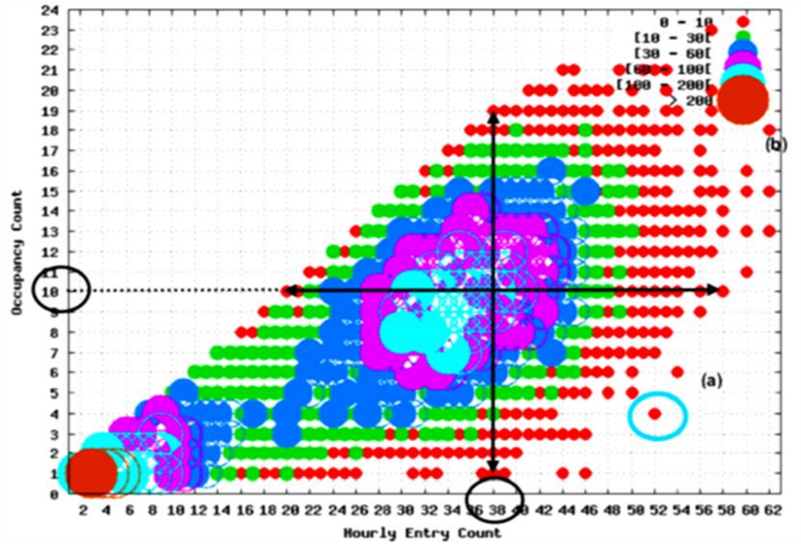


Figure 3: OCC/HEC points.

The results from AirTOp simulation and CAPAN implementation (i.e., the workload output) allowed calculating the regression HEC-OCC curve and identifying the maximum HEC that controllers can manage without overload.

## 3. Results and discussion

AirTOp Reporter gave output to assess the capacity: work duration, section entry, and occupancy count: the results derive from implementing the proposed workload model in the fast time simulation software when different traffic volumes are expected. The traffic volume was 1441 movements during the busiest day in 2019 in the 6 analyzed sectors and was progressively increased until reaching the maximum workload of ATCO. The workload of the radar controller of an examined sector (hereafter called S1) has been assessed for 20-minute steps and a 1-hour duration. The total of the tasks for each hourly slot gives the workload. Table 2 shows an extract of the results from a clone simulation carried out for S1. For each sector, 11 clones (i.e., scenarios with increasing traffic compared to the current one) have been developed to identify the overload threshold.

Table 2: Report workload of S1 (time) radar controller.

| *Hour* | *First call by P (min)* | *Squawking SSR code by C (min)* | *First instruction by C (min)* | *First contact by P (min)* | *Descending/climbing clearance by C (min)* | *Level change by P (min)* | *Conflict by C (min)* | *Last call by P (min)* |
|---|---|---|---|---|---|---|---|---|
| 05:00:00 | 00:02:13 | 00:00:00 | 00:03:10 | 00:04:26 | 00:03:00 | 00:00:20 | 00:00:00 | 00:01:54 |
| 05:20:00 | 00:03:23 | 00:00:00 | 00:04:50 | 00:06:46 | 00:04:50 | 00:00:20 | 00:00:00 | 00:03:03 |
| 05:40:00 | 00:05:22 | 00:00:09 | 00:07:40 | 00:10:44 | 00:07:40 | 00:00:10 | 00:00:00 | 00:05:09 |
| 06:00:00 | 00:05:36 | 00:00:09 | 00:08:00 | 00:11:12 | 00:08:00 | 00:00:30 | 00:00:00 | 00:05:42 |
| 06:20:00 | 00:04:33 | 00:00:18 | 00:06:30 | 00:09:06 | 00:06:20 | 00:00:50 | 00:00:00 | 00:04:10 |
| 06:40:00 | 00:03:58 | 00:00:09 | 00:05:40 | 00:07:56 | 00:05:20 | 00:00:10 | 00:00:00 | 00:04:02 |

Table 3 lists the reporting workload of S1 in terms of the number of tasks and reports the overall load time duration. TX-RX refers to the transmission and reception tasks between ATCO of adjacent sectors.

Table 3: Report workload of S1 (number of tasks) and total workload radar controller.

| *Hour* | *First call by P (min)* | *Squawking SSR code by C (min)* | *First instruction by C (min)* | *First contact by P (min)* | *Descending/climbing clearance by C (min)* | *Level change by P (min)* | *Conflict by C (min)* | *Last call by P (min)* | *TX-RX* | *Total workload (min)* |
|---|---|---|---|---|---|---|---|---|---|---|
| 04-05 a.m. | 15 | 0 | 15 | 15 | 14 | 2 | 1 | 14 | 24 | 16.38 |
| 05-06 a.m. | 19 | 0 | 19 | 19 | 18 | 2 | 1 | 17 | 29 | 20.03 |
| 06-07 a.m. | 25 | 0 | 25 | 25 | 24 | 2 | 1 | 26 | 42 | 26.72 |
| 07-08 a.m. | 29 | 0 | 29 | 29 | 29 | 2 | 1 | 29 | 50 | 30.78 |
| 08-09 a.m. | 36 | 0 | 36 | 36 | 36 | 2 | 3 | 36 | 64 | 41.18 |
| 09-10 a.m. | 46 | 1 | 46 | 46 | 46 | 1 | 4 | 41 | 78 | 51.62 |
| 10-11 a.m. | 48 | 1 | 48 | 48 | 48 | 1 | 3 | 44 | 81 | 52.10 |
| 11-12 a.m. | 48 | 1 | 48 | 48 | 48 | 3 | 3 | 48 | 85 | 53.43 |
| 12-01 p.m. | 40 | 2 | 40 | 40 | 39 | 4 | 3 | 41 | 70 | 45.70 |
| 01-02 p.m. | 39 | 2 | 39 | 39 | 38 | 5 | 3 | 39 | 67 | 44.60 |
| 02-03 p.m. | 35 | 2 | 35 | 35 | 33 | 4 | 1 | 33 | 53 | 36.10 |
| 03-04 p.m. | 34 | 1 | 34 | 34 | 32 | 6 | 1 | 37 | 56 | 36.52 |

Figure 4 shows the output obtained in a 24-hour-long simulation for S1: the obtained pairs of workload-sector entries (blue points in Figure 4) have been interpolated to identify the hourly overload condition (maximum HEC) from a regression curve (dashed red line in Figure 4).

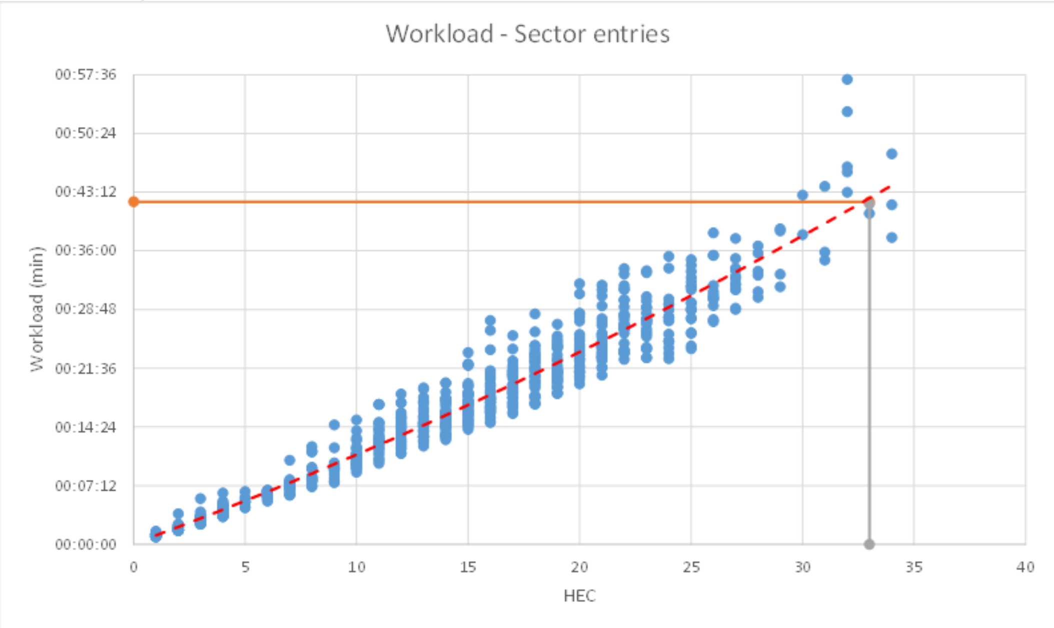


Figure 4: Workload-sector entries for S1.

Figure 4 shows that the S1 ATC can manage 34 hourly movements (HEC) without overload. Table 4 exemplifies the occupancy factors assessed for S1 during a 1 hour-analysis (from 00:00 am to 1:00 am) to implement the CAPAN method having regard to sector occupancy. Therefore, it was possible to obtain the total occupancy (i.e., the total number of aircraft in the sector during the given period -TO) and the maximum occupancy (i.e., the maximum number of aircraft in the sector during the given period -MO). For each pair of occupancy indexes, the taskload model in Table 1 allowed calculating the workload.

Table 4: Occupancy report of S1 ANE.

| *Clone* | *Rolling period* | *Entry count* | *TO* | *MO* | *Workload (s)* |
|---|---|---|---|---|---|
| CL_000 | 00:00 - 00:20 | 1 | 2 | 2 | 00:01:11 |
| CL_010 | 00:00 - 00:20 | 1 | 2 | 2 | 00:01:11 |
| CL_020 | 00:00 - 00:20 | 1 | 2 | 2 | 00:01:11 |
| CL_030 | 00:00 - 00:20 | 1 | 2 | 2 | 00:01:11 |
| CL_040 | 00:00 - 00:20 | 1 | 2 | 2 | 00:01:11 |
| CL_050 | 00:00 - 00:20 | 1 | 2 | 2 | 00:01:11 |
| CL_060 | 00:00 - 00:20 | 1 | 2 | 2 | 00:01:11 |
| CL_070 | 00:00 - 00:20 | 2 | 3 | 3 | 00:03:45 |
| CL_080 | 00:00 - 00:20 | 3 | 5 | 2 | 00:03:08 |
| CL_090 | 00:00 - 00:20 | 1 | 2 | 2 | 00:01:11 |
| CL_100 | 00:00 - 00:20 | 4 | 5 | 4 | 00:04:14 |
| CL_000 | 00:20 - 00:40 | 1 | 1 | 1 | 00:01:01 |
| CL_010 | 00:20 - 00:40 | 1 | 1 | 1 | 00:01:01 |
| CL_020 | 00:20 - 00:40 | 1 | 1 | 1 | 00:01:01 |
| CL_030 | 00:20 - 00:40 | 1 | 1 | 1 | 00:01:01 |
| CL_040 | 00:20 - 00:40 | 3 | 3 | 2 | 00:02:08 |
| CL_050 | 00:20 - 00:40 | 1 | 1 | 1 | 00:01:01 |
| CL_060 | 00:20 - 00:40 | 1 | 1 | 1 | 00:01:01 |
| CL_070 | 00:20 - 00:40 | 2 | 2 | 2 | 00:02:02 |
| CL_080 | 00:20 - 00:40 | 2 | 3 | 2 | 00:02:12 |
| CL_090 | 00:20 - 00:40 | 3 | 3 | 2 | 00:02:48 |
| CL_100 | 00:20 - 00:40 | 1 | 1 | 1 | 00:01:01 |
| CL_000 | 00:40 - 01:00 | 2 | 2 | 1 | 00:01:42 |
| CL_010 | 00:40 - 01:00 | 2 | 2 | 1 | 00:01:42 |
| CL_020 | 00:40 - 01:00 | 2 | 2 | 1 | 00:01:42 |
| CL_030 | 00:40 - 01:00 | 2 | 2 | 1 | 00:01:42 |
| CL_040 | 00:40 - 01:00 | 2 | 3 | 2 | 00:01:57 |
| CL_050 | 00:40 - 01:00 | 2 | 2 | 1 | 00:01:42 |
| CL_060 | 00:40 - 01:00 | 3 | 3 | 1 | 00:02:43 |
| CL_070 | 00:40 - 01:00 | 2 | 2 | 1 | 00:01:42 |
| CL_080 | 00:40 - 01:00 | 2 | 2 | 1 | 00:01:42 |
| CL_090 | 00:40 - 01:00 | 4 | 5 | 2 | 00:03:39 |
| CL_100 | 00:40 - 01:00 | 3 | 3 | 2 | 00:02:28 |

In S1, the maximum TO within the workload threshold was 16: up to 16 movements can be managed safely by an ATCO for 1 hour.

Figure 5 summarizes the occupancy results of S1 during a 24-hour-long analysis: the most critical slots are between 7:00-8.00 am and 8:00-9:00 pm.

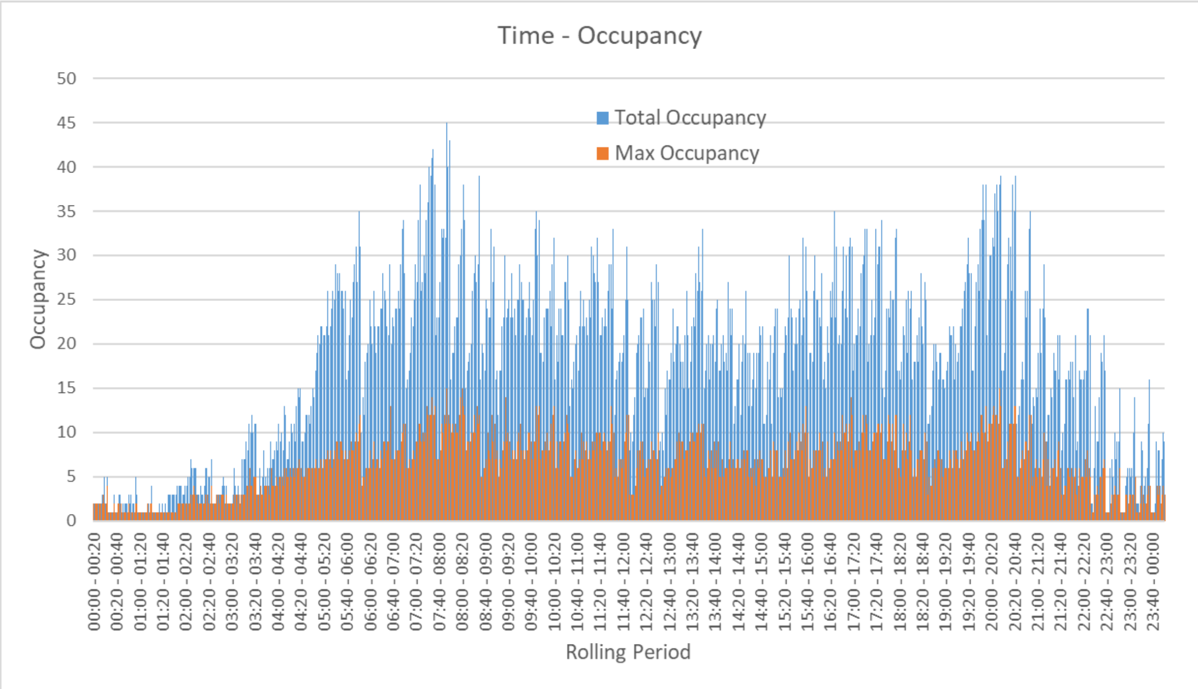


Figure 5: Time-occupancy curves for S1.

Figure 6 shows the relationship between TO and MO values obtained in the complete occupancy report of S1: given the maximum TO value within the overload threshold (i.e., 16), MO ranges between 10 (upper MO value) and 4 (lower MO value).

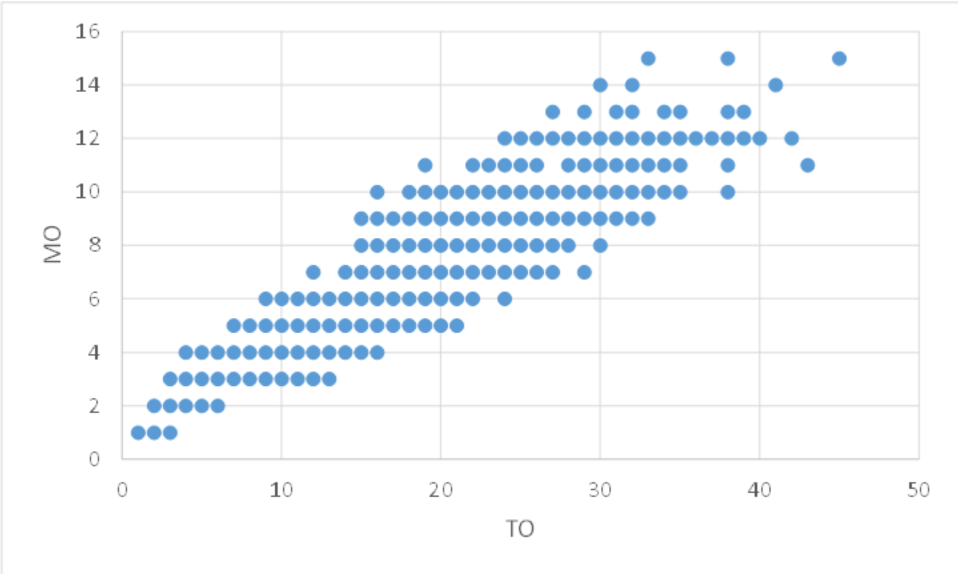


Figure 6: MO-TO for S1.

However, the most relevant variable to obtain a relationship between workload and sector occupancy is TO because MO represents a single timing of the rolling period instead of a clone. Therefore, Figure 7 shows the pairs of TO-workload obtained from the analysis. Their red dashed interpolation curve allowed the identification of the TO value that causes ATCO overload during a run period. The overload threshold is reached when the workload duration is more than 14 minutes during the 20-minute-long rolling period (i.e., 70% of 20 minutes).

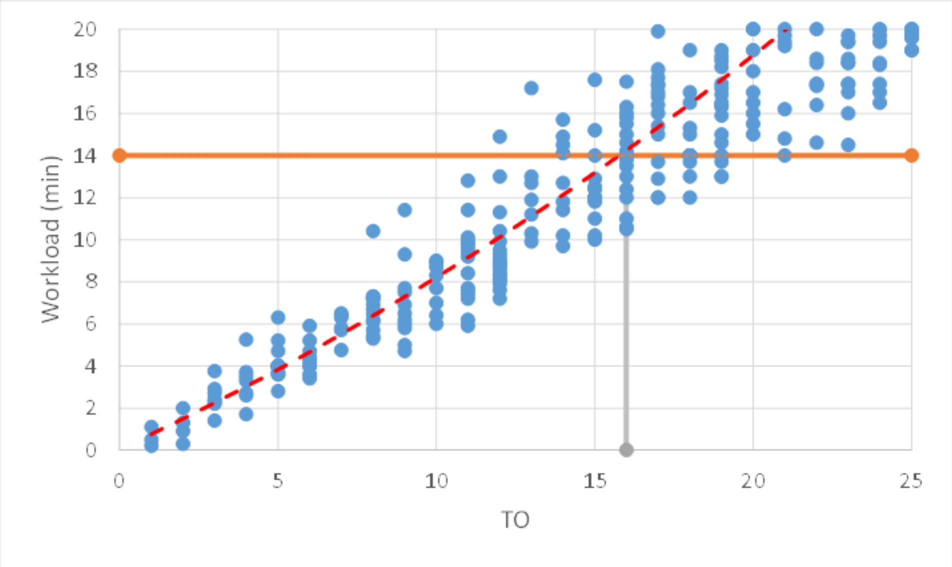

Figure 7: Workload-TO for S1.

According to the regression curve obtained from data in Figure 7, the sustainable TO of S1 is 16 movements/20 minutes.

The same analysis approach (from MO-TO to TO-workload) has been implemented in all the sectors of the TMA to obtain different relationships between occupancy and ATCO overload thresholds. Table 5 summarizes the obtained results for all the examined sectors.

Table 5: HEC and occupancy results.

| *Sector* | *maximum HEC (movements/hour)* | *TO* | *maximum HEC (movements/hour)* | *TO* |
|---|---|---|---|---|
| S1 | 34 | 16 | 10 | 4 |
| S2 | 42 | 18 | 6 | 3 |
| S3 | 44 | 18 | 7 | 6 |
| S4 | 34 | 15 | 8 | 4 |
| S5 | 27 | 13 | 8 | 4 |
| S6 | 26 | 10 | 5 | 1 |

The results in terms of maximum HEC comply with the traffic managed by the sectors: S5 and S6 have the lowest maximum HEC values because they manage queueing arrivals to the busiest airport in the TMA. On the other hand, the highest HEC values are for S2 and S3 managing departures from the same busy airport. Such results confirm that arrivals management is more critical than departure management.

Figure 8 a to f compares MO-TO values obtained for sectors 1 to 6, respectively, during the run rolling periods. The same scale of representation has been adopted to discuss the results.

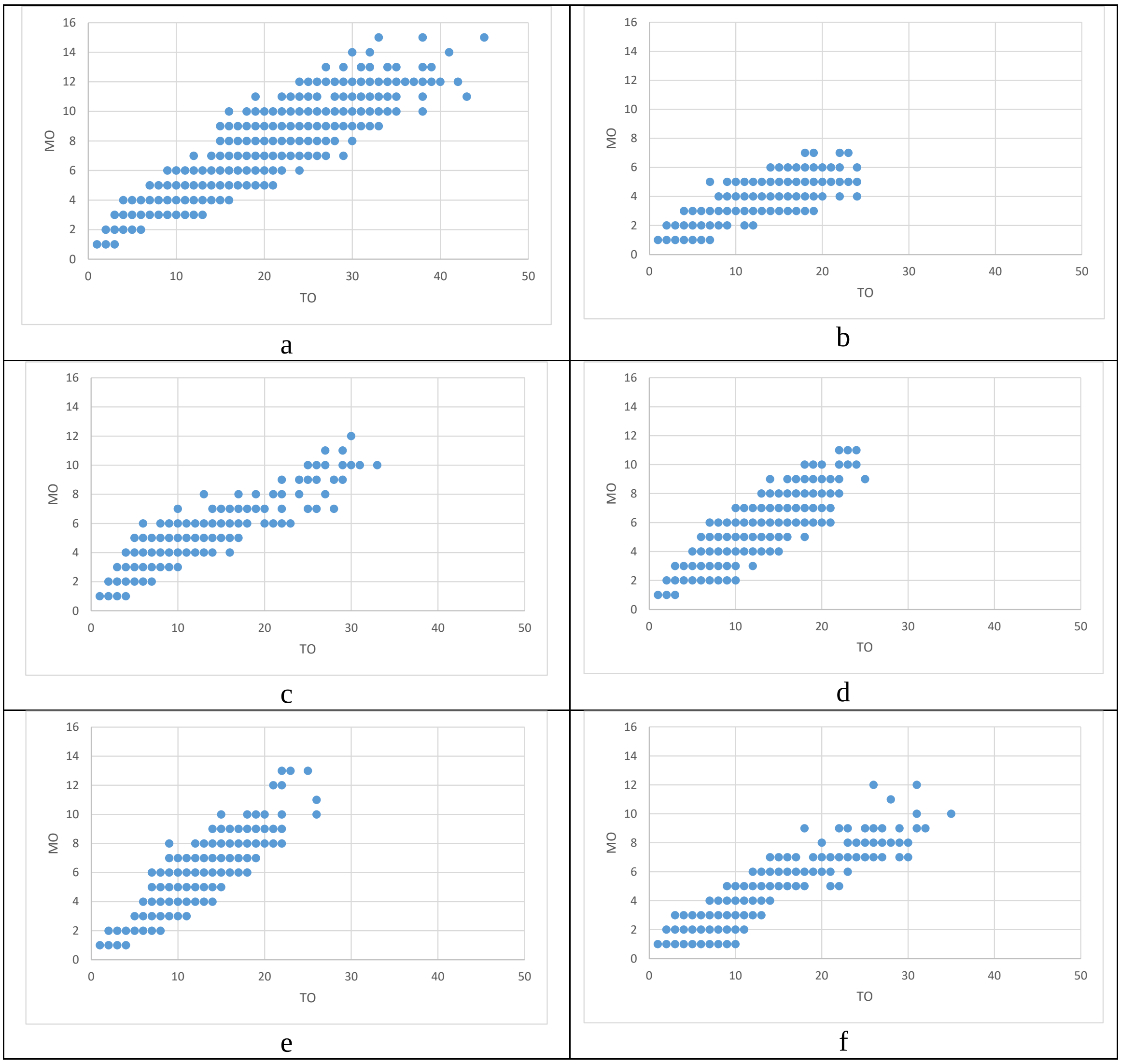


Figure 8: TO-MO for the examined sectors a) S1; b) S2; c) S3; d) S4; e) S5; f) S6.

Figure 9 shows the average occupancy curves obtained for the sectors during the runs over a 24-hour-long analysis.

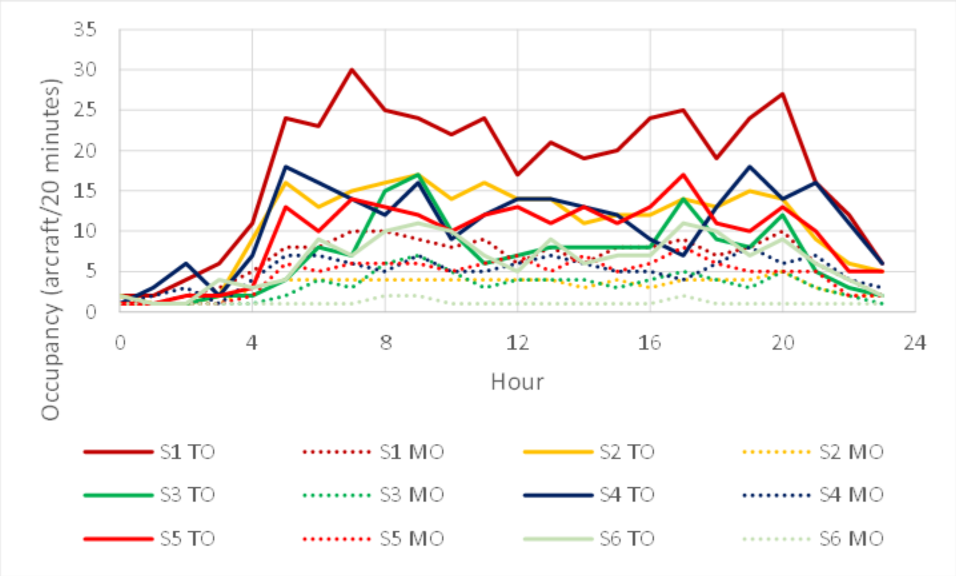


Figure 9: Occupancy curves for the examined sectors.

Both MO and TO values have peak hours in the early morning and late afternoon, according to the throughput performances of the most trafficked airport in the TMA (Di Mascio et al., 2020).

The results in Table 5, Figure 8, and Figure 9 highlight:

- the lowest maximum HEC has been obtained for S6 (i.e., 26), the sector that manages sequencing arrival traffic to the busiest airport in the TMA;
- sector S6 has the lowest TO value: both HEC and TO are affected by the traffic complexity (e.g., conflicts and level change);
- the highest maximum HEC has been obtained for S3 (i.e., 44), the sector that manages departures from the busiest airport in the TMA;
- the difference between upper and lower MO is highly variable between sectors: in S3 upper MO is 16% more than lower MO, while this difference is 400% in S6; in S3, trombones are implemented in the FTS model to sequence arrival flows: it supports continuously descent operations and allows improving the maximum HEC compared to the current condition of some sectors;
- the high difference between upper and lower MO confirms that the workload is not directly correlated with the maximum occupancy, and the flight's complexity affects the overload. Regarding S3, overload could be indifferently reached with 4 and 10 aircraft/20 minutes: it depends on the movements (e.g., conflicts) managed by ATCs.

## 4. Conclusions

Given the expected growth in the air transport sector, airport operators aim to increase the number of hourly movements within the safety limits, admitted delays, and workload of ATCS. Regarding an airspace sector during a given period, capacity and occupancy depend on the available team of controllers, their workload threshold, and the opened sectors. So far, the capacity value derives from controllers' experience, because a methodology lacks although the workload of ATCO is an integral part of the aviation system.

This study aims to evaluate the capacity of ATCO defined as the maximum number of aircraft that one air traffic controller can manage while maintaining a workload lower than the overload. For six different sectors of a TMA where tromboning procedures have been implemented, this study proposed an innovative approach to calculate the capacity in terms of occupancy. Trombones imply continuous descent operations and standardized procedures: automatic coordination tasks affect the procedures conducted by ATCOs.

Lower instructions about flight level instruction need, and the benefits are appreciable in the sectors managing arrival traffic to the busiest airport in the modelled TMA. The authors attributed an execution time to each task to define a taskload model according to CAPAN. NEST and AirTOp software have been used to model the TMA sectors and assess their capacity. The FTS analysis overcame the traditional approach in terms of hourly entry count (i.e., the number of aircraft entering airspace) to consider the sector occupancy. In particular, two parameters have been calculated: the total occupancy is more associated with the ATC workload than the maximum occupancy because MO represents a single timing instead of a rolling period. The workload model affects the results, and further investigation shall be carried out to confirm the output.

The proposed method to calculate the ATCO workload could be used in different TMAs: its structure allows modifications and adjustments to model the carried-out tasks. The identified sector capacity thresholds could lead to modifying of the airspace configuration set by the controllers during the day: dynamic rearrangement (e.g., the possible opening of new sectors) may answer the traffic demand avoiding the ATCs overload. When implemented in FTS software, it provides a tool for management bodies and/or authorities to evaluate strategies, procedures, and policies to improve sector capacity.

*Acronyms list*

ACC Area Control Centre
APP approach
AirTOp Air Traffic Optimization
ATCO ACC controllers
ATCS Air traffic control service
ATS Air Traffic Service
ATZ Aerodrome Traffic Zone
C ATC controller
CAPAN ATC Capacity Analyser
CTR Control zone
DEP departure
EXE ATCO executive
FIR Flight Information Region
FTS Fast Time Simulator
HEC Hourly Entry Count
ICAO International Civil Aviation Organization
MO maximum occupancy
NEST NEtwork Strategic Tool
OCC Occupancy Count
P Pilot
PBN Performance Based Navigation
RX reception tasks

TMA Terminal Control Area
TO total occupancy
TX transmission tasks

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