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16. Abstract

This report documents a comprehensive Cognitive Task Analysis (CTA) conducted by The MITRE Corporation's Center for Advanced Aviation Systems Development (CAASD) for the Federal Aviation Administration (FAA) Human Factors Division (ANG-C1). The primary objective was to analyze key air traffic workforce positions at Air Route Traffic Control Centers (ARTCCs)—including Radar (R) and Radar Associate (RA) controllers, Operations Supervisors (OSs), Traffic Management Coordinators (TMCs), Supervisory Traffic Management Coordinators (STMCs), and Oceanic controllers—to inform operational changes, improve procedures, training, interfaces, and decision support aids. The research adopted a holistic CTA approach, spanning systems and capturing the overall operational workflow rather than focusing on system-specific tasks. Data collection involved approximately 60 hours of facility observations and guided discussions at Seattle (ZSE), Oakland (ZOA), and Miami (ZMA) ARTCCs, enabling the team to document both observable actions and underlying cognitive processes. MITRE developed multi-level CTA models using flowcharts for task flows and GOMS-based cognitive models to represent decision-making criteria, automation interaction, and communication. Key findings highlight the complex interplay of attention, vigilance, communication, and perceptual skills required across all ARTCC positions, with unique operational characteristics observed in oceanic areas and supervisory roles. The CTA results provide a baseline for discrete event task network modeling, supporting the FAA's efforts to anticipate cognitive performance issues and improve individual and team performance. Recommendations include further research to expand efforts to the TRACON and ATCT, further validate model applicability across additional ARTCC facilities and expanding supervisor task analysis to include both operational and administrative responsibilities to inform insights beyond the scope of this effort such as those focused on overall workload experience. Next steps involve formatting task flow diagrams for integration with the Improved Performance Research Integration Tool (IMPRINT) and extending CTA research to Terminal Radar Approach Control (TRACON) and Airport Traffic Control Tower (ATCT) facilities.

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Special appreciation is extended to the staff at each Air Route Traffic Control Center (ARTCC); Seattle (ZSE), Oakland (ZOA), and Miami (ZMA) for their cooperation, expertise, and participation in both operational observations and guided discussions. Their contributions were essential to the successful collection of data and the development of accurate cognitive task models.

We are grateful to all individuals and organizations who contributed their time, knowledge, and support to this research effort.

Executive Summary

The Federal Aviation Administration's (FAA) Human Factors Division (ANG-C1) requested that The MITRE Corporation's Center for Advanced Aviation System Development (MITRE CAASD) conduct a comprehensive Cognitive Task Analysis (CTA) of key air traffic workforce positions with the goal of providing insights to inform operational changes, improve procedures, training, interfaces, and decision support aids.

This project focuses on applying a holistic CTA approach, spanning systems and capturing the overall operational workflow of air traffic personnel rather than being system-specific. The analysis targeted the cognitive drivers behind air traffic tasks and activities for positions at Air Route Traffic Control Centers (ARTCCs), including Radar (R) and Radar Associate (RA) controllers, Operations Supervisors (OSs), Traffic Management Coordinators (TMCs), Supervisory Traffic Management Coordinators (STMCs), and Oceanic controllers.

MITRE CAASD developed CTA models for six ARTCC positions: R, RA, OS, Traffic Management Unit (TMU) (that includes the STMC and TMC), and Oceanic controller. CTA models consist of task flow diagrams and cognitive models, informed by internal MITRE CAASD Air Traffic Control (ATC) Subject Matter Experts (SMEs), facility observations, and guided discussions with current air traffic controllers, supervisors, and managers at three ARTCC facilities: Seattle (ZSE), Oakland (ZOA), and Miami (ZMA). The research included approximately 60 hours of facility observations and extensive guided discussions, enabling MITRE CAASD to capture both observable actions and the underlying cognitive processes that drive decision-making and problem-solving in air traffic operations. As a result, MITRE CAASD developed CTAs for a total of 633 tasks across these roles, including 368 tasks for the R/RA controller positions, 77 tasks for the OS position, 54 tasks for TMU positions, and 134 tasks for the Oceanic controller position.

Key findings highlight the complex interplay of attention, vigilance, communication, and perceptual skills required across all ARTCC positions. The CTA results provide a baseline of detailed knowledge representations for key ARTCC positions that will inform discrete event task network modeling, allowing the FAA to anticipate cognitive performance issues and improve individual and team performance.

Lessons learned include the unique operational characteristics for managing oceanic areas, the complexity of supervisory roles, and the critical value of guided discussions with facility staff. Recommendations emphasize the need for further research to expand CTA data collection efforts to Terminal Radar Approach Control (TRACON) and Airport Traffic Control Tower (ATCT) facilities, to further validate and refine the applicability of these models across additional ARTCC facilities, and to expand the scope of supervisor task analysis to include both operational and administrative responsibilities to inform insights beyond the scope of this effort such as those focused on overall workload experience.

As next steps, MITRE CAASD will format the task flow diagrams for integration with the Improved Performance Research Integration Tool (IMPRINT). Future research opportunities which examine TRACON and ATCT facilities could leverage the methodology established by MITRE CAASD. This report provides a foundational resource for the FAA to improve air traffic operations through a deeper understanding of the cognitive demands placed on its workforce.

Table of Contents

List of Figures

List of Tables

1 Introduction

Human performance is at the center of enabling a safe and efficient air transportation system. An objective understanding of air traffic tasks and activities and how they are approached/executed by the workforce can provide insights about cognition drivers and help inform decisions about implementing operational changes as well as developing mitigations to emerging needs/shortfalls. Some examples include new operating procedures, improved training, refined user interfaces, decision support aids, and/or automating workload intensive tasks.

The Federal Aviation Administration's (FAA) Human Factors Division (ANG-C1) requested that The MITRE Corporation's Center for Advanced Aviation System Development (MITRE CAASD) conduct a cognitive task analysis (CTA) of key air traffic control (ATC) workforce positions that reflect current operational roles and responsibilities and their use of information, equipment/technologies, and system capabilities/tools.

Ultimately, CTA results will be used by the FAA to anticipate cognitive performance problems and specify ways to improve individual and team performance, much like a workforce digital twin. CTA results will also be used by the FAA to identify human factors (HF) risks within technologies, systems, and procedures, and to determine where opportunities exist to improve the use of them.

CTA is a method used to understand the mental processes and skills experts use to perform complex tasks. It involves various techniques, such as interviews and observations, to capture the knowledge, goals, strategies, and decisions underlying task performance. At its core, CTA involves identifying, analyzing, and structuring the mental processes and skills experts use to perform complex tasks [1]. It focuses on capturing both visible actions and hidden mental activities to provide a comprehensive understanding of task [2]. This differs from traditional task analysis which emphasizes the explicit tasks, sub-tasks, and cues involved in performing a task, without delving into the cognitive aspects such as decision-making, judgment, and problem-solving strategies [3]. While traditional task analysis provides a clear, objective account of task steps, it may miss the nuanced cognitive skills that CTA captures [4, 3].

Recent ATC CTAs conducted have been system specific and bound to the tasks and operations that specific system touches. This work takes a more holistic approach to capturing CTAs that span systems. Rather than focusing on the impact one system has on a small set of operations, this research focuses on the overall operational workflow at each operational position at the Air Route Traffic Control Center (ARTCC) to include Radar (R) and Radar Associate (RA) controllers, Operations Supervisors (OSs), Traffic Management Coordinators (TMCs), Supervisory Traffic Management Coordinators (STMCs), and Oceanic controllers.

ATC is an inherently demanding cognitive field, and the tools and resources implemented within the National Airspace System (NAS) are designed to help reduce the mental workload on controllers. This work highlights the extent of that cognitive demand and offers valuable insights into how even seemingly minor tasks require varying levels of mental effort.

2 Method

MITRE CAASD took the following steps to develop and refine representative CTAs for ARTCCs:

1. Developed CTA knowledge representations with internal resources. MITRE CAASD HF engineers conducted discussions and process tracing with internal MITRE CAASD ATC Subject Matter Experts (SMEs) to create initial ARTCC CTA knowledge representations consisting of task flow diagrams and cognitive models. The task flow diagrams provide a visual representation of the specific steps the air traffic personnel take to complete a task. The cognitive models capture the decision cues, goals, and strategies of a given task. They highlight how the air traffic personnel carry out each step and what automation capabilities and information are being leveraged to accomplish tasks and make decisions. More details regarding how MITRE CAASD developed the initial knowledge representations and what programs were used are documented in the CTA Plan deliverable [5].
2. MITRE CAASD visited three different ARTCC facilities to observe operations and conduct guided discussions to update and validate our initial CTA knowledge representations. MITRE CAASD conducted an assessment comparing ARTCC facilities to a list of desired operational characteristics MITRE CAASD ATC SMEs and HF engineers developed (shown in Table 2-1) to determine which facilities would provide a good representative variety of ARTCC operations and tasks.

Table 2-1. ARTCC Positions and Operational Characteristics

ARTCC Positions	Diverse Operational Characteristics of Interest for ARTCC

• Sector Controller
  ○ Radar (R)
  ○ Radar Associate (RA)
• Oceanic Controller
• Operations Supervisor (OS) / Controller In Charge (CIC)
• Traffic Management Unit (TMU)
  ○ Traffic Management Coordinator (TMC)
  ○ Supervisor Traffic Manager Coordinator (STMC) / CIC
	• Identify staffing challenges
	• Combines and splits sector positions
	• ARTCC with and without underlying Core 30 airports[1]
	• Includes airspace to the surface
	• Includes Special Activity Airspace (SAA), New Entrants, or Space Operations
	• Has ultra-high-altitude sectors
	• Includes verbal and electronic communications
	• Includes mountainous terrain
	• Includes non-radar airspace
	• Has a variety of weather conditions
	• Has a TMU
	• Located adjacent to an Air Navigation Service Provider (ANSP)
	• Includes Oceanic positions

[1] The FAA "Core 30" airports are a specific set of 30 of the nation's busiest airports used for tracking and assessing performance metrics, such as the Aviation System Performance Metrics (ASPM). These airports are not defined by a specific criteria like commercial enplanements, but are a dynamic list identified by the Federal Aviation Administration (FAA) as the most significant airports in the system.

Based on the list of desired operational characteristics, three facilities, Seattle ARTCC (ZSE), Oakland ARTCC (ZOA), and Miami ARTCC (ZMA) were selected and agreed to by the FAA and the National Air Traffic Controllers Association (NATCA). Table 2-2 shows how the selected ARTCCs align with the list of diverse operational characteristics.

Table 2-2. Operational Characteristics Matchup with Selected ARTCCs

Operational Characteristics of Interest	ZSE	ZOA	ZMA
Identify staffing challenges			
Combines and splits sector positions	X	X	X
ARTCC with and without underlying Core 30 airports	X	X	X
Includes airspace to the surface	X	X	X
SAA, New Entrants, or Space Operations	X	X	X
Has ultra-high-altitude sectors	X	X	X
Includes verbal and electronic communications	X	X	X
Includes mountainous terrain	X	X	
Includes non-radar airspace	X	X	X
Has a variety of weather conditions	X	X	X
Has a TMU	X	X	X
Located adjacent to an ANSP	X	X	X
Includes Oceanic Positions		X	

As required, MITRE CAASD submitted the research protocol to the FAA Institutional Review Board (IRB), and they determined that the research met the criteria for exempt approval. With the FAA IRB approval, the FAA coordinated with NATCA National to receive approval to conduct this research at ARTCC facilities under Article 51. The FAA also coordinated with the FAA's Program Management Organization (PMO), Resource Utilization Team (AJT-3), and Management Services (AJG) to coordinate the facility visits and ensure there were at least three NATCA representatives from each facility assigned to support the guided discussions.

2.1 ARTCC Positions and Tasks Modeled

The objective of this work was to develop representative models of the key tasks performed by the air traffic workforce. Our analysis focuses on tasks that occur most frequently and have a direct impact on operational performance. As a result, tasks such as On-the-Job Training

Instruction (OJTI) and other primarily administrative activities have been excluded from this analysis. The tasks for each position are listed in 0. Key tasks identified are a combination of tasks derived from the FAA's job task analysis (JTA) [6] [7], Raytheon's JTA [8], and additional tasks MITRE CAASD discovered through facility observations, to capture in CTAs for this work.

MITRE CAASD developed CTAs for the following ARTCC positions:

1. **Radar (R) Controller Position / Radar Associate (RA) Controller Position (R/RA)** – The R controller is the primary controller responsible for directly communicating with pilots and managing aircraft separation using radar data. The RA works alongside the R to provide support and manage tasks that enhance the Radar controller's ability to focus on direct communication and aircraft separation. These positions work together to ensure the safe and efficient movement of aircraft within controlled airspace. Their collaboration is essential for maintaining situational awareness and handling the high workload associated with busy airspace.
2. **The Traffic Management Unit (TMU) (TMC and STMC)** – Working as a team, these positions are responsible for directing traffic flows, implementing Traffic Management Initiatives (TMIs), and coordinating with the Air Traffic Control System Command Center (ATCSCC) to ensure safe and orderly movement of air traffic.
3. **Operations Supervisor Position (OS)** – This position is responsible for overseeing air traffic operations within a specific area or sector, ensuring safety, efficiency, and compliance with FAA policies and procedures. This role is critical in managing complex airspace environments, handling emergencies, and ensuring compliance with FAA regulations.
4. **Oceanic Controller Position** – This position plays a specialized role in managing air traffic over oceanic airspace, which often lacks the radar coverage and direct communication capabilities found in domestic airspace. Oceanic controllers must rely heavily on pilot reports, advanced technologies, and careful planning to ensure safety and efficiency. Additionally, oceanic operations often involve international coordination, requiring controllers to work closely with foreign ATC facilities.

2.2 Facility Data Collection

As previously described, MITRE CAASD developed initial CTAs prior to conducting activities at the ARTCC facilities. We achieved the following goals with the facility data collection:

1. Observed operations and identified and captured additional key tasks and verified initial task flows.
2. Conducted guided discussions and documented underlying cognitive processors, decisions, and considerations the air traffic workforce is making that cannot be observed.

Between April and May of 2025, observation teams of two MITRE CAASD HF engineers, two MITRE CAASD ATC SMEs, and the designated NATCA Article 114 representative collected data at three different facilities (ZSE, ZMA, and ZOA) for three consecutive days each. The teams observed operations and tasks performed by R and RA controllers, OS, and personnel within the TMU to include the STMC and TMC among the three different facilities. Specific to ZOA, we observed their Oceanic operations area and established CTAs for that position and identified tasks we had not previously captured. Additionally, at ZMA, we observed space operations and collected data that we could not capture at the other two facilities (e.g., coordination activities, data entry, activating hazard and Debris Response Areas [DRAs]).

The observations were carried out using a mixture of over-the-shoulder observations and listening to the position audio via a headset. The MITRE CAASD HF engineer documented what the air traffic personnel were doing and the MITRE CAASD ATC SME assisted with explaining what task was being performed at the time. Between MITRE CAASD ATC SMEs, the NATCA Representative, and facility area representatives assigned to assist us at each facility, MITRE CAASD HF engineers were able to collect task flow data on a wide range of tasks across ARTCC positions. Our task recording began at the point when ATC personnel received the position relief briefing. Activities or tasks that occurred prior to this step were not included in our analysis. Overall, MITRE CAASD observed approximately 60 hours of ARTCC operations across the three facilities. In addition to this, MITRE CAASD also led guided discussions with the area representatives each facility identified to support this activity. These took the form of drilling down into what considerations go into different decisions, as well as getting feedback to document how certain tasks may be prioritized or shared across positions. Additionally, to the extent possible, we also gathered feedback from the ATC personnel working at each facility.

2.3 Facility Data Collection Insights

Our observations at the ARTCCs visited during data collection underscore the complex interplay of attention, vigilance, communication, and perceptual skills (e.g., auditory, visual, etc.) required across all ARTCC positions. Coupled with that, the guided discussions enabled us to capture detailed documentation of the cognitive processes employed by controllers, TMCs, and supervisors that are not always visible. Whether a radar controller or supervisor, much of the mental load consists of reviewing information from various sources to make decisions. This entails committing these bits of information to working memory and it enables ATC personnel to maintain an updated mental model - what controllers call “the picture” or “flick” - as well as aids in decision making and problem solving [9]. Though the explanation above provides a simple view of the cognitive demands of ATC personnel, the examples below highlight the true complexity and depth of these mental processes in action.

Radar Controller

During observations of radar controllers, the importance of maintaining situation awareness was clearly highlighted as controllers continuously monitored several screens, flight strips (when applicable), and communication channels [10]. This requires them to scan and prioritize information in real-time, focusing on the most relevant aircraft and priority situations while remaining alert to new developments from pilots and other controllers. Scanning may be goal driven (i.e., "top-down"), or "bottom-up" as when attention is captured by an alert [11].

One controller was observed managing a sector with multiple transmitters on a single voice frequency, requiring careful selection to ensure pilots received transmissions despite terrain-induced signal blockages. This example illustrates the intricate visual and auditory perception skills required, as well as the need for vigilance to avoid miscommunication that could compromise safety [12] [13]. Other observations showed the wide-ranging use of tools available to the controller to help maintain situation awareness and assess the operation, as well as, for use as memory aids to complement their scan. For example, controllers were observed using Distance Reference Indicators, which places a static ring around the aircraft and are commonly referred to as J-rings, as a visual reminder of potential proximity issues with other aircraft. Similarly, it was discovered during guided discussion that route and vector lines were frequently used to assess potential conflicts and maintain a general picture of the situation. These tools exemplify cognitive offloading and external cognition—strategies that reduce working memory demands and support prospective memory for anticipated separations or conflicts [14] [15].

OS

Observations also highlighted the unique role of ARTCC OSs and the cognitive challenges they face. Their first and primary duty is to provide operational safety oversight of the operations. In addition to his duty, they must be able to manage and prioritize administrative functions in conjunction with monitoring operational safety. For example, they must anticipate traffic fluctuations by synthesizing information from multiple sources and make proactive decisions about when to combine or split sectors, all while balancing staff availability, break schedules, training needs, and unexpected changes to staffing levels. Such activity reflects advanced situation awareness—particularly projection to future states—as well as the application of rule- and knowledge-based reasoning to adapt to changing conditions [10] [16].

For instance, we observed a supervisor monitoring the Traffic Situation Display (TSD) presented on a large screen in the area that visually represented traffic flows to specific arrivals indicated by color. The supervisor also looked at the NAS Monitor to further inform their assessment of sector workload as it shows predicted capacity levels for the sector. Through guided discussions, we were informed that the NAS Monitor does not account for traffic managed using Visual Flight Rules (VFR), prompting the OS to also review radar scopes directly to update their situation awareness and ensure a comprehensive understanding of all aircraft in the sector.

On one occasion, the supervisor identified a potential imbalance in arrival sequences and controller workload. Illustrating team communication, they promptly contacted the TMU to reroute certain aircraft, demonstrating real-time decision-making to optimize both traffic flow and controller workload. These actions reflect team situation awareness and the use of shared mental models to coordinate effectively across roles [17]. Further guided discussions revealed that the OS was also monitoring the frequencies of the controllers working to gauge communication intensity—recognizing that increased, complex transmissions indicate higher workload. Supervisors consider not only quantitative factors but also qualitative cues such as controller posture and historical performance.

In another example, we observed the OS determine that a sector would, in time, get busy and need to be split. The OS utilized the Traffic Organization Resource Tool (Cru-X/ART) and determined that a radar controller was due to come back from their break before the predicted traffic and inferred increase in workload would come to fruition. As the surge approached, even though the controller was due to arrive at the sector, the supervisor took extra precautions and used an intercom to call to make sure the controller would return from their break on time to split the sector before the surge. Doing so, the OS ensured seamless coverage and workload distribution. This process involved forward-thinking, rapid assessment, and the ability to integrate multiple variables—demonstrating the unique mental agility required in supervisory roles and the projection component of situation awareness [10].

TMC

Through this research MITRE CAASD identified operational tasks at the facility that lacked existing documentation, with space launches serving as a prime example. As space launches are a relatively new operational event, they are not yet included in published CTAs, JTAs, or similar guidance. Accordingly, documenting space launch procedures was a high priority during facility observations. One such space launch event did occur, which MITRE CAASD was able to watch in the TMU and on the floor. Leading up to the launch, MITRE CAASD observed the TMC gathering and distributing essential materials (e.g., latitudes and longitudes of hazard areas, times, routes, etc.), entering hazard areas into En Route Automation Modernization (ERAM), and participating in a hot line communication[2]. As the event proceeded, MITRE CAASD observed the TMC communicating launch status to the rest of the TMU for their awareness as well as the OSs while monitoring the launch live via YouTube. The OSs used the space launch status to assess sector opening and closing requirements, then conveyed observed or anticipated traffic impacts to the TMU. Finally, as the event concluded, the TMC communicated with necessary areas to coordinate the end of any associated Traffic Management Initiatives (TMIs). At various points throughout the launch, observers were able to query the TMC about decision making criteria and high workload subtasks. These activities demonstrate sensemaking under novel conditions, team situation awareness and shared mental models to achieve coordinated action, and the use of external artifacts to support memory and attention across distributed systems [17] [18]].

Oceanic

During observations in the oceanic area at ZOA, the team identified operational and cognitive differences between ATOP-supported oceanic operations and ERAM-supported domestic operations that warranted a dedicated cognitive task analysis for these tasks. This distinction was evident by the markedly different workstation – the ATOP workstation equips the controllers

[2] A hot line is a dedicated, open phone line that allows individuals at different facilities to communicate and coordinate in real time. Although, hot line communications are typically scheduled for special events like space launches, military operations, VIP movements, etc.

with dual large flat panel displays, a conventional mouse, and a full-size keyboard. Operationally, differences were evident in the controllers' procedural control-by-exception approach, sustained attention to sector queue lists and conflict alerts within ATOP, and work under non-radar, delayed-communication conditions (i.e., High Frequency Radio [HF]/ Controller Pilot Data Link [CPDLC]). Notable observations include consistent use of range bearing lines and visual reminders (e.g., routes and windows left open) to maintain "the picture," request of HF full position reports when Automatic Dependent Surveillance-Contract (ADS-C) was missing, and searching for acceptable altitudes when ATOP's suggestions were not preferred. These practices reflect situation awareness, cognitive offloading, and vigilance consistent with the other ATC domains discussed in previous paragraphs.

An example that represents a common ATOP task is updating and reconciling flight plans when information is incomplete or changing. In one observation, controllers resolved missing route details (initially only coordinate pairs) by retrieving and copying plans from the error queue, verifying active airspace, and issuing reroutes that did not tie to the original route-then manually integrating the new path to the downstream entry point. Refueling operations added similar workload, with controllers typing details for a second aircraft and incorporating revisions when initial submissions were incorrect. Throughout, they monitored sector, operational, and error queue lists, and coordinated with the pilot via HF/CPDLC as needed.

Data Analysis and Aggregation into CTA Revisions

After the facility visits, the team aggregated observation and guided discussion data to determine CTA knowledge representation changes. The team then updated the CTAs based on what was learned from the facility visits and once again incorporated MITRE CAASD ATC SME feedback on changes made. Once a final revision of the CTAs was agreed upon, MITRE CAASD held debrief sessions with each facility, the FAA, and the designated NATCA Article 114 representative to closeout the activities by summarizing our observations, discussing how some tasks were represented, and outlining how the FAA intends to use this information, moving forward. The final knowledge representations of the CTAs are provided as a restricted access webpage, which can be found at https://cre.mitre.org/atm-cta. This program enables the CTAs to be searchable and interactive, making it easy to identify tasks and systems associated with tasks, and establishing an interface to easily update, find, and replace ARTCC ATC tasks and task elements in the future.

MITRE CAASD will facilitate the onboarding of users (i.e., the FAA and identified stakeholders) to the webpage hosting the CTA knowledge representations. This will be accomplished through an interactive demonstration of select CTA models, designed to familiarize users with the information format and provide guidance on accessing the models. MITRE CAASD will address any technical inquiries and remain available post-delivery to offer critical support as requested by the FAA. In addition to hosting the models and related findings, MITRE CAASD will provide the FAA sponsor with direct access to Mermaid charts, Cogulator models, and the software code for the interactive site via Box cloud-based content management service.

3 Cognitive Task Analysis Breakdown

CTAs require breaking down complex mental processes and knowledge required to perform a task. This type of analysis goes beyond simply listing observable actions; it delves into the decision-making processes, interactions with automation, and cognitive demands necessary to manage air traffic effectively. To represent ARTCC tasking, decision-making, and automation interaction, MITRE CAASD developed a multi-level CTA: a higher level which uses flowcharts to list subtasks, their order, and important decision-making points and a lower level where decision making criteria, automation interaction, and communication/coordination is described using the Goals, Operators, Methods, and Selection Rules (GOMS) human performance modeling language.

Levels of Analysis

To understand what qualifies, for the purposes of this analysis, as higher and lower-level task analysis, it is useful to consider the controller's tasking temporally using Newell's Time Scale of Human Action [19]. According to Newell, the higher-level task analysis described here is at the "Unit-Task" level. These are tasks that take a few seconds to a few minutes to complete. These higher-level Unit-Tasks map well to the common duties of an air traffic controller. For example, resolving a conflict, accepting handoffs, or performing a position relief briefing. In FAA JTAs [7]**,** these are called controller sub-activities and for consistency, MITRE CAASD adopts the same terminology.

Our lower-level task analyses require breaking down what FAA JTA's term "Tasks". Tasks are the building blocks of a Sub-Activity. On the Time Scale of Human Action, these Tasks can be described at the "Operations" or "Deliberate Acts" levels which take anywhere from 50 milliseconds to a few seconds to complete. Using conflict resolution as an example Sub-Activity, a Task would be to optionally use the Conflict Probe to evaluate potential resolution.

Analysis Tools

The Sub-Activity analysis orders the JTA Tasks and makes clear the important decision-making points and overall cognitive process. This is a type of hierarchical task analysis [20] and, in this analysis, takes the form of flowcharts. In the flowchart, each node represents a Task in the Sub-Activity and branching indicates key decision points. All flow charts were generated using Mermaid.js [21]: an open-source, JavaScript tool that enables the generation of diagrams and flowcharts from text-based definitions. This approach facilitates version control, collaboration, and rapid diagram creation without the need for graphical user interfaces or specialized drawing software. It also enables the flowcharts to be deployed as an interactive element on a web page.

To describe Tasks at the "Operations" or "Deliberate Acts" level, GOMS was used. GOMS is a family of cognitive models used in Human-Computer Interaction (HCI) to describe, predict and analyze expert user performance with interactive systems. Developed by [22], GOMS models decompose user tasks into a hierarchy of: Goals (what the user wants to achieve), Operators (elementary perceptual, cognitive, or motor actions), Methods (sequences of operators and sub-goals to achieve a goal), and Selection Rules (rules for choosing among multiple methods for a goal). For this analysis, GOMS was a formal method used for describing decision-making criteria and automation interaction for each Task rather than for task time prediction. Selection Rules were not employed, as key decision-making points are captured in the higher-level flowcharts. All Task models were constructed using Cogulator [23] which is an open-source, text-based software tool designed to facilitate the creation and evaluation of GOMS models.

CTA Example

To illustrate the CTA process, consider a simplified example of Accepting Handoffs. The JTA would name the sub-activity (Accept Handoffs) and list the tasks that make up the sub-activity:

Accepting Handoffs

- Receive Manual Handoff
- Receive Automated Handoff
- Evaluate Handoff
- Coordinate Handoff
- Reject Handoff
- Accept Handoff

Note that the Tasks are not listed in order, and not all Tasks will be completed each time the Sub-Activity is executed. The flowchart imposes order on the Task listing and clearly indicates decision points, as shown in Figure 3-1.

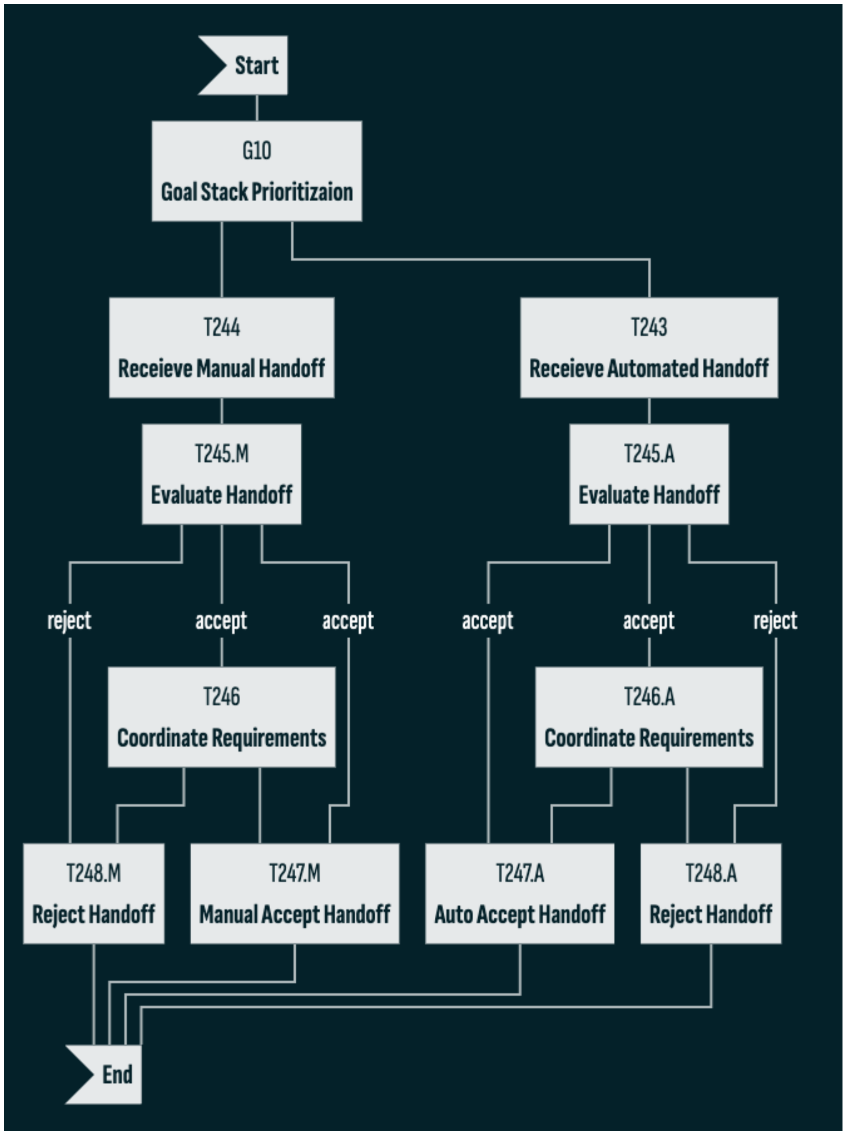

Figure 3-1. Flowchart for "Accepting Handoffs" Sub-Activity

While the flowchart provides a good overview of the task process, it does not offer insight into how a controller arrives at a decision or what decision support tools are used. Therefore, each node on the flowchart is linked to a GOMS model. For example, Figure 3-2 reflects the GOMS model for the "Evaluate Handoff" task node (T245.M), shown in Figure 3-1. This model describes the factors considered by the controller in evaluating a handoff for acceptance (e.g., current workload, weather, active TMIs, the validity of the aircraft's flight plan). The tools used by the controller are also indicated (e.g., ERAM Traffic Display and En Route Decision Support Tool [EDST] aircraft list). Note that if you were to run this model in Cogulator, it would provide an inaccurate time estimate. As stated earlier, the modeling effort focused on clarifying the decision-making process rather than producing accurate task times. As a result, controller cognitive processes are often overrepresented in the models, prioritizing detailed task descriptions over precise task time estimates.

```
Goal Evaluate Handoff

*Evaluate sector state to gather information required to to determine data that apply to the handoff
. Goal Evaluate Sector State
. . Recall [Current_Workload] to [Establish_Awareness]
. . Cognitive_processor verify workload allows acceptance of aircraft
. . Recall [Current_TMIs] to [Establish_Awareness]
. . Cognitive_processor verify TMIs to apply to flight
. . Recall [Current_Wx] to [Establish_Awareness]
. . Cognitive_processor verify wx does not prevent acceptance

* Search for any conflicts that might impact the handoff
. Goal Evaluate Conflicts
. . Search for conflicting aircraft on [ERAM_TD] to [Establish_Awareness]
. . Cognitive_processor verify workload allows acceptance of aircraft

* Review the flight plan
. Goal Review Flight Plan
. . Search for target in [EDST_ACL] to [Establish_Awareness]
. . Read KMIA.   TYBEE.   KSAV
. . Cognitive_processor Verify aircraft state in line with flight plan

* Think of any requirements for sector entry that would apply to the flight
. Goal Requirements
. . Think [Sector_Requirements] to [Establish_Awareness]
. . Cognitive_processor final determination accept or reject
```

Figure 3-2. Cognitive Model for "Evaluate Handoff" (T245.M) Task Node

3.1 Example CTAs

In this section, we break down how the observation and guided discussion data is represented in the CTA knowledge representations.

OS Example: Manage Position Workload

Recall from Section 2.2 that we observed the OS executing a sector split to effectively manage position workload.

Figure 3-3 illustrates the workflow for this task, highlighting the range of decisions available to the OS for balancing the workload among radar controllers. These decisions include combining/splitting a sector, managing flows, assigning controllers to specific positions (R or RA), assigning training, or opting to maintain the current configuration.

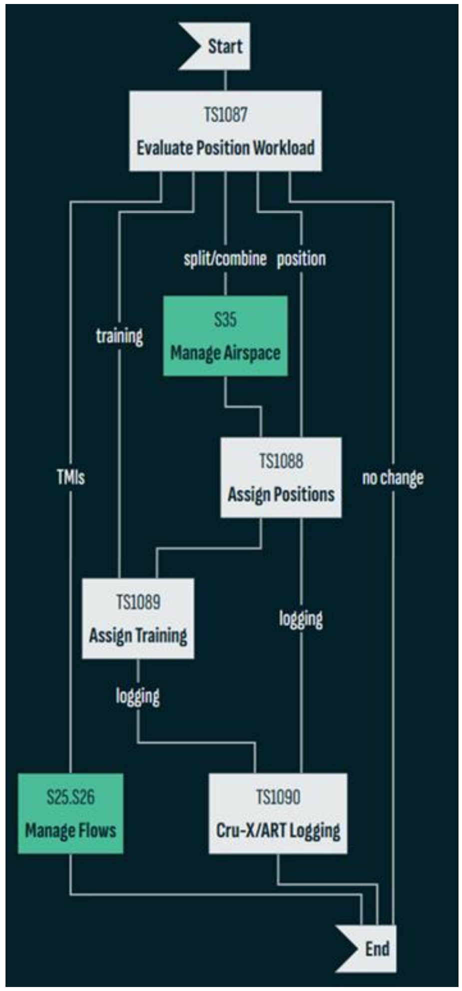

Figure 3-3. Task Flow Diagram for "Manage Position Workload" Sub-Activity

Our observations identified the crew scheduler as a key resource the OS uses to aid in their assessment about position workload and the following actions. By reviewing staff schedules, the OS can quickly determine who is currently on position, who is on break, and who may be in training, among other staffing details. As illustrated in Figure 3-4, the model shows the OS gathering this information to evaluate whether operational adjustments are needed.

Additionally, the model incorporates insights gained from guided discussions, such as controller disposition and work history, which are considered alongside staffing data. This information is retained in working memory and integrated with airspace status and current and projected capacity, providing a comprehensive foundation for OS decision-making.

```
Goal Evaluate Workload
. Goal Monitor Time on Position
. . Interact with [CruXArt] to [Enhance_Awareness] of current time on position.
. . Cognitive_processor update [Current_Workload] for [Decision_Making] on position staffing
. Goal Determine If Staffing Change Necessary
. . Recall [Current_Wx/Current_TMIs/Current_Demand] for [Decision_Making] *information used to make these decisions gathered in previous tasks and used to update mental models
. . Think whether staffing changes are necessary given need to split/combine airspace, current time on position, familiarity with the controller skills and disposition and
[Current_Wx/Current_TMIs/Current_Demand] for [Decision_Making]
. . Cognitive_processor verify staffing available to split position
. . Cognitive_processor verify position staffing changes
```

Figure 3-4. Cognitive Model for "Evaluate Position Workload" (TS1082) Task Node

Within the "Manage Airspace" task node (T35), the diagram in Figure 3-5 illustrates how the OS either identifies an airspace need or receives a request for one prior to determining an appropriate plan of action.

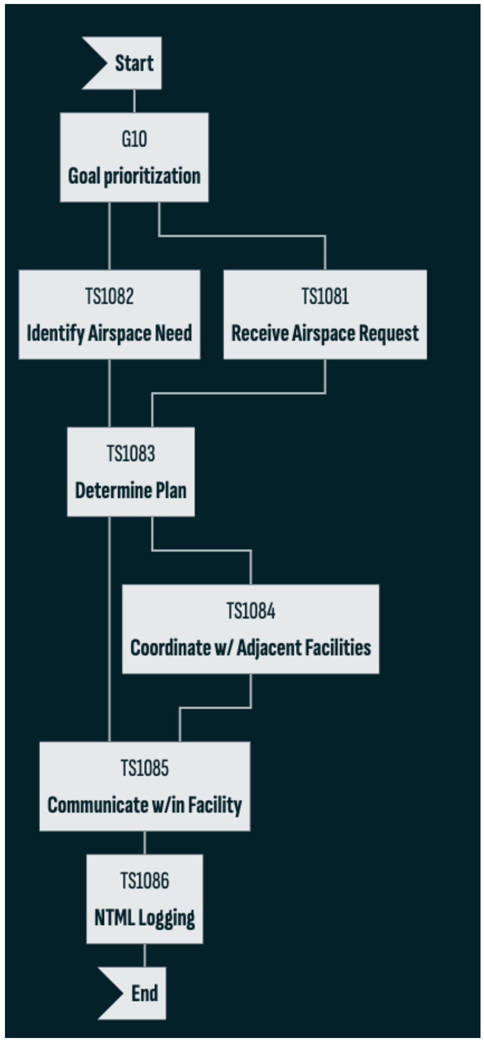

Figure 3-5. Task Flow Diagram for "Manage Airspace" Sub-Activity

Examining the cognitive model for the "Identify Airspace Need" task node (TS1082) in Figure 3-6 capture how, as we observed, information from various traffic displays and maps support this decision-making process. The model demonstrates the controller's analysis and retention of relevant information, which informs their strategies for managing the airspace and balancing position workload.

Goal Identify Airspace Need
. Search [ERAM_TD] to [Establish_Awareness] of an airspace need
. Search [MAP] to [Establish_Awareness] of an airspace need
. Search[TFMS_TD] to [Establish_Awareness] of an airspace need
. Think current conditions warrant a reconfiguration
. Store <need>

Figure 3-6. Cognitive Model for "Identify Airspace Need" (TS1082) Task Node

Radar Controller Example: Determine Appropriate Transmitter

As previously discussed, our observations revealed that radar controllers operating in mountainous regions sometimes need to select among multiple transmitters to ensure effective communication. Note that while this was the case for our observations, it was discovered through guided discussions that this scenario can exist in other facilities due to a large geographical area covered by one sector. In response to these findings, we enhanced the "Establishing Radio Comms" task (T25) by incorporating a dedicated node that specifically highlights the decision-making process ARTCC controllers undertake when choosing a transmitter. This addition is illustrated in Figure 3-7.

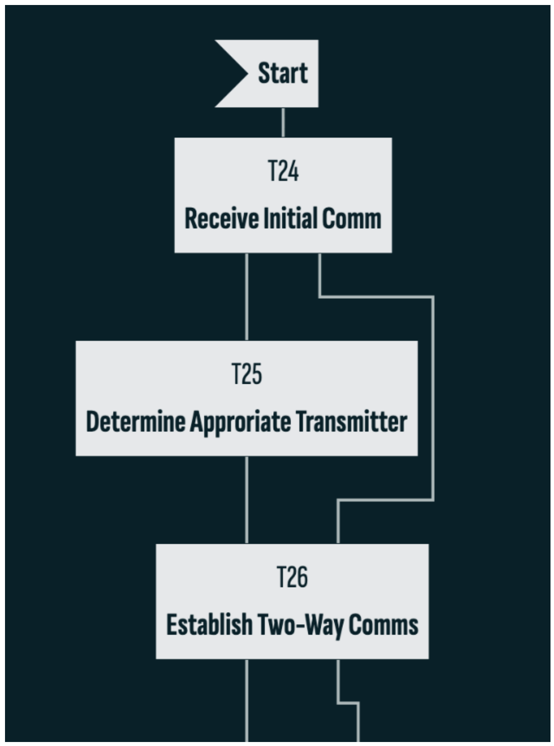

Figure 3-7. Task Flow Diagram for "Establishing Radio Communications" Sub-Activity

Between receiving the initial communication and establishing two-way communications with the pilot, controllers may need to determine the appropriate transmitter to use to ensure optimal signal quality. When the T25 node is selected, the cognitive model representing this decision-making process is displayed on the screen, as shown in Figure 3-8.

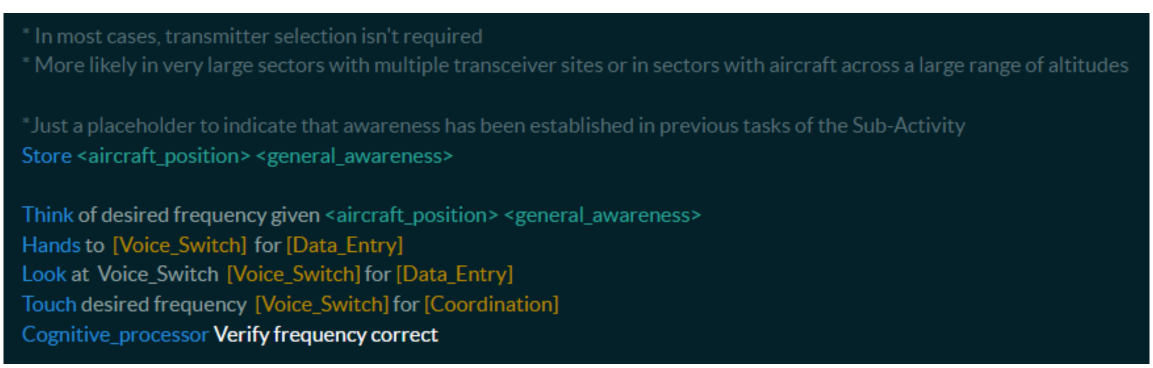

Figure 3-8. Cognitive Model for "Determine Appropriate Transmitter" (T25) Task Node

In most situations, controllers don't have to perform this additional step. However, when it becomes necessary, controllers first assess the aircraft's location and retain this information in working memory. They then evaluate which transmitter frequency is most suitable for the situation. After making their selection, the controller uses the voice switch to activate the chosen frequency and mentally confirms that it is correct. While this decision-making process is typically completed quickly, it does contribute to the overall cognitive workload of the controller. The mental demand is the aspect we wish to emphasize.

TMC Example: Manage Space Ops

Figure 3-9 captures the previously discussed TMC workflow for managing space operations, including coordination activities, data entry, hazard and DRA activations, as well as spin down of TMIs used during the launch.

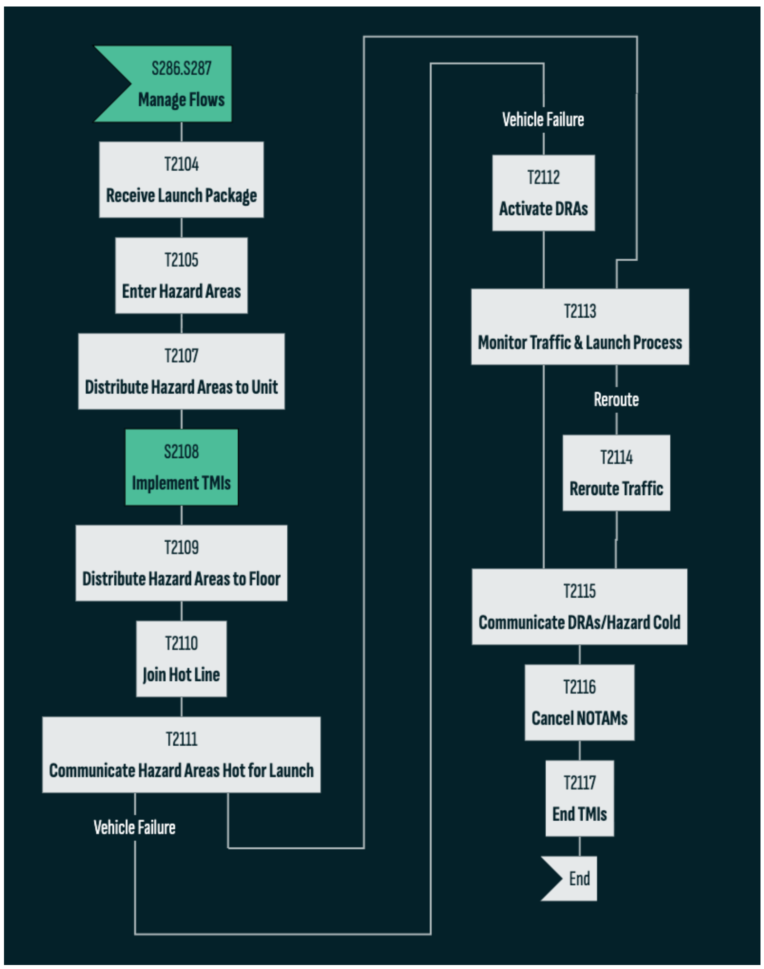

Figure 3-9. Task Flow Diagram for "Manage Space Ops" Sub-Activity

Observations and guided discussions revealed that the TMC is responsible for entering hazard area and DRA boundaries into ERAM using the Plan View Display (PVD)-Draw functionality. Figure 3-10 demonstrates how these actions are represented in the cognitive models. For example, the TMC uses a printout of the launch package to read aloud critical details and enters hazard area information—such as longitude, latitude, and start time—into the ERAM system. Figure 3-9, illustrates how hazard area information is subsequently distributed, highlighting the coordination and activities that follow.

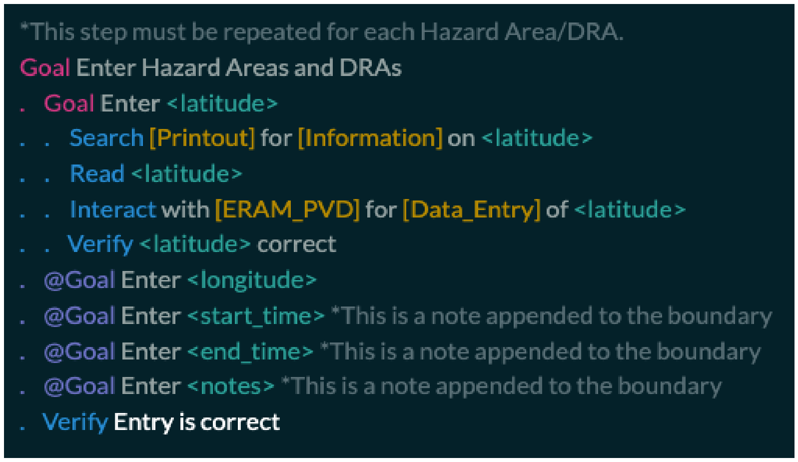

Figure 3-10. Cognitive Model for "Enter Hazard Area" (T2105) Task Node

Oceanic Controller Example: Update Flight Plans

Our observations found that Oceanic controllers regularly evaluate and coordinate changes to flight plans as part of routine operations over oceanic airspace, where unique separation standards and procedural requirements apply. Figure 3-11 illustrates the workflow for Oceanic controllers updating a flight plan.

When an ATOP controller detects that a flight's route is incomplete, an abbreviated plan, or that a weather-driven or airline-requested deviation will affect the next FIR, the controller initiates a flight-plan update. The controller first verifies the need (e.g., a profile update that moves the coordination-fix ETA beyond the maximum allowable deviation, triggering a sector-queue warning). After confirming the change meets separation and operational limits, the controller coordinates with the downstream facility (or the upstream facility for inbound changes), edits the flight plan in the coordination window, and the system automatically propagates the revised route, altitude, and speed to the pilot via CPDLC or voice clearance (via ARINC HF).

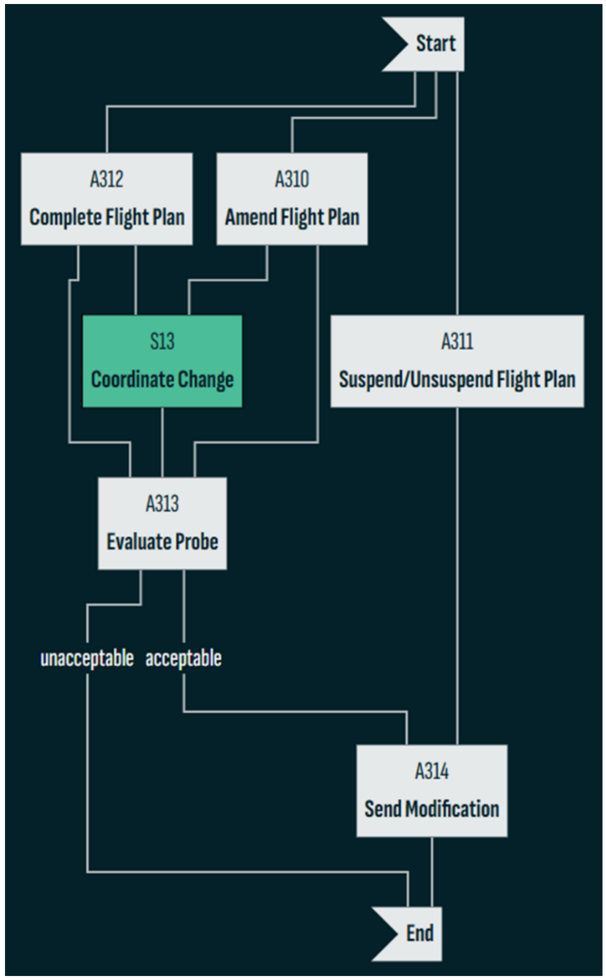

Figure 3-11. Task Flow Diagram for "Update Flight Plans" Sub-Activity

At the cognitive level, the model depicted in Figure 3-12 for the "Amend Flight Plan" task node, captures the Oceanic controller's interaction, searching and entering information into a system to accomplish this task.

```
*Update or correct flight plan data in the FPEA window to reflect current operational needs.
Goal Amend Flight Plan Information
. Search for aircraft in [Flight_Strip_Window] for [Data_Entry]
. Select aircraft -> amend in [Flight_Strip_Window] for [Data_Entry]
. Look at [FPEA_Window] for [Data_Entry]
. Interact with [FPEA_Window] for [Data_Entry] to enter amendments (e.  g.  , speed, altitude, time over fix, hold, etc)
. Cognitive_processor [FPEA_Window] to [Verify_Data] entered correctly
* At this point, amendment is ready to be probed, which occurs in the next step
```

Figure 3-12. Cognitive Model for "Amend Flight Plan (A310) Task Node

4 Lessons Learned

Throughout the course of this research, MITRE CAASD identified several key lessons that can inform and enhance future iterations of this work. Some insights are listed below:

Unique operational characteristics for oceanic areas

The Oceanic area, its operations, and the way controllers execute their tasks using the ATOP system differ significantly from those in radar. Observing these distinctions highlighted the necessity of developing dedicated CTA models specifically tailored to the unique demands of oceanic operations and procedures. Unlike R/RA positions, where goals and tasks are well-documented and researched, oceanic procedures lack that same level of comprehensive analysis. As a result, MITRE CAASD was required to build these CTAs from the ground up, without the benefit of existing JTAs or prior foundational work.

Complexity of STMC and Operations Supervisor (OS) roles

From the beginning it was clear that defining discrete tasks for STMC and OS positions would be more challenging compared to radar positions. Unlike radar tasks, which are more tactical and procedural, STMC and OS positions involve a higher degree of strategic decision-making and situation awareness that assesses the current information, including system-provided predictions, to develop their own prediction about how certain events can be managed to lessen the impacts to the operation. For example, personnel in the supervisor roles rely on a combination of forward thinking, rapid assessment, and the ability to integrate multiple variables from various sources (e.g., system data, tone of voice, seating posture, and historical context of the controller), and creative problem-solving to ensure airspace safety and manageability. These nuanced and dynamic factors make task delineation for these positions inherently complex.

Value of guided discussions with controllers

Facility observations were incredibly valuable but guided discussions with controllers, TMCs, and supervisors were perhaps more important to understanding decision making processes that cannot be observed directly. It was through these discussions that MITRE CAASD was able to capture nuanced feedback to inform and refine the cognitive models. Given the complexity of air traffic control tasks, which include both observable and non-observable elements, these conversations were instrumental in bridging the gap between engineering perspectives and the realities of day-to-day ATC operations.

5 Recommendations

Recommendation for expanding CTA methodology to TRACON and ATCT facilities

Building on the success of the holistic CTA approach at ARTCCs, MITRE CAASD recommends that the FAA extend this methodology to key workforce positions within TRACON and ATCT facilities. The established process to develop representative CTAs—collaborating with SMEs to identify key positions and tasks, developing initial knowledge representations through discussions and process tracing, and validating models via targeted facility observations and guided discussions—has proven effective in capturing both observable actions and underlying cognitive processes.

Applying this method will enable the development of representative CTA models for key TRACON and ATCT positions such as Arrival Feeder, Final Approach, Departure, Local Control, Ground Control, Clearance Delivery, and supervisory roles. It will provide the FAA with a comprehensive understanding of the cognitive demands, decisions, and workflows unique to these environments, which often differ from those found in ARTCCs due to factors like airport and airspace complexity, applicable separation rules and procedures, availability of different technologies and information, and dynamic weather conditions. This broader perspective will enable the FAA to extend the benefit of this work (i.e., identify cognitive performance bottlenecks, anticipate human factors risks, optimize individual and team performance, etc.) to additional segments of the air traffic workforce.

Recommendation for further research on model applicability across ARTCC facilities

The representative cognitive and task models developed from three distinct ARTCC facilities provide a strong foundation for understanding the cognitive drivers and operational practices common to ARTCC personnel. These models were intentionally designed to be facility-agnostic, capturing core processes and decision-making factors that are broadly relevant across the ARTCC environment. During the development process, we observed both significant commonalities and meaningful variations in operational practices and decision-making across facilities. These findings highlight the value of the current models while also underscoring the importance of further research to fully characterize the diversity present within the NAS.

To build on this foundation, MITRE CAASD recommends that the FAA consider two complementary approaches for future research. First, expanding data collection to additional ARTCC facilities using the established methodology would enable further validation and refinement of the models, ensuring their applicability across a wider range of operational contexts. Second, targeted simulation of specific operational scenarios in a controlled lab environment could provide deeper insights into decision-making and actions in response to infrequent or complex events that are difficult to observe in the field.

By pursuing these approaches, the FAA can determine whether the current models are universally applicable or if distinct facility types would benefit from tailored models. This research will strengthen the models' robustness and adaptability, supporting more precise assessments and operational improvements across the NAS.

Recommendation for focused research on Supervisor positions

For this effort, MITRE CAASD intentionally scoped supervisor tasks to emphasize those with direct operational impact, aligning with the project's goal of identifying inefficiencies, pain points, and opportunities for improvement in position Standard Operating Procedures (SOPs), systems, and technologies. By concentrating on operational drivers—such as information use, decision-making processes, and cognitive integration—the research provides actionable insights into areas where operational solutions can be most effectively implemented.

While administrative responsibilities were not included in the primary scope, MITRE CAASD recognizes that these tasks may influence operational effectiveness indirectly. If future research pivots toward understanding overall workload or informing staffing decisions, expanding the scope to include administrative tasks could be valuable.

6 Summary and Next Steps

MITRE CAASD completed CTAs for six ARTCC positions: R, RA, OS, TMU (that includes the STMC and TMC), and Oceanic controller. Leveraging system and operational expertise, MITRE CAASD completed data collection through real-time operational observations and guided discussions with air traffic personnel at three ARTCC facilities. As a result, MITRE CAASD developed CTAs for a total of 633 tasks across these roles, including 368 tasks for R/RA controller positions, 77 tasks for the OS position, 54 tasks for TMU positions, and 134 tasks for the Oceanic controller position.

As an immediate next step, MITRE CAASD will format the task flow diagrams for each CTA so that it can be read by the Improved Performance Research Integration Tool (IMPRINT) modeling tool [24] as requested by the FAA. MITRE CAASD has already gained access to IMPRINT and will use IMPRINT directly to input the task diagram information into the tool for FAA use. As the FAA already has some task models defined within IMPRINT, MITRE CAASD and the FAA agreed that where models already exist, MITRE CAASD will update those models based on the more recent information gathered through this recent analysis and input any new task models directly into IMPRINT.

6.1 CTA for Terminal Radar Approach Control (TRACON) and Airport Traffic Control Towers (ATCT) Facilities

As laid out in the CTA Plan document, the FAA has expressed their intent for MITRE CAASD to conduct CTAs, in collaboration with the FAA and NATCA, for TRACON and ATCT facilities using the same approach employed for ARTCC data collection. Doing so will provide a more complete representation of ATM operational position task flows. These envisioned steps are as follows:

1. Collaborate with SMEs to scope CTA in terms of operator positions and tasks.
2. Conduct discussions and process tracing with MITRE CAASD ATC SMEs to create initial knowledge representations.
3. Conduct facility visits to validate initial knowledge representations:
    a. Identify facilities to visit.
    b. Define target observations and guided discussion topics.
4. Update CTA knowledge representations based on facility data collection observation findings.

As we begin planning next steps, the following are some early thoughts toward CTA research for TRACON and ATCT facilities. MITRE CAASD once again will aim to identify a few facilities that provide a representative array of operational characteristics. Our initial list of operational characteristics for TRACON and ATCT facilities are listed in Table 6-1.

Table 6-1. Positions and Desired Operational Characteristics for TRACON and ATCT Facilities

TRACON Positions	Diverse Operational Characteristics of Interest for TRACON

• Arrival Feeder
• Final Approach
• Satellite
• Departure
• Flight Data/Clearnce Delivery
• Operations Supervisor/CIC
• TMU
  ○ TMC
  ○ STMC/CIC
• Tracker/assist positions
	• Identified staffing challenges
	• Combines and splits sector positions
	• Manages small, medium and large airports
	• Includes SAA, New Entrants, or Space Operations
	• Multiple areas contained in one facility
	• Includes verbal and electronic communications
	• Includes mountainous terrain
	• Includes non-radar airspace
	• Has dynamic weather conditions
	• Flying schools
	• Has a TMU
	• Combined tower and TRACONs
	• Located adjacent to an ANSP

ATCT Positions	**Diverse Operational Characteristics of Interest for ATCT**

• Local Control (LC)
• Helicopter Control
• Ground Control (GC)
• Clearance Delivery (CD)
• Flight Data (FD)
• Operations Supervisor/CIC
• TMU
  ○ TMC
  ○ STMC/CIC
• Assist positions (e.g. Local Assist)
	• Identified Staffing Challenges
	• Combines and splits sector positions
	• Small, medium, and large airports
	• Paper and Electronic Flight Strips
	• Multiple airport runway configurations
	• Arrival and departures utilizing a single runway
	• Blind spots
	• Includes SAA, New Entrants, or Space Operations
	• Includes verbal and electronic communications
	• Combined tower and TRACONs for certifications
	• Includes mountainous terrain
	• Flying schools
	• Has dynamic weather conditions
	• Has a TMU

From these characteristics, MITRE CAASD will identify a short list of facilities and coordinate with our FAA sponsor and NATCA Article 114 representative to select and obtain concurrence on the facilities in which to collect data for this work.

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Appendix A Sub-Tasks Modeled by ARTCC Positions

Table A-1. Radar & Radar Associate Sub-Activities and Tasks

56 Sub-activities (bolded)

368 Tasks

S0	**Maintain Safe & Efficient Flow of Traffic**			
S1	**Assuming position responsibility**			
		T1	Review system status information areas to gain situation awareness	
		T2	Consider current and projected traffic/weather/workload	
		T3	Receive briefing from controller being relieved	
		T4	Review briefing checklist	
		T5	Determine if ready to accept position responsibility	
		T6	Log into designated display/workstation in controller role	
		T7	Adjust workstation parameters and display to personal preference	
S0.Scan	**Scanning Areas**			
		S0.Scan.Sys	**Scan equipment and automation status**	
			T17	Monitor equipment and automation system status
			T353	Detect degradation or failure
		S0.Scan.Wx	**Scan weather information**	
			T267	Review graphical weather information
			T268	Review text-based weather information
			T273.P	Controller prompted to acquire weather information
			T17	Monitor equipment and automation system status
		S0.Scan.Brdr	**Scan borders for handoffs, pointouts, violations, and airspace**	
			T120.T	Determine in position to terminate radar services
			T72	Observe aircraft entering coverage area
			T134	Observe uncontrolled object/aircraft
			T177	Identify potential or actual airspace violation
			T243	Observe automated handoff request

		T250	Identify need for pointout
		T258	Receive automated pointout request
		T298.O	Observe change in airspace status
		T283	Identify that another controller’s airspace is needed
	S0.Scan.Xflict	**Scan high conflict areas**	
		S13.E	Evaluate radar separation of aircraft
		T154	Identify potential or actual loss of separation
	S0.Scan.Cnfm	**Scan for flows for conformance and required maneuvers**	
		T54	Determine the need for an amendment
		T74	Observe loss of contact
		T145	Observe aircraft nonconformance
		T167	Identify potential or actual unsafe altitude situation
		T206	Observe radar target/data block/strip of arrival aircraft
		S27.E	Evaluate time-based metering of traffic
		T330	Detect an emergency
		T185	Determine need for advisory or alert
S0.Requests	**Receive Requests**		
	T18	Receive information regarding equipment	
	T24	Receive initial radio communication from pilot	
	T24.NR	Receive initial radio communication from pilot	
	T120.R	Receive request to terminate radar services	
	T49	Receive request for flight plan	
	T55	Receive request for flight plan amendment	
	T73	Receive request from pilot to verify aircraft identification	
	T103	Receive notice of special operation	
	T111	Receive request for flight following	
	T122.R	Receive request for help from pilot flying VFR	
	T140	Receive pilot request to deviate	

	T145	Receive notice of aircraft nonconformance	
	T157	Observe aircraft conflict alert indication	
	T168	Detect Minimum Safe Altitude Warning (MSAW) indication	
	T190	Receive request for release of departure aircraft	
	T219	Receive information regarding traffic management initiative	
	T230.A	Receive automation request for transfer of aircraft identification	
	T230.M	Receive manual request for transfer of aircraft identification	
	T244	Manual Handoff Request	
	T259	Receive manual pointout request	
	T273	Controller prompted to acquire additional weather information (verbal)	
	T289	Receive request for temporary use of airspace	
	T298	Receive notice of the change in status of airspace	
	T313	Receive notice to prepare for sector or position reconfiguration	
	T329	Receive notice of emergency	
	T354	Receive notice of degradation or failure	
S0.Prioritization	**Task Prioritization and execution**		
	T0.P	Prioritize Tasks	
	T0.D	Determine next task	
	S5.E	**Establishing radio communications**	
		T25	Determine most appropriate transmitter-receiver site
		T26	Establish two-way radio communications
		T27	Issue altimeter and most current automatic terminal information service (ATIS) information if appropriate
	S5.E.NR	**Establishing VFR radio communications**	
		T24.D	Decide whether to allow entry
		T25	Determine most appropriate transmitter-receiver site
		T26.NR	Establish two-way radio communications
		T26.D	Deny Entry
		T27	Issue altimeter and most current ATIS information if appropriate

S5.T	**Transferring radio communications**		
		T28	Determine frequency in use by receiving sector
		T29	Issue change of frequency to pilot and verify readback
		T29.CPDLC	Issue change of frequency to pilot
		T29.NR	Handle No CPDLC Response
S5.T.NR	**Terminating radar services issuance VFR**		
		T29.NR	Issue services terminated
		T1001	Drop track
S103	**Transmitter Management**		
		T1050	Determine need for transmitter change
		T1051	Determine appropriate transmitter
		T1052	Select appropriate transmitter
S8	**Respond to Flight Plan Request (including Copy Instrument Flight Rules [IFR] Clearance)**		
		T49.A	Amended Request
		T50	Evaluate request for new flight plan or request to pickup new clearance
		T51	Enter flight plan data
		T52	Evaluate flight plan for accuracy
		T53	Issue clearance as appropriate
		T53.D	Deny Request
S9	**Amending flight plan data**		
		T56	Enter flight plan changes NAS
		T57	Review amended flight plan for accuracy
		T58	Update information locally or in the NAS if required
		T59	Coordinate any unsuccessful transmission messages
		T59.D	Deny amendment request
		T59.A	Pilot makes amended request
S11	**Processing departure or en route time information**		
		T69	Enter departure or en route time message

	T70	Receive departure or en route time notices
	T71	Monitor departure or en route time notices
S12	**Establishing and maintaining positive aircraft identification and position**		
	T76	Identify appropriate aircraft identification procedure(s)
	T77	Perform appropriate aircraft identification procedure(s)
	T78	Verify aircraft identification by observing procedure results
	T75	Inform pilot that contact is lost if appropriate
	T76	Identify appropriate aircraft identification procedure(s)
	T77	Perform appropriate aircraft identification procedure(s)
	T78	Verify aircraft identification by observing procedure results
	T79	Inform pilot that contact has been established if appropriate
	T80	Transfer aircraft identification
	T81	Verify aircraft leaving sector
S13.E	**Evaluate radar separation of aircraft**		
	T82	Review flight plan data
	T83	Verify aircraft is in conformance with flight plan
	T85	Project mentally an aircraft's trajectory
	T86	Identify potential or actual conflicts
	T87	Establish required separation
S13	**Performing radar separation of aircraft**		
	T88	Maintain required separation
	T89	Determine potential control actions
	T90	Prioritize control actions
	T91	Issue appropriate control instructions
	T92	Verify pilot conformance to instructions
S14	**Track nonradar aircraft**		
	T93	Request current pilot position report
	T94	Record flight information on flight progress strip

		T95	Track aircraft movement on flight progress strip
S14.S	**Performing nonradar separation of aircraft**		
		T96	Identify potential or actual conflicts
		T97	Establish required separation
		T98	Maintain required separation
		T99	Determine potential control actions
		T101	Issue appropriate control instructions
		T102	Verify pilot conformance to instructions
S15	**Responding to special operations**		
		T104	Evaluate impact of special operation
		T105	Determine appropriate plan of action
		T106	Implement plan of action as required
		T107	Re-evaluate plan of action
		T108	Revise plan of action if required
		T109	Coordinate special operation with others
		T110	Receive notice of termination of special operation
S16	**Processing requests for VFR flight following**		
		T112	Evaluate conditions for providing flight following
		T113.A	Approve flight following request
		T113.B	Deny flight following request
		T114	Issue beacon code to aircraft
		T115	Enter flight information into automation
		T116	Ensure correct data entry for flight following requests
		T117	Identify the aircraft
		T118	Issue appropriate clearance or control instructions
		T119	Ensure compliance with clearance or control
		T120	Receive request for cancelation of air traffic services
		T121	Acknowledge request

S17	**Providing radar assistance to VFR aircraft**		
		T122	Determine if pilot and aircraft are qualified and capable of IFR flight if appropriate
		T123.IFR	Request that the pilot file an IFR flight plan
		T124.IFR	Receive clearance request from pilot
		T125.IFR	Acknowledge pilot request for flight plan
		T126.IFR	Query pilot regarding existence of IFR flight plan
		T128.IFR	Determine potential control actions
		T130.IFR	Issue the appropriate clearance
		T131.IFR	Coordinate with adjacent affected
		T132.IFR	Receive request for cancelation of air traffic services
S18	**Monitoring uncontrolled objects/aircraft**		
		T135	Solicit information about uncontrolled object/aircraft
		T136	Initiate track on uncontrolled object/aircraft if appropriate
		T137	Flight-follow uncontrolled object/aircraft if appropriate
		T138	Coordinate with others if appropriate
		T139.A	Continue to monitor until track drop
		T139.B	Continue to monitor until loss of radar
S19	**Responding to pilot requests for flight path deviation**		
		T141	Evaluate pilot request for deviation
		T142	Propose alternative plan if required
		T142.AA	Alternative plan accepted by pilot
		T142.AR	Alternative plan rejected by pilot
		T142.R	Request rejected by controller
		T143	Coordinate deviation with the next controller if required
		T144	Issue instruction
S20	**Responding to aircraft nonconformance**		
		T145.R	Receive notification of non-conformance from supervisor or another controller
		T145.O	Observe aircraft non-conformance

	T147	Inform other controller of nonconformance
	T148	Query pilot about intentions
	T149	Determine appropriate action to resolve nonconformance
	T150	Issue appropriate control instructions
	T152	Verify compliance with instructions
	T153	Inform supervisor of nonconformance
S21	**Performing aircraft conflict resolutions**	
	T158	Evaluate validity of the potential or actual aircraft conflict
	T159	Determine appropriate action to resolve conflict situation
	T163	Issue advisory or safety alert as appropriate
	T160	Issue appropriate control instructions to ensure separation
S21.M	**Monitor conflict resolution**	
	T161	Verify pilot conformance with instructions
	T162	Suppress conflict alert if appropriate
	T164	Inform pilot when traffic no longer a factor
	T166	Restore conflict alert function to normal
S22	**Performing unsafe altitude resolutions**	
	T171	Determine validity of unsafe altitude/MSAW
	T172	Determine appropriate action to resolve unsafe altitude
	T173	Issue appropriate control instructions to resolve unsafe altitude
	T174	Suppress MSAW function if appropriate in accordance with procedures and directives
	T175	Issue advisory or safety alert as appropriate
	T176	Restore MSAW function to normal
S23	**Performing airspace violation resolutions**	
	T180	Determine validity of airspace violation
	T181	Determine appropriate action to resolve airspace violation
	T181.C	Coordinate with controlling sector
	T182	Issue appropriate control instructions

S25	**Managing departure flows and sequences**		
		T190	Receive request for release of departure aircraft
		T191	Verify departure route via automation and/or flight progress strip
		T192	Issue appropriate clearance with restrictions if required to establish departure flow
		T193	Approve departure release with restrictions if required
		T194	Enter departure or en route time message
		T195	Acknowledge departure or en route time notice
		T196	Receive notice of canceled departure
		T196.1	Controller cancels departure
		T197	Coordinate the canceled or revised departure
		T198	Observe auto acquisition
		T199	Ensure that the correct flight plan information is in the NAS if auto acquisition is not observed
		T200	Associate the flight plan and data block with the aircraft
		T201	Identify the aircraft
		T202	Determine sequence within departure flow
		T203	Issue appropriate control instructions to sequence departures into existing traffic to expedite flow
		T204	Re-evaluate traffic sequence
		T205	Issue revised control instructions if required
S26	**Managing arrival flows and approach sequences**		
		T207	Determine arrival sequence
		T208	Ensure coordinated arrival routing
		T209	Verify pilot has current approach information
		T210	Issue current approach information if required
		T211	Issue appropriate control instructions to implement approach sequence
		T212	Re-evaluate traffic sequence
		T213	Issue revised control instructions if required
S27	**Ensuring time-based metering of traffic**		
		T215	Verify aircraft is in conformance with flight plan

		T216	Verify aircraft is in conformance with any other specific control actions requested for spacing
		T217	Develop control actions to fix deviations from time meter fixes
		S102	Issue control actions to fix deviations from time meter fixes
S28	**Responding to traffic management initiatives**		
		T219	Receive information regarding traffic management initiative
		T220	Discuss impact of traffic management initiative with supervisor or traffic management unit
		T221	Evaluate traffic management initiative for effect on traffic flow
		T222	Develop options for bringing aircraft into conformance with traffic management initiative
		T223	Determine appropriate action to bring aircraft into conformance with traffic management initiative
		T224	Advise pilot of a traffic management initiative if necessary
		T225	Coordinate with local TMU and/or appropriate air traffic facility as necessary
		T226	Issue appropriate control instructions to comply with traffic management initiative
		T227	Verify compliance with instructions by pilot and other facilities
		T228	Receive notice of cancellation of traffic management initiative
		T229	Coordinate cancellation of traffic management initiative with others
S29	**Initiating handoffs**		
		T230.D	Determine whether to offer requested handoff
		T230.RM	Reject manual handoff request
		T230.RA	Reject automated handoff request
		T231	Determine need for transfer of aircraft identification
S21	**Ensure all conflicts are resolved**		
		T233	Coordinate restrictions with receiving controller as necessary
		T234	Initiate automated handoff
		T235	Observe automated handoff failure
		T236	Retract handoff if required
		T237	Initiate a Route Force (RF) message if appropriate
		T238	Initiate manual handoff

		T239	Issue appropriate control instructions to redirect aircraft from airspace as required
		T240	Receive manual handoff acceptance
		T241	Issue appropriate control instructions as required
		T242	Observe the handoff acceptance
		T242.H	Datablock housekeeping
S30	**Accepting handoffs**		
		T245.A	Determine response to auto handoff request
		T245.M	Determine response to manual handoff request
		T246.A	Coordinate restrictions with initiating controller as necessary
		T246.M	Coordinate restrictions with initiating controller as necessary
		T247.A	Accept handoff (automated)
		T247.M	Accept handoff (manual)
		T248.A	Deny handoff (automated)
		T248.M	Deny handoff (manual)
		T249	Receive control of aircraft according to Letter(s) of Agreement (LOAs) and SOPs
S31.A	**Issuing pointouts automated (non verbal)**		
		T251	Initiate automated pointout
		T253.M	Receive approval of pointout with restrictions
		T253.A	Receive approval of pointout without restrictions
		T254	Adhere to restrictions if required
		T255.A	Receive rejection of pointout
		T256	Issue appropriate control instructions to remain clear of airspace if rejected
		T257	Initiate handoff if rejected
S31.M	**Issuing pointouts manual (verbal)**		
		T252	Initiate manual pointout
		T253.M	Receive approval of pointout with restrictions
		T253.M.NR	Receive approval of pointout without restrictions
		T254	Adhere to restrictions if required

	T255	Receive rejection of pointout
	T256.M	Issue appropriate control instructions to remain clear of airspace if rejected
	T257	Initiate handoff if rejected
S32.A	**Responding to pointouts (automated)**	
	T262	Determine response to pointout
	T263.A	Approve pointout without restrictions
	T265.A	Assume radar identification via automation (initiating handoff)
	T265.M	Assume radar identification voice (initiating handoff)
	T264.D	Deny pointout
S32.M	**Responding to pointouts manual (verbal)**	
	T260	Initiate automated track of aircraft as necessary
	T263.M	Approve pointout with restrictions
	T263.M.NR	Approve pointout without restrictions
	T264.M	Deny pointout
	T265.A	Assume radar identification via automation (initiating handoff)
	T265.M	Assume radar identification voice (initiating handoff)
	T266	Suppress automated track after pointout is no longer a factor
S33	**Processing weather information**	
	T269	Determine lowest usable flight level
	T270	Gather runway condition/use data
	T272	Forward runway condition/use data
S34	**Responding to severe weather information**	
	T274	Solicit Pilot Reports (PIREPs) as required
	T274.E	Enter PIREP into system via Enroute Information Display System (ERIDS)
	T275	Request weather information from others
	T276	Receive request for weather information
	T277	Determine the impact of weather on traffic routes and flows
	T278	Disseminate weather information as appropriate

		T280	Issue appropriate control instructions
		T281	Notify the supervisor or traffic coordinator of weather-related route impacts
S35	**Requesting temporary release of airspace**		
		T284	Request the use of airspace
		T285.A	Receive approval including conditions if any for the use of airspace
		T285.B	Receive conditional approval including conditions if any for the use of airspace
		T286	Issue appropriate control instructions
		T287	Return airspace when no longer needed
		T288	Receive rejection
S36	**Responding to requests for temporary release of airspace**		
		T291	Evaluate temporary airspace release
		T293.A	Approve temporary release of airspace
		T293.B	Conditionally approve temporary release of airspace
		T293.C	Deny temporary release of airspace
		T296	Receive notification that released airspace is returned
S37	**Responding to changes in airspace status**		
		T299	Coordinate change in status of airspace with others
		T301	Change automation to reflect the change in airspace status
		T302	Determine appropriate actions to ensure separation from airspace
		T303	Issue appropriate control instructions
		T304	Ensure status information areas are updated
		T305	Receive notice that airspace use is terminated
		T306	Inform others that airspace use is terminated
S38	**Transferring position/sector for reconfiguration**		
		T309	Give briefing to the receiving controller taking the airspace
		T310	Verify that the receiving controller has necessary settings for communication system and automation system
		T311	Configure communication and automation system to reflect changes
		T312	Adjust display for the new configuration

S39	**Receiving position/sector for reconfiguration**		
		T314	Adjust display for the new configuration
		T315	Configure communication and automation system to reflect changes
		T316	Receive briefing from the controller relinquishing the airspace
		T317	Determine if ready to accept position responsibility
		T318	Assume control of position/sector
S42	**Responding to emergencies**		
		T331	Evaluate the situation
		T331.S	Inform supervisor
		T332	Determine appropriate plan of action
		T333	Respond to emergency as required
		T334	Declare emergency if necessary
		T335	Review emergency checklist
		T336	Amend traffic flow and sequence to expedite emergency aircraft
S44	**Responding to system/equipment degradation or failure**		
		T355	Coordinate degradation or failure information with others
		T356	Initiate backup system if appropriate
		T357	Implement backup procedures
		T358	Initiate nonradar separation procedures if required
		T359	Coordinate with others regarding repair if required
		T360	Receive notice of return to service
		T361	Verify accuracy of system data
		T362	Resume normal operations
		T363	Notify others of return to normal operations
S100	**Utility Tasks**		
		T1002	Drop Track
		T1011	Display Route
S101	**Situation Awareness Tasks**		

		T1016	Update Workload Picture
		T1017	Update TMI Picture
	S102	**Issue Maneuver**	
		T998	Determine maneuver type to issue
		T999	Determine issue via voice or CPDLC
		T1003	Issue altitude via voice
		T1004	Issue speed via voice
		T1005	Issue vector via voice
		T1006	Issue direct to via voice
		T1012	Issue route amendment via voice
		T1007	Issue altitude via CPDLC
		T1010	Issue direct to via CPDLC
		T1013	Issue route amendment via CPDLC
		T1023	Verify CPDLC Response
		T1024	Handle CPDLC No Response
S4	**Relinquishing position responsibility**		
	T1	Review system status information for comprehensiveness and accuracy	
	T4	Review briefing checklist and/or notes to assure comprehensiveness of briefing coverage	
	T21	Initiate mandated recording of briefing	
	T22	Brief relieving controller	
	T23	Sign off position log if required	

Table A-2. TMU Sub-Activities and Tasks

15 Sub-activities (bolded)

54 Tasks

S0	**Maintain Safe & Efficient Flow of Traffic**			
S33	**Accept Position**			
	T129	Receive Position Relief Briefing		
	T130	Setup equipment		
	T131	Accept position responsibility		
T0. Picture	Synthesize information to update current picture			
T0	Respond to Coordinated Requests			
S285	**Monitor Traffic Flows**			
	T2000	Monitor flow information sources		
	T2001	Monitor weather sources		
	T2002	Monitor traffic		
S0. Prioritization	**Task Prioritization**			
	T0.Prioritization	Task Prioritization		
	S401	**Manage Space Operations**		
			T2104	Receive Launch Package
			T2105	Enter Hazards Areas/DRAs
			T2107	Distribute Launch Info to Unit
			S2108	Implement TMIs
			T2109	Distribute Hazard Areas / DRAs to Floor
			T2110	Attend Hot Line Call
			T2111	Communicate Areas Hot
			T2112	Activate DRAs (Vehicle Failure)
			T2113	Monitor Traffic & Launch Process
			T2114	Reroute Traffic as Required
			T2115	Communicate Areas Cold
			T2116	Cancel Notice to Airmen (NOTAMS)

	T2117	End TMIs	
S2108	**Implement TMIs**		
	T2118	Determine TMIs to be Implemented	
	S321	**Create Miles-in-Trail (MIT)/Minutes-in-Trail (MINIT) TMIs**	
		T1258	Develop MIT/MINIT TMIs
		T1259	Issue MIT/MINIT TMIs
		T1261	Monitor MIT/MINIT TMIs
	S323.324	**Create ground stop/delay TMIs**	
		T1278	Receive ground delay program TMIs
		T1280	Collaborate Ground Delay Program TMIs
		T1281	Disseminate ground delay program TMIs
		T1282	Monitor ground delay program TMIs
	S325	**Create airspace flow programs**	
		T1285	Receive airspace flow program TMIs
		T1287	Collaborate airspace flow program TMIs
		T1288	Disseminate airspace flow program TMIs
		T1289	Monitor airspace flow program TMIs
	S327	**Create reroute TMIs**	
		T1300	Develop reroute TMIs
		T1301	Issue reroute TMIs
		T1303	Monitor reroute TMIs
	S326.332	**Create metering/sequencing TMIs**	
		T1293	Develop metering TMIs
		T1294	Issue metering TMIs
		T1296	Monitor metering TMIs
S345.346.347.348	**Manage Temporary Flight Restrictions (TFRs)**		
	T1388	Evaluate TFR Request	
	T1388.C	Coordinate TFR	

		T1388.RR	Reroute Traffic Flows as Required
		T1388.N	Generate TFR NOTAM
		T1388.E	End TFR
	S400	**Manage Call for Release**	
		T2100	Develop Call For Release (CFR) Plan
		T2101	Manage Automation
		T2102	Respond to CFRs
		T2103	End CFRs
	S286.287	**Manage En Route Flows & Sequences**	
		T1090	Balance Traffic Flows
		T2003	Share Flow Evaluation Area (FEA)/Flow Constrained Areas (FCAs) as required
		T1092	Coordinate En Route traffic flow and sequences as required
S34	**Relinquish Position**		
	T133	Conduct Position Relief Briefing	
	T134	Transfer position responsibility	

Table A-3. OS/CIC Sub-Activities and Tasks

19 Sub-activities (bolded)

77 Tasks

S0	**Maintain Safe & Efficient Flow of Traffic**		
S1	**Assuming position responsibility**		
	TS1020	Review system status information	
	TS1021	Consider current and projected workload	
	TS1022	Receive briefing from supervisor/CIC being relieved	
	TS1023	Review briefing checklist	
	TS1024	Determine if ready to accept position responsibility	
	TS1025	Log into designated display/workstation	
	TS1026	Adjust workstation parameters	
	TS1027	Check workstation for proper configuration,	
	TS1028	Update system status information if required	
TS001	Monitoring traffic volume/flow		
TS002	Monitoring frequency and landline communications.		
TS003	Communicating initiatives, Weather (Wx), and operational information		
TS004	Monitor time on position		
S33	**Processing weather information**		
	TS1072	Review graphical weather information	
	TS1073	Review text-based weather information	
	TS1074	Determine lowest usable flight level	
	TS1075	Receive notice of runway or airport condition changes	
	TS1077	Forward runway airport condition/use data changes	
S0.Prioritization	**Task Prioritization**		
	TS005	Task Prioritization	
	S15	**Responding to special operations**	
		TS1043	Receive notice of special operation
		TS1044	Evaluate impact of special operation

	TS1046	Implement plan of action as required	
	TS1047	Re-evaluate plan of action	
	TS1050	Receive notice of end of special operation	
	TS1051	Coordinate termination of special operation with others	
S21	**Performing aircraft conflict resolutions**		
	TS1054	Monitor for conflicts	
	TS1055	Notify controller of potential conflict	
S22	**Performing unsafe altitude resolutions**		
	TS1056	Monitor for unsafe altitude	
	TS1057	Notify controller of potential unsafe altitude	
S23	**Performing airspace violation resolutions**		
	TS1058	Monitor for airspace violations	
	TS1059	Notify controller of potential airspace violations	
	TS1060	Coordinate with appropriate controlling agency	
S25.S26	**Managing arrival/departure flows and sequences**		
	TS1061	Coordinate flow requirements	
	TS1062	Monitor to ensure required flow	
S27	**Ensuring time-based metering of traffic**		
	TS1065	Monitor to ensure time-based management achieved	
	TS1066	Coordinate flow requirements	
S28	**Responding to traffic management initiatives**		
	TS1068	Monitor to ensure conformance to TMIs	
	TS1070	Coordinate with adjacent facilities	
	TS1071	Communicate TMIs to the area	
S34	**Responding to severe weather information**		
	TS1078	Communicate Wx information	
	TS1079	Coordinate severe Wx plan	
	TS1080	Request controllers solicit PIREPs	
S36	**Manage Position Workload**		

	TS1087	Evaluate current workload	
	S35	**Manage Airspace**	
		TS1081	Receive request for airspace management
		TS1082	Identify need for airspace management
		TS1083	Determine management plan
		TS1084	Coordinate with adjacent facilities as required
		TS1085	Communicate within facility as required
		TS1086	National Traffic Management Log (NTML) logging as required
	TS1088	Assign positions/relief from positions	
	TS1089	Assign training	
	TS1090	Cru-X/ART logging	
S42	**Responding to emergencies**		
	TS1098	Receive notice of emergency	
	TS1100	Evaluate the situation	
	TS1101	Determine appropriate plan of action	
	TS1106	Coordinate emergency information with others	
S44	**Responding to system/equipment failure**		
	TS1119	Detect degradation or failure	
	TS1120	Receive notice of degradation or failure	
	TS1121	Coordinate information with others	
	TS1122	Initiate backup system if appropriate	
	TS1123	Implement backup procedures	
	TS1124	Initiate nonradar separation procedures	
	TS1125	Coordinate with others regarding repair	
	TS1126	Receive notice of return to service	
	TS1127	Verify accuracy of system data	
	TS1128	Resume normal operations	
	TS1129	Notify others of return to normal operations	

	S45	**Manage space operations**	
		TS1130	Coordination with areas/adjacent facilities
		TS1132	Review weather information
		TS1133	Validate TMIs are appropriate
		TS1134	Managing position assignments
		TS1135	Communicate status to area of responsibility
S4	**Relinquishing position responsibility**		
	TS1038	Review system status information	
	TS1039	Review briefing checklist	
	TS1040	Initiate mandated recording of briefing	
	TS1041	Brief relieving supervisor	
	TS1042	Sign off position log if required	

Table A-4. Oceanic Sub-Activities and Tasks

21 Sub-activities (bolded)
134 Tasks

S0	**Maintain Safe & Efficient Flow of Traffic**			
S2	**Assuming position responsibility**			
	A110	Review system status information areas to gain situation awareness		
	A111	Consider current and projected traffic/weather/workload		
	A112	Receive briefing from controller being relieved		
	A113	Review briefing checklist		
	A114	Determine if ready to accept position responsibility		
	A115	Log into designated display/workstation in controller role		
	A116	Adjust workstation parameters and display to personal preference		
A0.Picture	Update Picture			
A100	Monitor Aircraft Situation Display			
A101	Monitor Sector Queue			
A102	Monitor Error Queue			
A103	Monitor Weather			
A104	Monitor Airspace Reservations			
A105	Respond to Verbal Coordination			
S1	**Task Prioritization**			
	A0.Prioritization	Task Prioritization		
	S4	**Performing Procedural Separation of Aircraft**		
			A14	Mental Projection of Aircraft's Trajectory
			A15	Trial Resolution
			A16	Determine Potential Control Actions
			A17	Issue Control Instructions
	S6.Cntrl	**Initiate Transfer of Control**		
			A23	Coordinate Transfer of Control (TOC)
			A25	Determine TOC type

	A26.A	TOC Automated	
	A26.M	TOC Manual	
	A27.A	Handle TOC Accepted	
	A27.R	Handle TOC Rejected	
	A28	Contact Aircraft	
S6.Comms	**Initiate Transfer of Comms**		
	A24.AvM	Determine Whether Manual	
	A24.A	Transfer of Communication Automated	
	A24.M	Transfer of Communication Manual	
	A24.V	Verify Transfer of Communication	
S7	**Accept Transfer of Control**		
	A31	Confirm Coordination Status	
	A29	Receive Handoff Offer	
	A30	Verify Aircraft Data Block	
	A31.D	Decide Whether to Accept Handoff	
	A33	Resolve Outstanding Coordination Issues	
	A34	Handle Outstanding Restrictions	
	A35.A	Accept Transfer of Control	
	A35.R	Reject Transfer of Control	
	A36	Confirm Automatic Dependent Surveillance–Contract (ADS–C) and CPDLC Connections	
S5	**Update Flight Plans**		
	A110	Amend Flight Plan	
	A111	Suspend Flight Plan	
	A112	Complete Flight Plan	
	S13	**Coordinate Flight Plan**	
	A113	Evaluate Probe	
	A114	Send Flight Plan	
S8	**Resolve error queue messages**		

		A37	Notice Error
		A38	Identify Error Type
		A39.a	Data Entry and Format Errors
		A39.b	Missing or Incomplete Required Information
		S13	**Coordinate as required**
		A39.c	System and Database Limitations
		A39.d	Privilege and Authorization Issues
		A39.e	Operational and State Restrictions
		A39.f	Conflict and Processing Failures
		A40	Reprocess Error
		A41	Acknowledge Resolution
S9	**Handling non-responsive aircraft**		
		A42	Notice non-responsive aircraft
		A43	Verify Aircraft Communication Status
		A45	Assess Out-of-Conformance Conditions
		A46	Initiate Manual Position Report Request
		A47	Override Procedural Conflicts
		A48	Emergency Procedures
		S13	**Coordinate with Adjacent Facilities**
		A50	Solicit Position Reports from Nearby Aircraft
		A51	Broadcast Alerts on 121.5
		A52	Update Flight Plan or Enter New Data
		A53	Analyze Temporary Profile Results
		A54	Handle ADS–C Position Report Overdue
		A55	Monitor Automatic Dependent Surveillance–Broadcast (ADS–B) and Radar Data
		A56	Suspend or Unsuspend Data Blocks
		A57	Document Actions and Notify Supervisor
		A58	Activate Alerting Service

		A59	Re-coordinate Flight Plan if Contact Established
		A60	Update Flight Plan or Enter New Data
S11	**Responding to emergencies**		
		A61	Notified of Emergency
		A62	Identify Intentions
		A63	Declare Emergency
		A64	Notify Supervisor
		A65	Update Flight Plan
		S5	**Manage ATOP Flight Plan Information**
		A66	Manage Emergency ADS–C Contracts
		A67	Override Procedural Conflicts
		A68	Suppress Non-Essential Alerts
		A69	Determine Coordination
		A70.a	Coordinate with Adjacent Facilities
		A70.b	Coordinate Alternate Airports
S12	**Responding to airspace restrictions**		
		A71	Notification of Airspace Activation
		A72	Monitoring Scheduled Activations
		A73	Activation of Airspace
		A74	Coordination with Adjacent Facilities
		A75	Apply expanded buffers
		A76	Deactivation of Airspace Reservation
S13	**Initiating Coordination Request**		
		A77	Initiate Coordination
		A78	Send Message
		A79	Monitor Acknowledgement
		A79.A	Negotiate Coordination
		A79.B	Cancel Outbound Coordination

	A79.C	Acknowledge Acceptance of Request	
S14	**Respond to Coordination Request**		
	A80	Receive Coordination Request	
	A80.B	Accept Coordination	
	A80.C	Reject Coordination	
S15	**ATOP and Radar Control**		
	A90	Monitor and Update Aircraft Position	
	A91	Apply Radar Separation	
	S5	**Issue and Modify Clearances in ATOP**	
S16	**Respond to Pilot Deviation**		
	A81	Deviation Notification or Detection	
	A82	Query Pilot	
	S18	**Respond to Pilot Request**	
	S9	**Handle Non-Responsive Aircraft**	
	A84	Required Coordination	
S17.Entry	**Manage Aircraft to Special Use Airspaces (SUAs)**		
	A200	Receive Entry Request	
	A201	Evaluate Entry Request	
	A202	Clear into SUA	
	A203	Reject Entry Request	
	A204	Suspend Flight Plan	
S17.Exit	**Manage Aircraft from SUAs**		
	A200	Receive Exit Request	
	A201	Evaluate Exit Request	
	A202	Clear from SUA	
	A203	Reject Exit Request	
	A209	Unsuspend Flight Plan	
	A210	Receive Pilot Clear Report	

	S18	**Respond to Pilot Requests**	
		A213	Evaluate Pilot Request
		S5	**Manage Flight Plan**
		A214	Accept Pilot Request
		A215	Propose Modification
		A216	Reject Pilot Request
	S19	**Respond to Position Reports (early/delayed at fix)**	
	A211	Evaluate Position Report	
	A212	Determine Flight Plan Revisions	
	S5	**Update Time Over Fix**	
	A83	Apply Lateral Offset Procedure	
S3	**Relinquish Position Responsibility**		
	A110	Review system status information	
	A113	Review briefing checklist	
	A119	Initiate mandated recording of briefing	
	A120	Brief relieving controller	
	A121	Sign off position log if required	

Appendix B Abbreviations and Acronyms

Term	Definition
ADS-B	Automatic Dependent Surveillance-Broadcast
ADS-C	Automatic Dependent Surveillance-Contract
AISR	Aeronautical Information System Replacement
AJG	Management Services
AJM-131	ATO Specialty Engineering
ANG-C1	Human Factors Division
ANSP	Air Navigation Service Provider
ARTCC	Air Route Traffic Control Center
ATC	Air Traffic Control
ATCSCC	Air Traffic Control System Command Center
ATCT	Airport Traffic Control Tower
ATO	Air Traffic Organization
ATOP	Advanced Technologies & Oceanic Procedures
CD	Clearance Delivery
CFR	Call For Release
CIC	Controller In Charge
CPC	Certified Professional Controller
CPDLC	Controller-Pilot Data Link Communications
Cru-X/ART	Traffic Organization Resource Tool
CTA	Cognitive Task Analysis
DRA	Debris Response Area
EDST	En Route Decision Support Tool
ERAM	En Route Automation Modernization
ERIDS	Enroute Information Display System
FAA	Federal Aviation Administration
FCA	Flow Constrained Area
FD	Flight Data
FEA	Flow Evaluation Area
FPEA	Flight Plan Enter/Amend
GC	Ground Control

GOMS	Goals, Operators, Methods, and Selection Rules
HCI	Human-Computer Interaction
HF	High Frequency Radio
HF	Human Factors
IFR	Instrument Flight Rules
IMPRINT	Improved Performance Research Integration Tool
IRB	Institutional Review Board
JTA	Job Task Analysis
LC	Local Control
LOA	Letter of Agreement
MAP	Monitor Alert Parameter
MIT	Miles-in-Trail
MINIT	Minutes-in-Trail
MITRE CAASD	The MITRE Corporation's Center for Advanced Aviation System Development
MSAW	Minimum Safe Altitude Warning
NAS	National Airspace System
NATCA	National Air Traffic Controllers Association
NOTAM	Notice To Airmen
NTML	National Traffic Management Log
OJTI	On The Job Training Instructor
OS	Operations Supervisor
PBWP	Product Based Work Plan
PGUI	Planview Graphical User Interface
PVD	Plan View Display
R	Radar Position
RA	Radar Associate Position
RF	Route Force
SAA	Special Activity Airspace
SME	Subject Matter Expert
SOP	Standard Operating Procedures
STMC	Supervisory Traffic Management Coordinators
SUA	Special Use Airspace
TFMS	Traffic Flow Management System

TFR	Temporary Flight Restriction
TGUI	Timeline Graphical User Interface
TMC	Traffic Management Coordinators
TMI	Traffic Management Initiative
TMU	Traffic Management Unit
TOC	Transfer of Control
TRACON	Terminal Radar Approach Control
TSD	Traffic Situation Display
VFR	Visual Flight Rules
WX	Weather
ZMA	Miami ARTCC
ZOA	Oakland ARTCC
ZSE	Seattle ARTCC

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