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Application of the Augmented Operator Function Model for Developing Performance Metrics in Persistent Surveillance

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APPLICATION OF THE AUGMENTED OPERATOR FUNCTION MODEL FOR DEVELOPING PERFORMANCE METRICS IN PERSISTENT SURVEILLANCE

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By

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY Tiffany M. Paul ENTITLED Application of the Augmented Operator Function Model for Developing Performance Metrics in Persistent Surveillance BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Master of Science in Engineering

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ABSTRACT

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Difficulties with the implementation of persistent Wide Area Motion Imagery (WAMI) sensors to support real-time military missions have risen within Intelligence, Surveillance, and Reconnaissance organizations. In this study, cognitive models were developed of operators performing real-time missions currently supported by narrow field of view Full Motion Video (FMV) and WAMI sensors. These models were used in conjunction with a cognitive task analysis, creating an augmented operator function model (OFM-COG). This thesis describes the OFM-COG and demonstrates how this model-based analysis technique can document the cognitive implications of persistent surveillance with motion imagery. The analytic procedures required to build this model result in a methodology for the definition of an information display system specific for intelligence analysis tasks. Specifically, the models developed examine the cognitive demands of an Imagery Analyst (IA) during a real-time mission, with WAMI and/or FMV. From this, a set of cognitive metrics for analyst performance were identified for the real-time military missions in persistent surveillance.

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I. INTRODUCTION

1.1 Background

Real-time and forensic military missions are supported by narrow field of view Full Motion Video (FMV) and persistent Wide Area Motion Imagery (WAMI) sensors. Cognitive models of real-time missions currently supported by these sensors and analysts can help understand the effects of using imagery in Intelligence Surveillance and Reconnaissance (ISR) missions. These models can be used in conjunction with human computer interaction analysis in which to develop cognitive metrics.

1.2 Research Objective

There are three main objectives to this research. They are:

1) Develop a working cognitive model for intelligence analysis using FMV
2) Develop a working cognitive model for intelligence analysis using WAMI
3) Develop cognitive metrics for imagery analysis based on developed models

II. LITERATURE REVIEW

In order to understand and model the cognitive demands associated with the analysts tasks using motion imagery, the nature of the medium, the tasks involved, and a background understanding of cognitive modeling is needed. The following sections outline the topics that are relevant to understand the domain and methodology for this research.

2.1 Intelligence, Surveillance, and Reconnaissance (ISR)

The goal of ISR is to provide actionable intelligence to decision makers. The mechanics by which intelligence is obtained involves a complex operation of systems and processes. Developing metrics for cognition and performance for the Imagery Analyst (IA) in this system requires an understanding of the current structure.

The collection management processes can be thought of as the main entry point to the ISR process (Gibbs, Fendley, Hoenle, & Paul, 2013). Requests For Information (RFI) are received from all theater organizations. These requests are assessed for validity, consolidated, and analyzed against existing intelligence to determine if a new collection is required or if the request can be answered with existing intelligence. If a new Collection Requirement is necessary, a collection manager will integrate the requirement into the collection plan for a specific sensor. Customer RFIs are not passed on verbatim; as part of the consolidation process, they are reduced to common Essential Elements of Information (EEIs). These EEIs are the intelligence questions that mission planners attempt to collect data in support of, and analysts ultimately attempt to answer.

2.1.1 The ISR Team

The actual execution of the collection plan occurs under the responsibility of an officer within the Combat Operations Division. The officer responsible for a given mission is referred to as the Mission Operations Chief (or Commander) (MOC). The MOC coordinates execution of the mission and remains in constant communication with the pilot, sensor operator, and mission supervisors, such as the Imagery Mission Supervisor (IMS). The IMS is responsible for exploitation of imagery intelligence and coordinates the flow of information between analysts and the MOC. The work described here focuses on the viewpoint and tasks of the analysts after they receive information from the IMS.

2.2 Persistent Surveillance

ISR challenges are many. These include information overload coupled with new persistent surveillance processes, one of those being WAMI. There are also the issues of data overload, information gaps and the need for a clear user-centered interface design philosophy.

Clarity of the images is important, as well as the geolocation of a scene and all the elements in it. Future needs for full motion video includes the move toward higher resolution visible video, trends in data density from other sources, and how to handle the data load given bandwidth constraints and the need to complete tactical analysis in near real-time (Hogan, 2012).

Data Overload

Metadata is the data about the images, such as details of objects, input from different sensors, or other information related to the EEI and the area under inspection. Speed with which an analyst gets imagery, is able to examine it and then disseminate results in a suitable format is critically important. A problem that needs to be overcome is handling the large volumes of data produced.

An analyst spends 80% of their time discovering items of interest in imagery. Pixel level search algorithms can find and track items of a particular shape and color. These algorithms can help automate the process, and attempt to alleviate analyst workload.

Compression of data is needed and this can happen through on-board processing that can be adjusted to accommodate the changing bandwidth conditions. Software has been developed that stabilizes and geolocates video as it comes in; ensuring that what an analyst sees is not distorted by one feed being particularly clear or murky. Analysts can also set up ‘exclusion zones’ in the imagery, so that background movement of only a few pixels from frame to frame is ignored and only greater foreground motion is highlighted. Everything is pulled into a central view and the sensors are unified into one system. Because of this condensation, software and the full motion video can be manipulated. An example of this is to transmit moving objects or objects with an Infra-Red (IR) signature at a higher bit rate in order to highlight these for the IA, while transmitting the rest of the area at a much lower bit rate.

Information Gap

Integration across multiple sources creates an information gap in the analysis and there is a need to design the technology to fit the capabilities of humans. FMV can be overlaid with relevant data, such as events, force positions and intelligence from data streams involving radar, maps, persistent surveillance and other sensors. The goal is to tie all the intelligence assets together, which would increase the identification of a potential target. The software can isolate and pull out an image or recording instantly. There is a semantic gap within persistent surveillance imagery. The imagery presents a difference in representations of content of interest and data. The content of interest is defined in very abstract terms related to how humans interpret video imagery and the data is defined in very physical terms related to the imaging device.

Automation

Hogan (2012) states that the 480th ISR Wing's Hudson wants to see analysis more automated. He compares ISR to casinos detecting card counters, scam artists and other unknown troublemakers in a crowd. The recognition of object's using current software creates too many false positives and too many false negatives. Better algorithms, more computing power and sharper video may solve this problem. Even if systems that are being developed cannot identify objects with a high degree of certainty by automation, the system could reduce the workload by filtering out the unimportant aspects from the large amount of imagery. This will help to solve the manpower shortage and cognitive workload issues because analysts could then concentrate on a smaller amount of data.

User-Centered Design Philosophy

User models can be integrated with data-driven models in a way that provides scalable and dynamic model adaptation and refinement for particular end users and specific applications. The objective is to help increase the user's situation awareness and the main performance criterion is user productivity. Research can show how much data the user can reliably monitor. Three main areas of research address this issue; search, analysis and human computer interaction.

Search Tools

Tool development for the user community attempts to provide users with computational tools that help identify components of scenarios (e.g., activities). This includes automation of the more tedious and labor intensive parts of data exploitation. Four broad categories of search exist within the IA tasks; database queries, meeting queries, track queries, and coordinated track queries. An intelligence analyst may perform a database query to obtain computational information from a known database. Relationships between multiple track segments are meeting queries, and these have a high number of false alarms. Combined multiple track segments are track queries. Coordinated track queries focus on multiple vehicles driving similar or related routes (e.g., coordinated driving), driving to and from common locations, and also particular formations such as convoys or pursuit.

Analysis Environment

The aim is to provide an analysis environment where tools can be applied, data visualized, and human users empowered to monitor more data in less time. This includes

data aggregation maps used to focus a user's attention to a target. Visual analytics aims to complement, rather than replace users in data exploitation.

Human Computer Interaction

Human computer interaction is the interaction between the user, the search tools, and the analysis environment in the ISR system. This interaction contains valuable information about the user's preferences and priorities. It contains the user's domain knowledge of the data set and collection area. As progress is made in search tools and the analysis environment, folding the domain knowledge back into the data-driven model to maximize the joint human-computer productivity will become increasingly important for robust scenario extraction.

Feedback

An important mechanism to mitigate uncertainty in the data-driven model is to engage users to visually validate and correct query results through feedback (Porter, Fraser & Hush, 2010). By accumulating user feedback over a given geographic area and over long periods of time, each new user does not need to start from scratch. This can be accomplished by identifying the most popular queries and push these back into the data-driven model. The two main advantages are, it makes the query results immediately available to all users, and the query can be used to improve performance. This is known as accumulated feedback. The system records relevant feedback from the queries and the sequence of interactions between the user and the WAMI information system.

2.2.1 Video Imagery in ISR

WAMI is a rapidly developing sensing modality characterized by the collection of Electro-Optical or Infra-Red (EO/IR) images with very large spatial extents. Frame rates are typically quite low, one to two frames per second (FPS), well below the typical criteria of 24-30 FPS for FMV as defined by the National Geospatial-Intelligence Agency (United States Air Force, 2012).

WAMI is used in ISR to image small city-sized areas at approximately 0.5m/pixel. This allows for the observation of many dynamic phenomena that were previously inaccessible in street-level video data. Imagery is typically acquired by multiple independent cameras, physically arranged to have overlapping fields of view and co-mounted on an airborne platforms. As images are collected, they are passed through a series of feed-forward models that produce a higher-level compact representation that quantifies content and variation of interest. A feed-forward model includes: 1) georegistration and stabilization; 2) detection of vehicles and people; and 3) tracking of vehicles and people. The first step in developing ISR imagery is to stitch images from the multiple sensor cameras into a single frame (Porter, Fraser & Hush, 2010).

WAMI brings some unique characteristics to the field of ISR. It uses multiple, fixed, high frame-rate, and narrow field of view video cameras. It has a persistent data collection that allows systems to build and exploit statistical models of normal behavior over time. It has a fixed frame of reference that makes it easy to create models of the

observable area that can be used to provide contextual information relevant to many activities of interest.

WAMI exploitation has three levels. These levels are based on exploitation time. The first level is detecting immediate events using sensor data. Geospatial locations of vehicles and people at each point in time contribute to assessing identifiable events. The second level is to detect groups or patterns of events that correspond to activities of interest (e.g., vehicle tracks). These can include multivehicle activities such as meetings and coordinated driving. The last level is to detect groups of activities or scenarios that may unfold over days or weeks.

There are challenges to WAMI over the traditional FMV imagery collection method, these include georegistration and stabilization. Exploitation of this motion image data is challenging due to the size of the geographic area covered by the sensor collection and the complexity of urban environments. Georegistration challenges occur due to collection geometry and the significant variation in ground plane elevation due to the wide field of view. One way to compensate for these effects is to use elevation maps, but they are rarely up-to-date or at the resolutions required. WAMI also only offers lower levels of spatial and temporal resolution which can be troublesome.

In ISR robust object detection is critical, and this can be difficult in WAMI. Low spatial resolution means objects of interest, such as vehicles and people, cover very few pixels. Also, low temporal resolution means point-like moving objects can move significant distances between frames. Georegistration and stabilization errors in WAMI

can introduce a large amount of motion clutter. Some solutions to these problems have been introduced. One solution method is background subtraction from video analysis. This exploits the long-term temporal statistics of each pixel and can suppress specific spatial locations such as trees swaying in the wind. Change detection is another possible solution. This is from satellite image analysis and can mitigate sudden pervasive differences by exploiting the fact that these differences affect a large fraction of the image such as illumination, and mis-registration. Appearance cues can be used by the analyst to differentiate or classify different types of objects, e.g., vehicles versus people. Software algorithms can also be developed, such as interest point detectors, but there is much work that still needs to be done. Specificity of these algorithms is low, they need to be optimized for speed, and spatial resolution and the image quality needs to improve before the large body of appearance-based object detection and recognition algorithms will become more relevant.

In a typical ISR mission, tracking is a necessity and while WAMI is efficient there are some challenges. Tracking is defined as viewing an object or person from the point of origin to their final destination (Porter, Fraser & Hush, 2010). The low-frame rate of WAMI means vehicles travel several vehicle-lengths between frames. The low specificity of object detectors in WAMI means all vehicle detections are treated equally. Motion clutter introduces large numbers of false detections when tracking in WAMI. Some solutions include tracking systems that can utilize movement and appearance cues, prior information related to the geographic location such as road maps, and normalcy

models. A state-transition-model specifically for WAMI can propagate the position, velocity and other attributes of vehicles through time to aid in tracking.

WAMI has the capability to use fused imagery. The sensors available include thermal, infrared, synthetic aperture radar, and multi- and hyper-spectral imagery. Fused imagery provides better fingerprints for specific objects of interest, extend the viable operating conditions of wide-area systems beyond daylight hours, and helps to deal with non-ideal weather conditions such as clouds.

2.3 Human-System Modeling

In a Joint Cognitive System (JCS) the human operators and technology are viewed as symbiotic, or simply a single entity. Understanding and guiding the user's process comes only with the shift to a joint systems view that emphasizes the interactions between people, technology, and work (Hollnagel & Woods, 2005). It is characterized as a relationship in which humans and computers work together to solve something that neither can solve alone (Brezillon & Pomerol, 1997). People and computers are not separate and independent, but are interwoven into a distributed system that performs work in context (Hollnagel & Woods, 2005).

The concern is that the human is being left out of the equation in a task. So the systems are being thought of as stand-alone systems with no human input. For example at border crossings, the machine is used to filter out difficult cases, and those difficult cases where the machine can't choose whether or not this is the person who they claim to be, will be handed over to a human operator, without any consideration of how well the

human will do this task. In fact we know the human will find that a rather difficult task, due to human-automation interaction issues or loss of situation awareness. Little consideration is given to what happens when the human is only given the difficult tasks to deal with. As a result it is apparent that the machine system and the human need to be considered together as a single entity (Hollnagel & Woods, 2005). Using model-based design can help achieve this goal.

Modeling human-system interactions aids in decision making, defining metrics, and developing Decision Support Systems (DSSs) for the human-system. Models are problem-driven and narrowly focused on joint cognitive systems. For example, cognitive models have proven useful in identifying mode transitions in jetliners (Degani, Mitchell & Chappell, 1995) and reducing cognitive workload during ship navigation (Lee & Sanquist, 2000). They have also been applied in usability assessments of complex Graphical User Interfaces (GUIs) and in developing training regimens for novices in experience-crucial tasks. Human system interaction models are bound by the collective limitations of the humans and the machines in the joint cognitive systems based on the unique limitations of each. The following five sections details human cognitive modeling, metrics from these models, and specific models used in this thesis.

2.3.1 Cognitive Modeling

The goal of cognitive modeling is to detail the relationship between a human operator and their environment from the point of cognitive processing. The human operator must be studied in a complex and dynamic environment to accurately diagram

relevant events and behavior. Because of this, the operator is able to be properly modeled within his world. These observed events identify specific behaviors, performance characteristics, decisions, related physical actions, and their relations to one another within the system.

There are many widely-used cognitive models developed from research, in both Engineering and Psychology disciplines. Because of the abundance of models, it has been found that specific models are best suited for particular types of systems, applications, and analyses (Stanton, Salmon, Walker, Baber, & Jenkins, 2012). Some models focus on attention, working memory, perception, or decision making at different degrees (Leiden K. , Laughery, Keller, French, Warwick, & Wood, 2001). An example of an attention based model is Situation Awareness Global Assessment Technique (SAGAT) (Endsley, 1988). The Goals, Operator, Methods, and Selection (GOMS) rule is a specialized human information processor model (Card, Moran & Newell, 1983). And the Recognition-Primed Decision (RPD) model is focused on human decision making processes and speed (Klein, 1993).

Cognitive modeling of human-system interactions entails identifying the salient information that is critical to the operator. This requires overcoming two key cognitive engineering challenges typically faced in complex, dynamic environments, such as the IA in the ISR system. These challenges are how to avoid brittleness and how to address semantic issues. Brittleness, or a lack of robustness, is due to the variability of the dynamic environment in which the operator is functioning (Fendley, 2009).

Improvements can be made by implementing DSSs that provide strategies to the operator and giving feedback about the results or increasing visualization in order to make the abstract information more concrete in better understanding the changes that occur within the environment. In order to make use of this requires careful understanding and representation of the system, which can be conceptualized as a cognitive model. The impact of a DSS on analyst biases while looking at the time taken to identify the targets in the images, the accuracy of the target designations, and the participants' confidence level in those designations is previous work by Fendley (2009). The second challenge is due to semantic issues. With a properly designed display the amount of semantic errors should be low and the operator must be able to properly internalize how the system works as it functions.

There are both subjective and objective measurements associated with cognitive modeling. In some instances objective measurements are hard to obtain and in these situations subjective measurements (i.e. confidence) are used and accepted. Subjective measurements can be used in order to accurately develop objective measures later on.

2.3.2 Operator Function Model (OFM)

Mitchell (1987) introduced the OFM as a method for model-based design. The OFM consists of a network of nodes and arcs that represent how an operator manages multiple concurrent activities within a complex, dynamic event-driven system (Jones, Chu, & Mitchell, 1995). The OFM is a structure of finite-state systems describing operator functions. In an OFM network nodes represent the activities of the operator at

multiple levels, and arcs connect conditions that can start, end, or sequence the activities. The OFM represents the relationships between dynamic system states and operator activities.

There are different components of the OFModel. Nodes, functions, sub-functions, actions, and arcs are identified and defined within the model. Discrete nodes (finite states) are organized within a network of arcs (state transition functions) to form a finite automaton. Arcs introduce the dynamic, event-driven dimensions to the model. Arcs can represent system events that interrupt, start-up, or complete an activity (Thordsen, Hutton, & Anastasi, 1998). Simultaneous activities are displayed as a collection of nodes without connecting arcs. The model is organized heterarchically and hierarchically, detailing discrete, alternative functions in parallel with their associated downstream sub-functions. Operator goals, functions, sub-functions, and physical actions are organized from top to bottom in a recognizable manner within the OFM. The OFM is a normative model, meaning given specific system states it predicts operator actions.

According to Muller and Narayanan (2009), "The goals of the modeling process are to determine the type and style of information to be presented to the human user, and to establish the technical demands of the system in the context of the user's needs." The OFM is a useful model due to its inherent flexibility, and through it we can study both the cognitive actions of the human and the transitions that occurred from one action to the next.

The OFM has some advantages as a cognitive model. The first is reduction of complexity: It consolidates a real-word system on paper and provides an understanding of manifold system states. It identifies mismatched system configurations (conditions under which the joint-cognitive nature fails). Finally, it offers a representation of system constraints and dynamics—the possible and impossible pathways are represented, providing a bounded system graphic. The second advantage is internal validation. The model showcases a high degree of validity in predicting outputs as a function of inputs. And the model is non-simulative and relatively easy to construct and iterate at almost no expense.

The OFM showed the greatest advantages and relevance in modeling IA tasks. The OFM has been proven effective in supporting real-world applications; including the types of actions an IA performs (Lee & Sanquist, 2000; Dave R. , Ganapathy, Fendley, & Narayanan, 2004; Jones & Jacobs, 2000; McNeese, Bautsch, & Narayanan, 1999). OFMs are well-established in supervisory controller and system monitoring tasks. The OFM captures the routine sensory/display tasks in a dynamic environment and the higher level cognitive tasks of the operator. Most importantly though, the OFM will be useful in answering critical performance-determining questions: What are the operator's needs? What cognitive challenges are experienced by the operator? Is there an aid that can address these needs and challenges? The OFM will offer solutions to these questions among others that have yet to be asked.

2.3.3 Cognitive Task Analysis

Cognitive Task Analysis (CTA) is a method for describing and representing a human operator's cognitive processes during a complex task or scenario. The CTA provides us with a set of methodologies for eliciting both general domain knowledge and specific knowledge pertaining to the decision requirements for the critical decisions made in the operational environment (Thordsen, Hutton, & Anastasi, 1998). CTA is a tool that is used to provide information about how operators frame the problem at hand and then it conceptualizes the cognitive demands of the tasks (Cooke, 1994). By using the CTA critical information and patterns of cues can be identified (Gordon, Schmierer, & Gill, 1993). Strategies that operators use to assess situations, solve problems, and make judgments and decisions are elicited from a CTA (Means, 1993). CTAs are frequently applied to usability analyses of software systems, graphic user interfaces, and physical control schemes. Any type of user interface and at any stage of development can be evaluated using the CTA. CTAs are particularly useful, according to Davidson (2002), because modern advances in technology trend toward increasing cognitive demands on operators instead of decreasing them—a modern system is not necessarily a more usable system. This type of analysis is typically used to test teams of individuals with varying domains and degrees of expertise to evaluate system prototypes and even completed systems. The test subjects complete individual tasks from different stages of use, in which these tasks are designed to expose flaws in system usability. The participants are observed, recorded (audio/video/paper), and probed while completing the tasks. The final

model of this analysis represents a progression of cognitive processes. Main goals are broken down into sub-goals, which are further analyzed to functions and actions to improve system performance, identify human-system mismatches, decision making pathways, and operator judgment. The goal of a CTA is to identify the cognitive skills, or mental demands, that are needed to perform a task. These include: critical cues and patterns of cues; assessment, problem-solving and decision-making strategies; difficulties associated with the system for novices; and common novice errors (Thordsen, Hutton, & Anastasi, 1998).

A technique used to conduct a CTA is the method of Cognitive Walkthrough (CW). This technique strives to address the operator's usability of the system, specifically the display interface. CWs provide insight as to how easily an operator can perform a complex problem solving scenario during a dynamic task or scenario. CW assumes operators employ problem-solving facilities during acquisition of new skills (Sears & Hess, 1999). A CW is not a lab-based method and is administered on- or off-site during regular activities. Because CW is more an applied "in process" assessment and less a "post-design" assessment it does not require a full system description prior to use. This renders the method easier to administer and more intuitive to the engineer without requiring intimate knowledge of the software or hardware. This method is iterative and may be applied continually throughout the design-period of a developing system, leading to unexpected and highly informative discoveries with direct benefit toward the usability of the system. CW maximizes usability in a Human-Computer Interface (HCI) and

positions the operator for superior decision-making in the majority of scenarios. The knowledge gained by these methods increase HCI robustness and mitigates operator errors.

2.3.4 Operator Function Model-Cognitive Task Analysis (OFM-COG)

The OFM itself does not capture the cognitive demands imposed on the operator, but these are the elements needed in developing cognitive metrics in analyst performance. Lee and Sanquist (2000) proposed an augmentation to the OFM using a table of cognitive functions. Using taxonomy of cognitive agent tasks derived from Miller (1974), they showed how a detailed model can be developed of the cognitive resources associated with an activity, and how those resources are utilized.

Lee and Sanquist (2000) tabulate cognitive operations in uniform system engineering terms. For each function and sub-function of an OFM, five characteristics are identified. These are: cognitive agent tasks using Miller's taxonomy (1974); inputs to the activity; human information processing resources – such as perceptual sensitivity, attention, memory, etc.; outputs from the activity; and task and environmental demands specific to the domain.

Cognitive Function Modeling provides a decision-centered view of the complex system. Cognitive Function Modeling combines function- and task-level descriptions from an operator's perspective with description of the level of "cognitive complexity" involved with each function and task. The Cognitive Function Modeling highlights tasks and functions that must be understood of the complexity of the task before allocating the

function to the physical system or the human operator. These are the tasks or functions which require complex decision making or judgments. These tasks and functions are flagged by a measure of cognitive complexity. The issues and possible design implications to deal with these issues are emphasized, and supported by data from a CTA which puts the task into the context of cognitive demands, decision, and judgments required of an operator trying to accomplish that task (Thordsen, Hutton, & Anastasi, 1998).

2.4 Cognitive Agent Tasks

Miller (1974) explores the importance of the interaction between human behavior and work situations in task analysis, through behavior and task strategies. Behavior strategies are techniques intended to maximize the operator as a processing resource. The operator learns strategies which specifically offset certain types of error, or which increase the amount of task information they can process in a given amount of time, or increase reliability in performance. Learned behaviors help the operator perform the task better, but at some risk to the task being properly accomplished. Task strategies are techniques for coping more effectively and efficiently with the uncertainties of a work environment. This distinction in work strategies helps generate a procedure for analysis of work situations that is comprehensive (Miller, 1974). Miller's (1974) taxonomy of information processing tasks adapted to the tasks conducted by an IA is shown in Appendix A.

2.5 Summary

The previous sections outlined the relevant information needed for this thesis on the Intelligence, Surveillance, and Reconnaissance system and Human System Modeling. With this were the types of models used and their purposes within the study of Joint Cognitive Systems. The next section of this thesis presents the research methodology. This includes the knowledge acquisition technique(s), data reduction process, selection of a cognitive model, and development of that model.

III. RESEARCH COMPONENTS

The research questions and methodology taken composed the backbone of this thesis. These components are described in the following two sections.

3.1 Research Questions

In this research there were three main research questions established based on the previously stated research objectives. These questions were:

1. What are the cognitive challenges associated with imagery analysis?
2. How do we measure the challenges of the tasks associated with imagery analysis?
3. Can we develop a model that addresses these challenges and identifies potential aids in the process?

The research approach taken was aligned with answering these three questions. The next section will outline and explain the research methodology utilized.

3.2 Research Framework

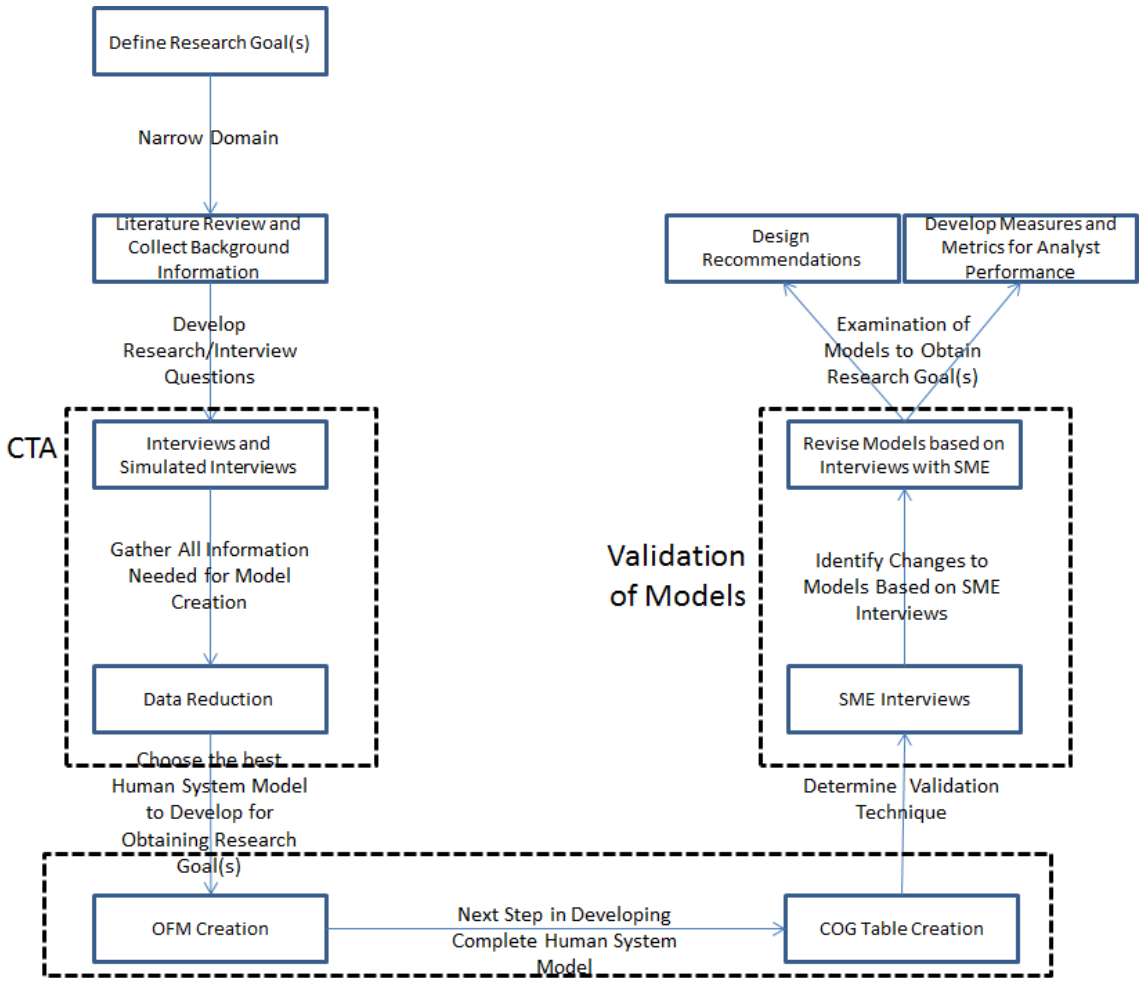

Figure 1. Research Framework

The first step in any research effort is to define the research objectives to be studied. These goals were stated in the Introduction as defining and understanding the cognitive challenges of an IA. Identifying the research objectives made it easier to narrow the domain that was to be examined.

A literature review and collection of background information was prepared in alignment with the research objectives. Based on the collected background information interview questions, topics were produced for Subject Matter Expert (SME) dialogues. The best elicitation methods for this research were chosen as interviews and simulated interviews, due to the classified nature of the real world ISR system and availability of SMEs. These interviews and simulated interviews were used as data collection techniques, and cognitive walkthroughs were used in conjunction in order to complete a CTA. During this phase all the information needed to create a cognitive model was gathered. The next step taken in this process was data reduction, in which irrelevant information was identified and filtered out. The reduction stage revealed four distinct missions that commonly occur within imagery analysis. Then the cognitive models for these missions were constructed.

Once all the data was collected and reduced, the cognitive model that best aligned with the research objectives was chosen as the representation method for identifying challenges and potential aids for imagery analysis. The Operator Function Model-Cognitive Task Analysis (OFM-COG) was chosen for this effort. First the OFMs for each of four missions were developed (see section 4.4.1 for detailed explanation of creation) from the data collected, then the cognitive tables for those four missions were created (see section 4.4.2 for detailed explanation of creation) in order to best complete the human system model based on the previous stated research objectives.

After the OFM-COG was developed, the technique chosen to validate the model was a review by a panel of SMEs. The SMEs used in this stage were different than the experts used in the data collection phase in order to give more accuracy to the models. The models were revised (see section 5.2 for detailed revisions) based on the experts' inputs obtained in the validation process. The final models were then analyzed to attain the answers for the research questions stated in the previous section. The cognitive challenges, metrics, and potential aids for imagery analysis acquired from the final OFM-COG are described in the discussion section of this thesis.

IV. METHODOLOGY

Figure 2 provides an outline of the detailed research methodology and is explained in the following sections.

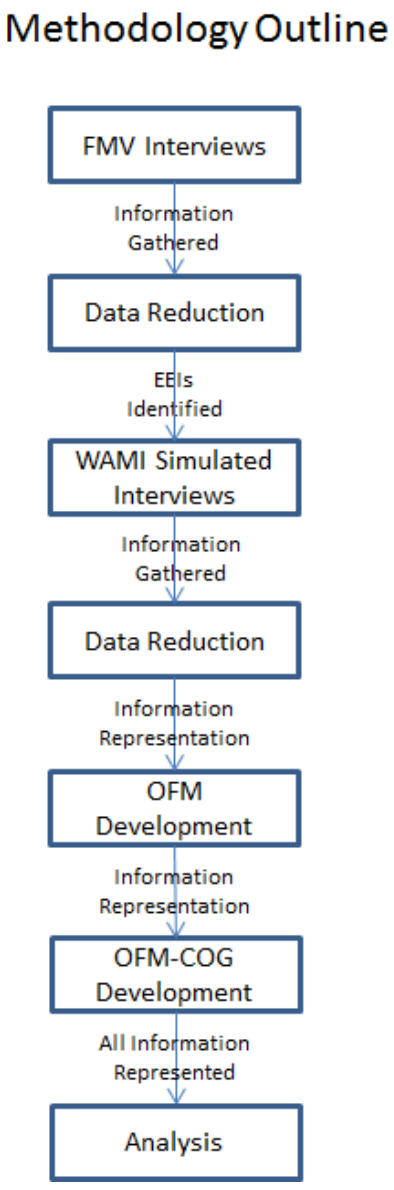

Figure 2. Outline for Data Collection and Model Development

4.1 Subjects

All subjects used in this study were former or current Intelligence Analysts. Both FMV and WAMI analysts were used in this study. Due to scarce availability of IAs three FMV analysts and four WAMI analysts were able to be studied.

The first FMV analyst had been in the intelligence community for six years, started work in the Army, and mainly works with FMV but has some training in Wide-Area Persistent Surveillance (WAPS). The second subject had 10 years special operations experience, five years in Joint Special Operations Command as an operator, three years working with Unmanned Aerial Vehicle (UAV) platforms, and an additional year working with UAV platforms as a contractor. The third subject had 12 years of intelligence experience as an Army imagery analyst, working with national imagery, and now works with UAV platforms and ISR management.

Four subjects currently using WAMI were observed in simulated interviews. The first subject had four years of intelligence experience with the past year being WAMI. The second subject has worked with intelligence imagery for five years and WAMI for two years. The third subject had 13 years of intelligence experience with the past two being with WAMI. The fourth subject had eight years intelligence experience with the Army and two years working specifically with WAMI.

4.2 Interview Data Collection

As part of this research, subject matter experts in FMV analysis at varying skill levels were interviewed, primarily FMV analysts providing real-time support to Army

customers. In Human Factors Engineering the three most common data collection techniques are; interviews, questionnaires and observations (Stanton, Salmon, Walker, Baber, & Jenkins, 2012; McNeese, Bautsch, & Narayanan, 1999). Interviews were chosen as the form of knowledge elicitation on IA task procedures for data collection. This approach delivered a balanced tradeoff between information quality and convenience to the IA—many were out of town and had limited time for interviews. In the course of these interviews, the typical missions and mission tasks they performed were discussed. All dialogues were held at an unclassified level.

The questions developed for the interview were structured to touch on four main areas based on the research objectives. The first area was identifying the salient information necessary for the analysts to successfully address and complete a given mission. Secondly, to address the physical and cognitive tasks performed by the IA during a mission. These tasks encompassed interactions with the software system and viewing the FMV sensor information. The next area was those cues that the IAs use when completing a given EEI. And lastly to identify the goals, functions, sub-functions, and actions essential to a successful mission. Basing interview questions on these areas of interest the challenges of FMV sensor analysis can be addressed in a cognitive model, which can be analyzed to determine cognitive metrics.

In order to conduct a CTA for development of cognitive models, CWs were employed during the analyst interviews. These were utilized for accurate development of the OFM-COG model for IAs performing fielded operations. This was appropriate

because the OFM-COG is used to support conditions for constraints on the execution of activities. These include Inputs (conditions for initiation of activities), Terminators (conditions for cessation of activities), Steps in Execution (logical requisites for execution of activities), and Outputs (logical requisites for completion of activities). A panel of investigators conducted the interviews to obtain accurate and quality information.

4.3 Interview Data Reduction

The combined interview/CW method elicited generous knowledge to the IA process. Topics discussed were pre-mission research, common mission types, tools utilized during missions, and communication.

Pre-Mission Research

The amount of pre-mission research analysts performed differed. One analyst reported performing little research, while a more experienced analyst uses connections within the intelligence community to acquire information. The type of historical information used focused on records of enemy activity. Records of Improvised Explosive Device (IED) incidents with geospatial location data in Keyhole Markup Language (KML) format are available for use by the IA. This gives the IA a quick overview of past activity in the area. There are also image databases of typical threat objects in use within the area. Analysts reported that these are less frequently referred to. Less than one hour is available for pre-mission research, however under dynamic tasking there is no time available for preparation outside the transit time of the aircraft.

Mission Types

The analysts reported performing a common set of mission tasks including counter-IED sweeps, monitoring of convoy routes, and battlefield surveillance for troops in contact with enemy fire. Based on this information EEIs were developed for the next round of interviews with WAMI analysts.

Tools

Minimal reliance on tools was reported by the analysts. A common general purpose media viewer is used to view FMV video. No geospatial metadata is available with this software. And change detection is performed by the analyst by mentally comparing images. An image analysis tool is not generally used.

Communication

The analysts remained in constant contact with the sensor operator and the customer during real-time missions. IAs stated that texting within a 'chat room' was the most common means of communication. Reporting was conducted immediately because before the mission the customer would state their desire to be informed of all indicators as soon as the analyst viewed the cue with no intermediate filtering. Analysts reported they would send texts of cues for possible significant activity as soon as they were viewed, followed by explanations to the significance. Then the customer would confirm or reject that cue later.

The analysts could request the sensor to focus on specific areas if needed. These requests were made from the analyst to the sensor operator directly through the chat

room. No machine interface or monitor is used. Analysts reported these sensor moving requests in terms of specific patterns of motion resembling visual search patterns, as a way of using a common language for guiding the sensor.

4.4 WAMI Data Collection

The WAMI interviews were structured as a CW with simulations using a similar software program as in a real world environment. EEIs that would be reportable for a given mission were presented to the subject matter experts. These high-level tasks were broken down into specific physical and cognitive tasks such as communications, mapping and tracking. The analysts identified cues to perform the specific EEI tasks. The tools and techniques used to answer those EEIs were observed. This made it possible to produce a set of goals, functions, sub-functions, and actions for each EEI. All tasks were given in a random order for each individual to obtain all details of missions.

4.5 WAMI Data Reduction

These simulated interviews with WAMI analysts showed differences among FMV and WAMI analysis procedures. The FMV interviews concluded that few tools were in use with exploiting FMV data for real-time support. In fact FMV analysts reported they did not multitask at all, while WAMI analysts reported monitoring and exploitation of multiple fields of view and multiple concurrent events within the sensor's area of interest.

Due to the vast amount of data collected from the SMEs, a method to reduce and organize was necessary to build the models. Four main mission types conducted by the IA were identified and used to form the basis of the models. The four types of missions

an IA could perform are: Counter Improvised Explosive Device (CIED) for a Route Scan, CIED for a Rural Scan, Threat to Convoy, and Patterns of Life. The cognitive processes and associated physical tasks for these four missions are described in the following sections.

4.5.1 CIED: Route Scan

Two CIED searches were identified by the analysts; route scan and area scan. For the CIED route scan mission the analysts described their initial search behavior as a "slow scan" along the whole route from beginning to end in a left to right fashion. More experienced analysts stated they would begin the route scan by spiraling out from the beginning of the route to better understand the activity and terrain in the area of interest. After this they would be more focused on the details of the route being scanned.

Physical and activity-based phenomena were reported by analysts as threat cues for route scan missions. Physical cues would include disadvantaged terrain, for example, an analyst would increase their attentiveness in areas that had limited lines of view or movement for convoys. Other cues that would need detailed attention would be areas that could potentially be used for IED placement and ambush, such as ditches, buildings and drainage culverts. Some of these areas could have previous IED or threat activity, so analysts would use historical information to acquire this knowledge. Analysts reported the reasoning behind using these previous reports was because if an attack occurred in that area before then the terrain or advantageous point may be of interest to another potential attacker. Activities that would be deemed cues include digging in areas that are

not agricultural, uncharacteristic traffic patterns, and people avoiding the route while walking.

During a route scan disturbed earth of thermal anomalies are signs of potential threats. These would be investigated by the analyst using a local image archive to compare images and determine timing of the anomaly. If an anomaly was detected, recent activity would have a priority over older activity. This is due to the reasoning that if the older activity was in preparation of an attack, that attack would have already occurred against past travelers down the route.

4.5.2 CIED: Rural Scan

Customer tips or "hits" would be given to analysts to follow up on potential harmful activity. This location would be within an area of interest (AOI) and the tip would be vague in detail. Analysts reported that this would require a tedious search for general suspicious activity within the AOI. The analyst stated that if they did not identify any potential threat after a length of time a call out to the customer would be made for additional information.

4.5.3 Threat to Convoy

During dynamic convoy monitoring missions analysts reported search methods similar to CIED route scans. More importance would be put on behavior based activity of pedestrians in the AOI. People's actions near the convoy would be reported more frequently and provided cues as to significant potential threats. In a convoy monitoring

mission the sensor would be constrained to only an “eyes-on” the lead vehicle in the convoy though, so sensor maneuverability would be limited.

4.5.4 Patterns of Life (POL)

POL missions are considered behavioral intelligence missions that emphasize the observed human activity information as compared to a baseline of normal behavior. Extended collection periods of persistent surveillance can create this type of intelligence. The same sensor records the anomalous and baseline activity for a POL type mission.

Analysts emphasized the need for cultural and local awareness in understanding the baseline for these missions. For example if the market is open during the morning it is expected that more people will be active, while later in the day the amount of people will decrease dramatically. If the analyst does not see this pattern in activity then this could be a potential anomaly detected. Other baseline activities include normal work hours, religious observance times and interactions between people. Analysts confirmed the EEIs that were given as cues for significant activity within a mission, but they were not able to articulate a list of behavioral cues. Instead, analysts gave vague and general statements such as, “normal within the AOI was key.”

4.6 Model Development

By structuring the simulated interviews to address specific EEIs, the knowledge elicited was used to generate a working cognitive model. The model developed was the OFM, which applied the goals, functions, sub-functions, and actions of the analyst during one of four missions. This model was then used to create the OFM-COG, which

examined the cognitive demands of these activities. The OFM-COG was generated to compare cognitive demands across tasks by outlining the mental flow using cognitive agent tasks. This led to the opportunity to find areas of high cognitive load with potential for reduction and significant challenges for the IA within the task.

4.6.1 Operator Function Model (OFM)

The procedure taken to construct the OFMs in this research was based on the approach taken by Mitchell and Miller (1986). During the simulation interview the goals, functions, sub-functions and actions were identified for each task to better create, develop, and understand the OFM. Four different EEIs were able to be modeled. The table below shows the steps in the OFM construction.

Table 1. *Steps in Operator Function Model Construction.*

Step	Description
1	Identify inputs
2	Identify outputs
3	Identify system components controlled by inputs or operator action
4	Identify operator functions and sub-functions as groups of operator actions
5	Identify groupings of components based on the operator actions and functions.
6	Define a next state transition function for each node in the network.
7	Create the model based

The model construction started with identification of exogenous inputs and system outputs. The inputs were any external or deterministic events that seem to drive the system. The outputs were the operator actions or lowest level event. Then the system

component nodes were identified, which are based on the understanding of the system. Next nodes were identified and grouped after a detailed analysis of operator function was made. Two groups of nodes were determined; operator actions and system components. The first group of nodes, operator actions, is a collection of operator actions undertaken to accomplish a control function. These function nodes are the mechanism the OFM uses to interpret or explain sequences of model outputs. The second group of nodes, system components, represents a set of modules whose status is often considered together in operator decision-making. These nodes make up several levels of the model and the number of levels needed was determined by the information gathered. From here the next state transitions were determined based on the input nodes, rank, arrangement of levels according to input priority, and meaning of the individual effects of state values for an input node at each level in the diagram. The input nodes constrain the state of the receiving nodes. After the next state transitions are defined, then the model is created using the nodes and the information about which nodes were inputs to other nodes. Then the representation of the OFM was completed.

Some similarities between mission OFMs were identified, because of the nature of the tasks. Within three of the OFMs (CIED: Route Scan, CIED: Rural Scan and POL) four main functions were identified. These functions were communication, mapping, scanning and observing historical data. Additionally, sub-functions within communication and observing historical data were identical for these three models. Mapping and scanning sub-functions were unique to the task at hand. Actions were the

same for all the missions and included reporting to the customer, tasks for final report, and communicating with other analysts for additional help.

4.6.1.1 CIED: Route Scan OFM

Figure 3 illustrates an OFM for the CIED mission described in Section 4.5.1. As seen below, the goal of the route scan is to search a route with defined start and end points for indications of IED emplacement.

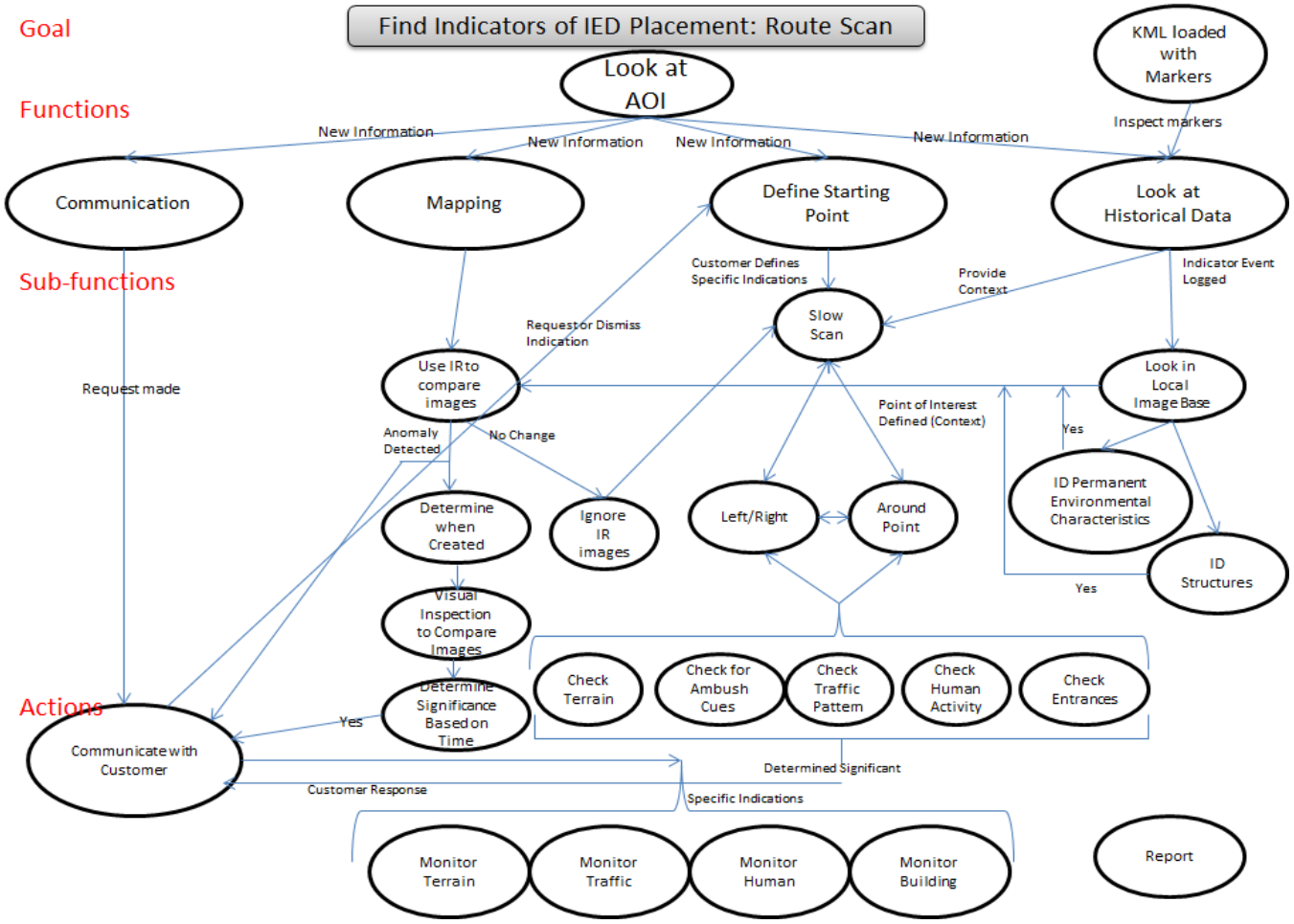

Figure 3. OFM for Counter-IED Route Scan

4.6.1.2 CIED: Rural Scan OFM

Figure 4 is an OFM for the CIED mission in rural areas described in Section 4.5.2. As shown below, the goal is to find indications of IED emplacement within a rural area. Indicators and cues are noticeably more complex than in the route scan mission and include more behavioral intelligence factors as well.

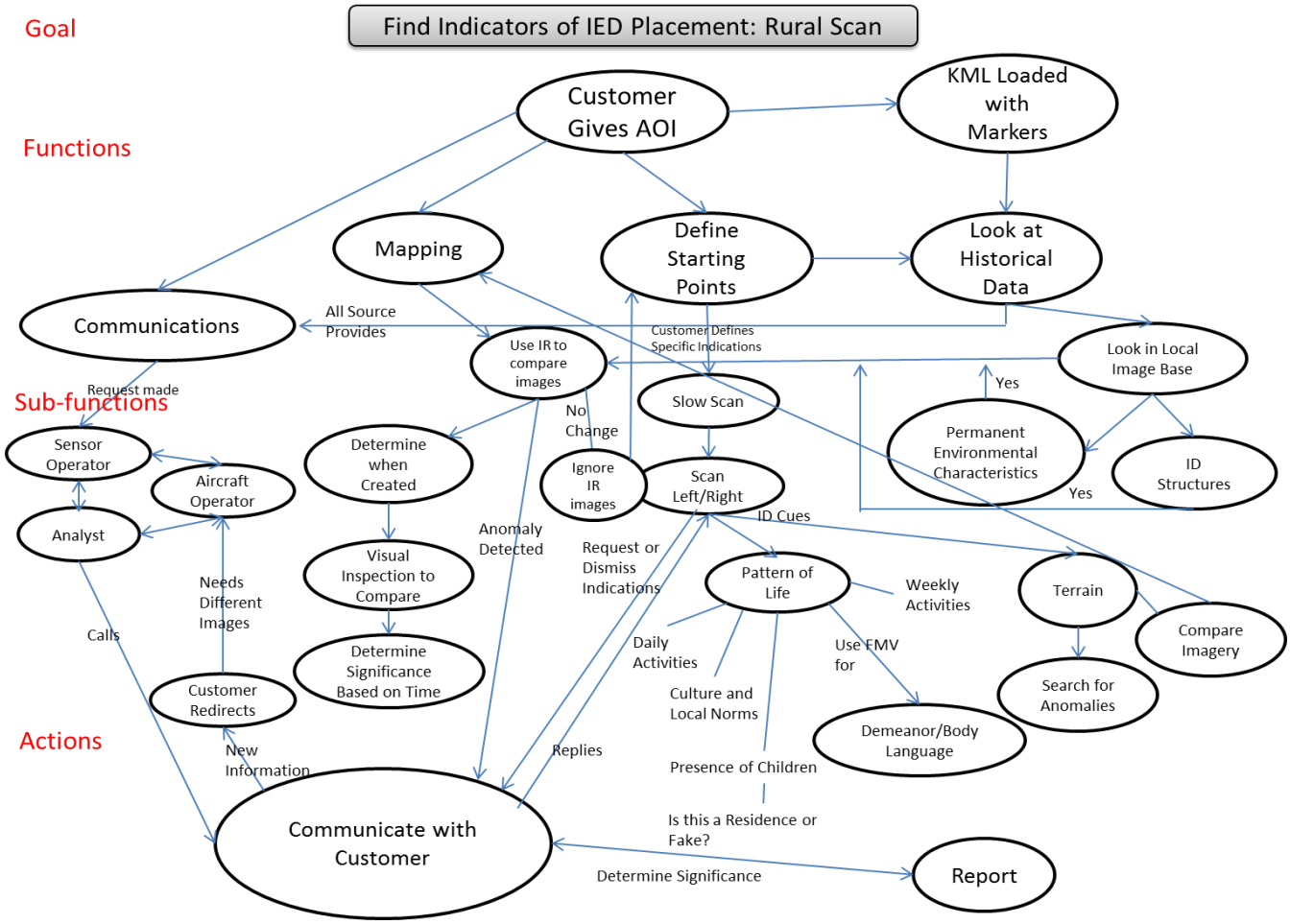

Figure 4. OFM for Rural Area Counter-IED Sweep

4.6.1.3 Threat to Convoy OFM

Figure 5 is an OFM for the Threat to Convoy mission described in Section 4.5.3. As shown below, the goal is to find indicators of potential threats including ambush attacks to a convoy traveling on a planned route. Indicators and cues include anomalous patterns of traffic indicating an abnormal reaction to the presence of the convoy.

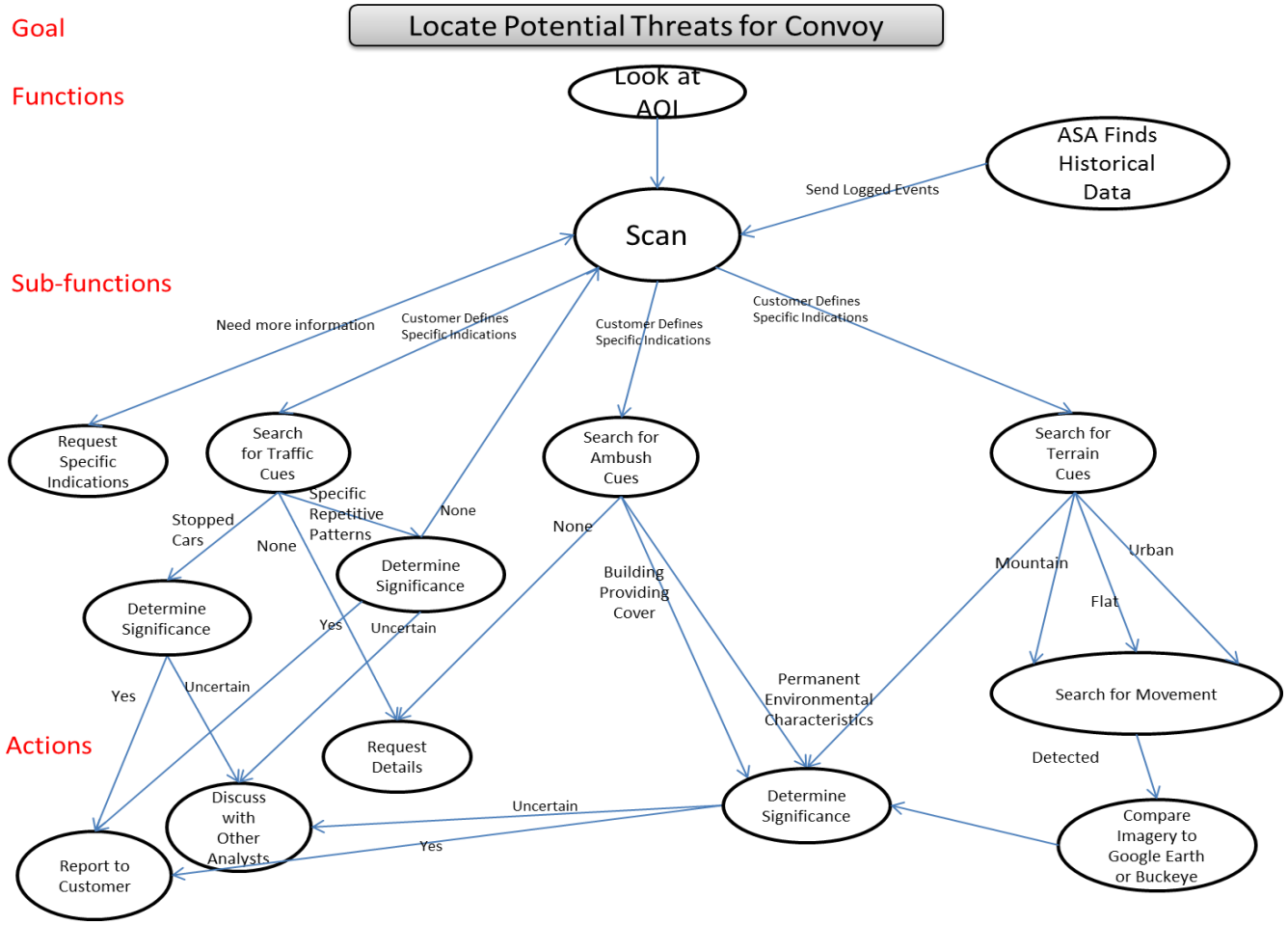

Figure 5. OFM for Convoy Threat Scan

4.6.1.4 Patterns of Life OFM

Figure 6 is an OFM for the POL mission described in Section 4.5.4. As shown below, the goal is to find indications of anomalous behavior. Indications and cues may evolve over the course of the mission to include tracking suspicious activity discovered previously in the mission.

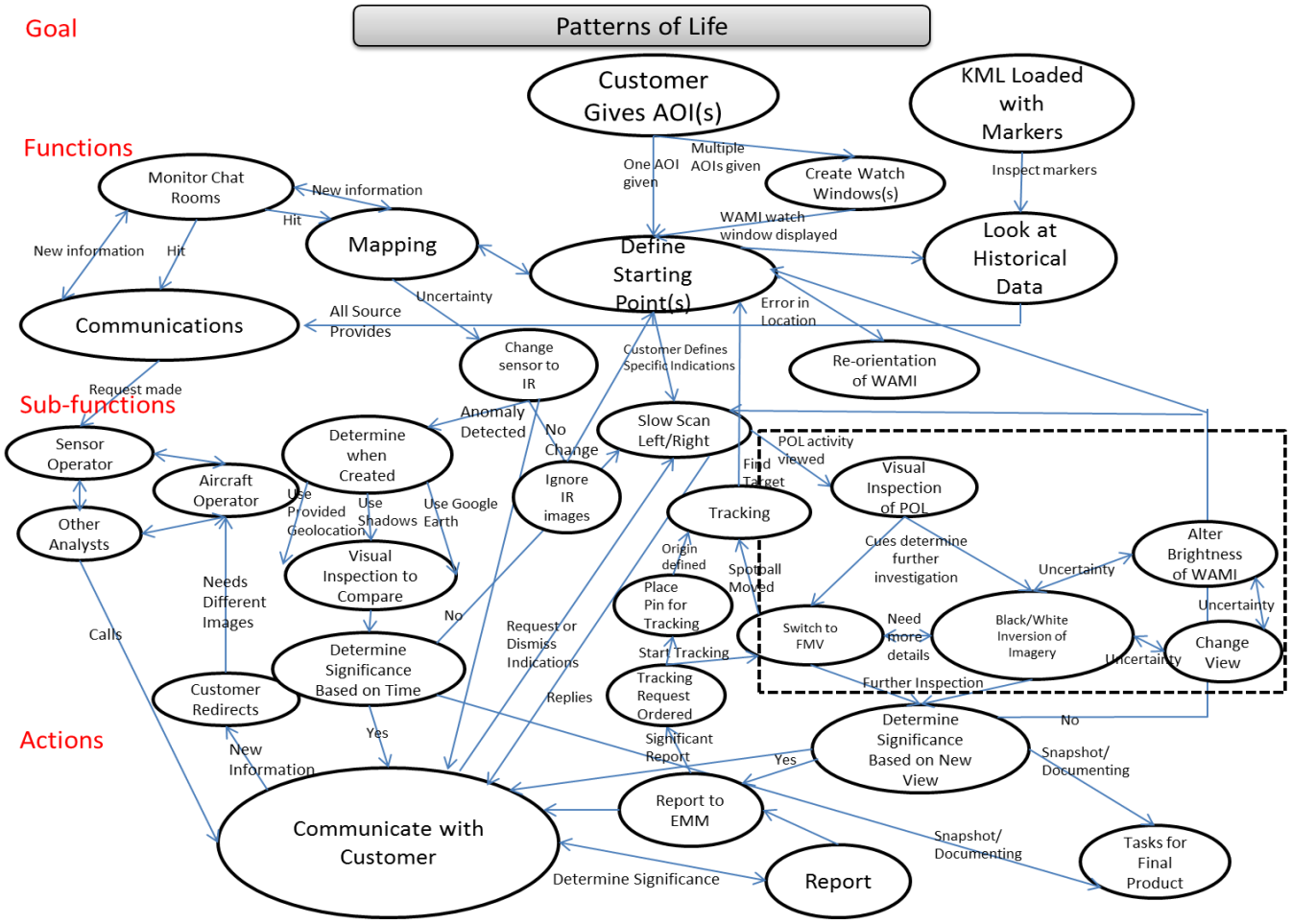

Figure 6. OFM for Patterns of Life Mission

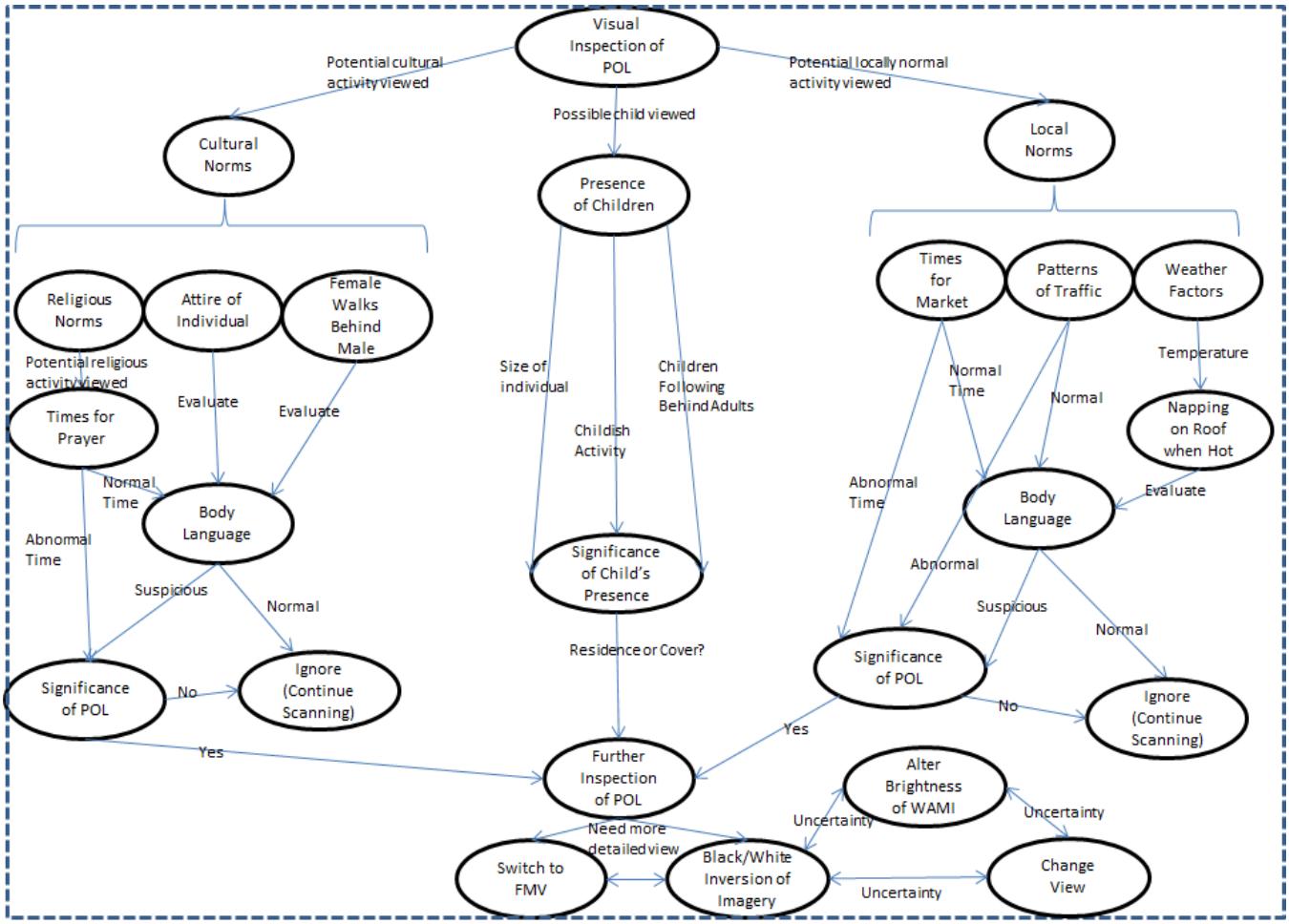

Figure 7. Detailed portion from OFM for Patterns of Life Mission

4.6.2 Operator Function Model-Cognitive Task Analysis (OFM-COG)

The Operator Function Model Cognitive Task Analysis model created was based off of Lee & Sanquists' (2000) proposed model format. This in-depth form of modeling applies cognitive agent tasks directly to the functions and sub-functions that are represented in the OFM. The first step in the OFM-COG table development was to map

the generalized information processing task functions from Miller (1974) to the tasks that are conducted by the IA. This table is shown in Appendix A.

Next the human information processing resources were applied to the appropriate function/sub-function based on the cognitive agent tasks identified within the cognitive task analysis. The application of the human information processing resources was based on work by Lee & Sanquist (2000). They defined which resources were in conjunction with each cognitive agent task from Miller's (1974) taxonomy. This is shown in Table 2 in Appendix A. The table is based on Lee & Sanquist's (2000) work and altered for the application to IA tasks.

The next step in the development of the OFM-COG tables was to define task and environmental demands an IA might encounter during a mission. Table 2 shows a preliminary list of possible task and environmental demands associated with IA tasks.

Table 2. *Task and Environmental Demands*

Task and Environmental Demands	
Rates of Change (in feeds)	Activity Levels
Visibility	Competing watch windows/NAIs/EEIs
Number of Targets	Competing chat rooms
Salience	Number of Sensor Cues
Quality of Image	Expertise
Quality of Communication Feed	Knowledge
Time Constraints	Vigilance
Computational aid	Situation Awareness
Display Representation	Expectations
Landmarks	Competing Transmissions

Shadows	Physical Task
Patterns/shapes	Visual Competition

This list was developed based on interview information and OFM analysis. These task and environmental demands were then applied to the appropriate functions/sub-functions, in which an IA might encounter them.

In addition to attributes of cognitive operations the OFM-COG developed in this research captured additional domain-specific data. Lee & Sanquist's (2000) model format was further augmented in this work to document the cognitive heuristics and biases used in performing the IA activities. The information processing resources, related task and environmental demands, and specific information related by the analysts during interviews was used to determine which cognitive biases most influenced cognitive processes and decision making as related to the cognitive agent tasks in IA mission scenarios. Table 3 is based off the work of Tversky & Kahneman (1974), and shows the relevant cognitive biases, their description and the cognitive heuristic associated with them.

Table 3. *Relevant Cognitive Biases*

Tversky & Kahneman Related Heuristic	Bias	Description
Availability	Imaginability	An event that is easily imagined is judged to be more probable
	Saliency	The tendency to focus on the most notable factors rather than the most relevant

	Recall	An event may seem more probable if an instance is easily recalled
	Search	An effective search strategy may make an event seem more frequent
Representativeness	Base rate	When other data are available the base rate is ignored
Anchoring and Adjustment	Confirmation	Confirming, rather than disconfirming, evidence is sought
	Redundancy	Redundant data may cause undue confidence in its accuracy and importance
	Selectivity	Expectation of the nature of an event influences what information is thought to be relevant
	Order	Undue importance may be placed on the first or last data point
	Complexity	Perceived task complexity may be increased by time pressure and information overload

Then based on OFM analysis and analyst reports cognitive biases were identified for each cognitive agent task used in the cognitive task analysis. Table 4 shows the cognitive biases associated with each cognitive agent task and the explanation.

Table 4. *Salient Cognitive Biases for Specific Cognitive Agent Tasks*

Cognitive Agent Task	Cognitive Bias	Explanation
Input Select	Saliency, Imaginability, Order	The order in which cues are presented may impact the saliency of the cue or how easily it can be brought to mind.
Filter	Redundancy, Base Rate, Search, Complexity	IA may eliminate redundancy and may lose relevant frequency or base rate of message from the number of cues.

Detect	Redundancy, Base Rate, Search, Complexity	IA may eliminate redundancy and may lose relevant frequency or base rate of message from the number of cues.
Identify	Confirmation, Recall	Once an object or entity is identified, then the IA tends to ignore information that is inconsistent with this. Recent events impact how cues are identified.
Code	Redundancy, Base Rate, Search, Complexity	In recoding, IA may eliminate redundancy and may lose relevant frequency or base rate of message from the number of cues.
Store in Buffer	Recall, Search	Patterns from variations (of size and type) in stored messages impact heuristics in use of the information to make decisions.
Compute	Imaginability, Recall, Similarity, Correlation	IA uses cues to answer the EEI, may use Short Term Memory or Long-Term Memory (learned patterns).

Note that not all biases occur in each instance of a cognitive agent task and more than one may be influencing decision making simultaneously.

An example of constructing an OFM-COG table for a function/sub-function set is the assignment of the cognitive agent *Decide/Select* task to the *Mapping/Use IR to Compare Images* function. To *Decide/Select* is to "choose a response to fit the situation" (Fleishman, Quaintance, & Broedling, 1984). The OFM in Figure 3 shows the input as the AOI (imagery data) and the output response alternatives are 1) call to customer if anomaly is detected or 2) continue scanning imagery data if no change. This is illustrated in Table 5.

Table 5. *Working OFM-COG for Sample OFM*

Mapping/ Change Sensor to IR

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demands
Input Select	Pay attention to imagery data	Selective attention	Filter out rest of possible visual distractions	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	Filter out rest of possible visual distractions	Selective attention	Determining if mapping can be accomplished using current visual feed	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	Determining if mapping can be accomplished using current visual feed	Perceptual sensitivity	Recognize cues for accurate mapping	Expertise, Expectations
		Distributed attention		
Search	Search for cues for accurate mapping	Sustained attention	Recognize cues for accurate mapping	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity	Recognize uncertainty	
Identify	Recognize cues for	Perceptual discrimination	Change to different	Expertise, Number of Cues, Rates of

	accurate mapping		visual feed format	Change in Feed, Situation Awareness
	Recognize uncertainty	Long-term memory	Change to different visual feed sensor	
		Working memory		
Control	Change to different visual feed sensor	Response precision	Choose IR sensor	Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
Decide/Select	Choose IR sensor	Long-term memory	Expectations of IR format	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Plan	Expectations of IR format	Working memory	Responding to uncertainty in mapping	Expectations, Expertise
		Processing strategy		
Adapt/Learn	Responding to uncertainty in mapping	Long-term memory	Efficient mapping to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			Using all resources to accurately map visual feed	

Goal image	Efficient mapping to complete mission	Long-term memory	Use IR sensor for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	Using all resources to accurately map visual feed	Processing strategy		

V. RESULTS

5.1 Validation of Models

Validation is also important in experimentation, including cognitive modeling and in particular the OFM. Muller and Narayanan (2009) validated their research by including a panel of experts in their evaluation process. These experts, who had no knowledge or experience with the specific model that was used, were able to assess the model on its content, without any bias. In Muller and Narayanan's study the experts viewed the data collected and gave input on the OFM developed. They based this off of a percentage of the experts' reviews, and edited the OFM accordingly.

5.1.1 Subject Matter Expert Validation

Validation of the developed models was a SME panel process. Three SMEs were given a copy of all the OFMs one at a time. An informal interview and cognitive walkthrough of each OFM was conducted. Both individual and group suggestions were recorded. Then the SMEs were given a copy of the Task & Environmental Demands. Additions and corrections were addressed based on the current list.

Three SMEs with intelligence experience were interviewed for validation purposes. The first expert had 32 years of intelligence work and one year intelligence imagery work. The second expert was a past aerospace engineer with 32 years government work and a year of intelligence imagery work. The third expert had 33 years intelligence work experience and 38 years specialized intelligence imagery work. The following section describes the input and revisions suggested by this SME panel.

5.1.2 SME Validation

This section will outline the reported changes that need to be included in the final validated models as per the SMEs.

Changes to all OFMs as reported by SMEs included:

- Add “walking up page” to Scan Left/Right
- Calls outs may not be shared with customer (EMM decides)
- Lead analyst/EMM passes of responsibility
- Watch Windows given to another analyst when significant report
- Tracking usually in FMV if available
- Stop/Pause/Fast Forward/Rewind function available if something missed
- Add shadows to determine object vs. person, position of object/person, and identifying object
- “When created” construction or destruction
- Add zoom to scanning process
- Add pass off other watch windows when determined significant or reported to EMM
- Add ask other analyst for advice when determining significance

Additional comments by SMEs:

- IR sensor not used during daylight
- Military vehicle present vs. absent is a significant cue
- Tracking cars is more difficult using FMV than WAMI

    - Traffic is a major factor
- Resolution and quality of feed
    - Grayscale vs. color
    - Easy to categorize objects if imagery in color

      Ex: “red car” vs. “car”
    - Clarity is an issue

5.1.2.1 Route Scan CIED OFM

Changes to the Counter-IED Route Scan OFM:

- IR definitely used freshly dug up dirt big cue under ‘Use IR to Compare Images’
- Field of View difficult for this task
- Is everyone moving to side of road under ‘Check Human Activity’

Figure 8 reflects the changes above by bolded and underlined text within the model.

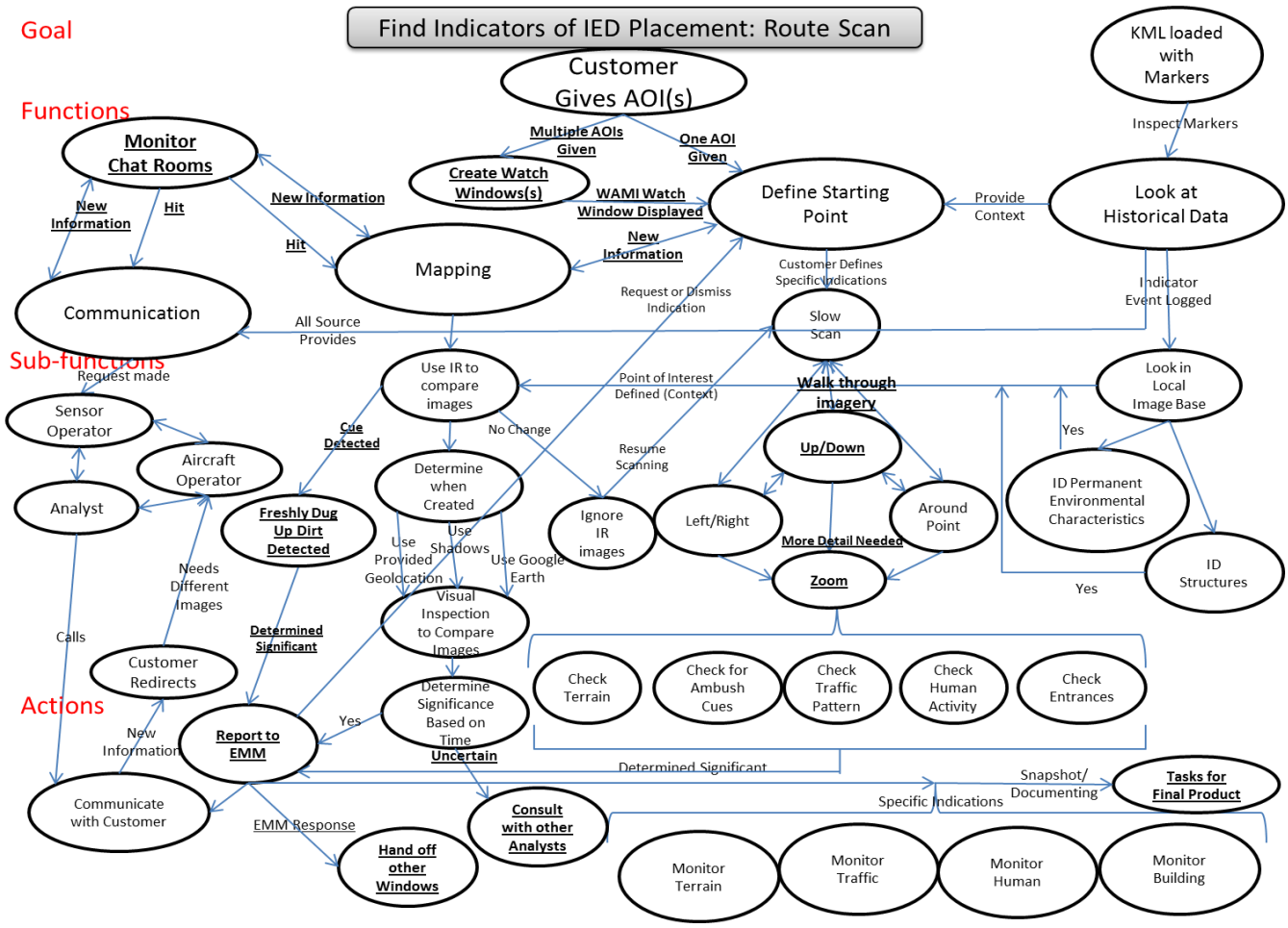

Figure 8. Final OFM for Counter-IED Route Scan

Figure 8 shows the final validated OFM for the CIED Route Scan mission.

5.1.2.2 Rural Scan CIED OFM

The change specific to the CIED Rural Scan OFM was to add the presence of animals to the POL detail section.

Figure 9 reflects this and additional changes by bolded and underlined text.

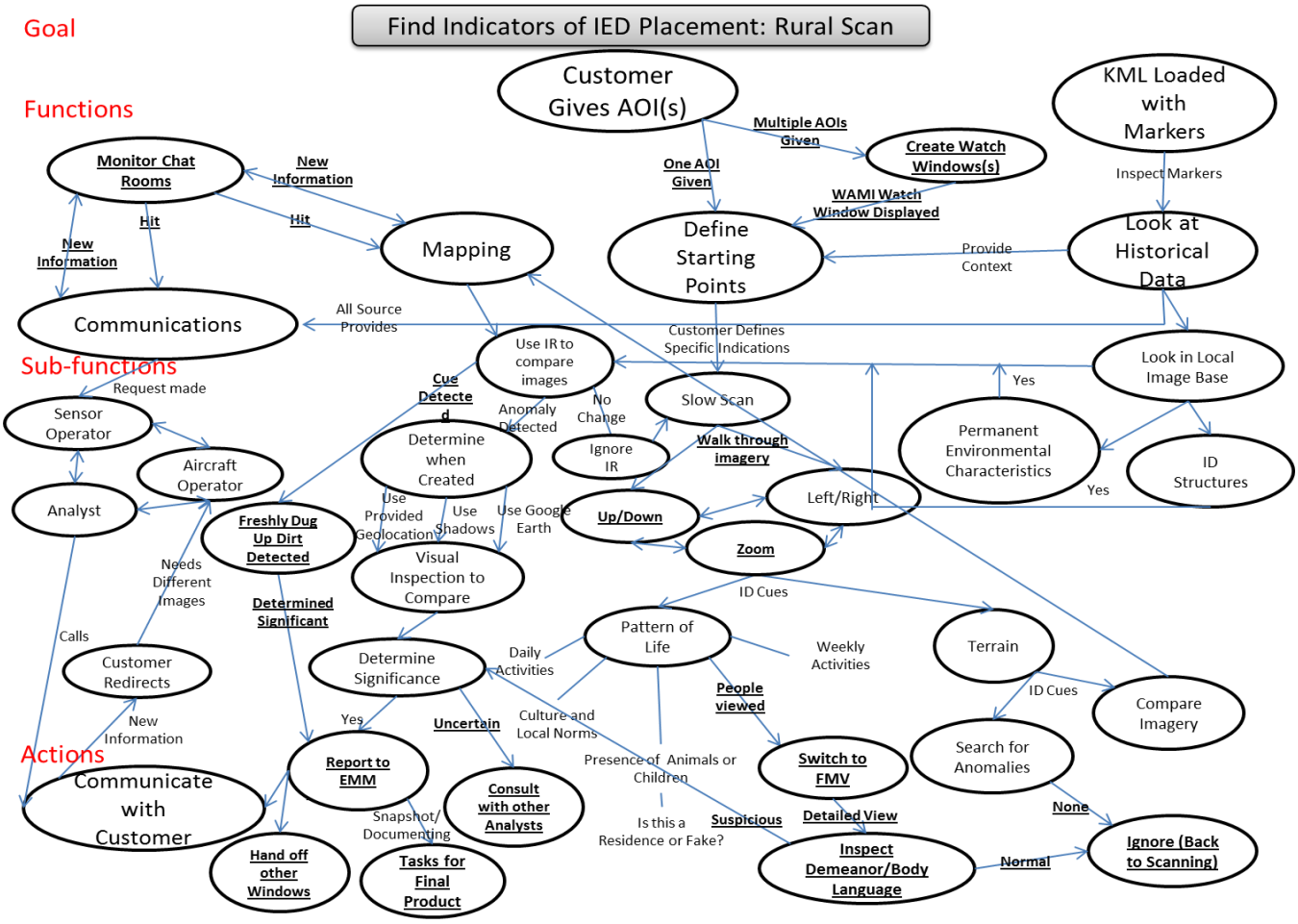

Figure 9. Final OFM for Rural Area Counter-IED Sweep

Figure 9 shows the final validated OFM for the Rural Area CIED Sweep mission.

5.1.2.3 Convoy OFM

Changes to the Convoy Monitoring OFM:

- Add open environment under ‘Search for Terrain Cues’

- Add terrain/vegetation masking under ‘Search for Terrain Cues’ and ‘Ambush Cues’
- Urban AOI harder because of dense activity
- Wooded/forest area harder to follow by aircraft and IA

Figure 10 is the final validated OFM for the Convoy Threat mission with the changes above shown by bolded and underlined text within the model.

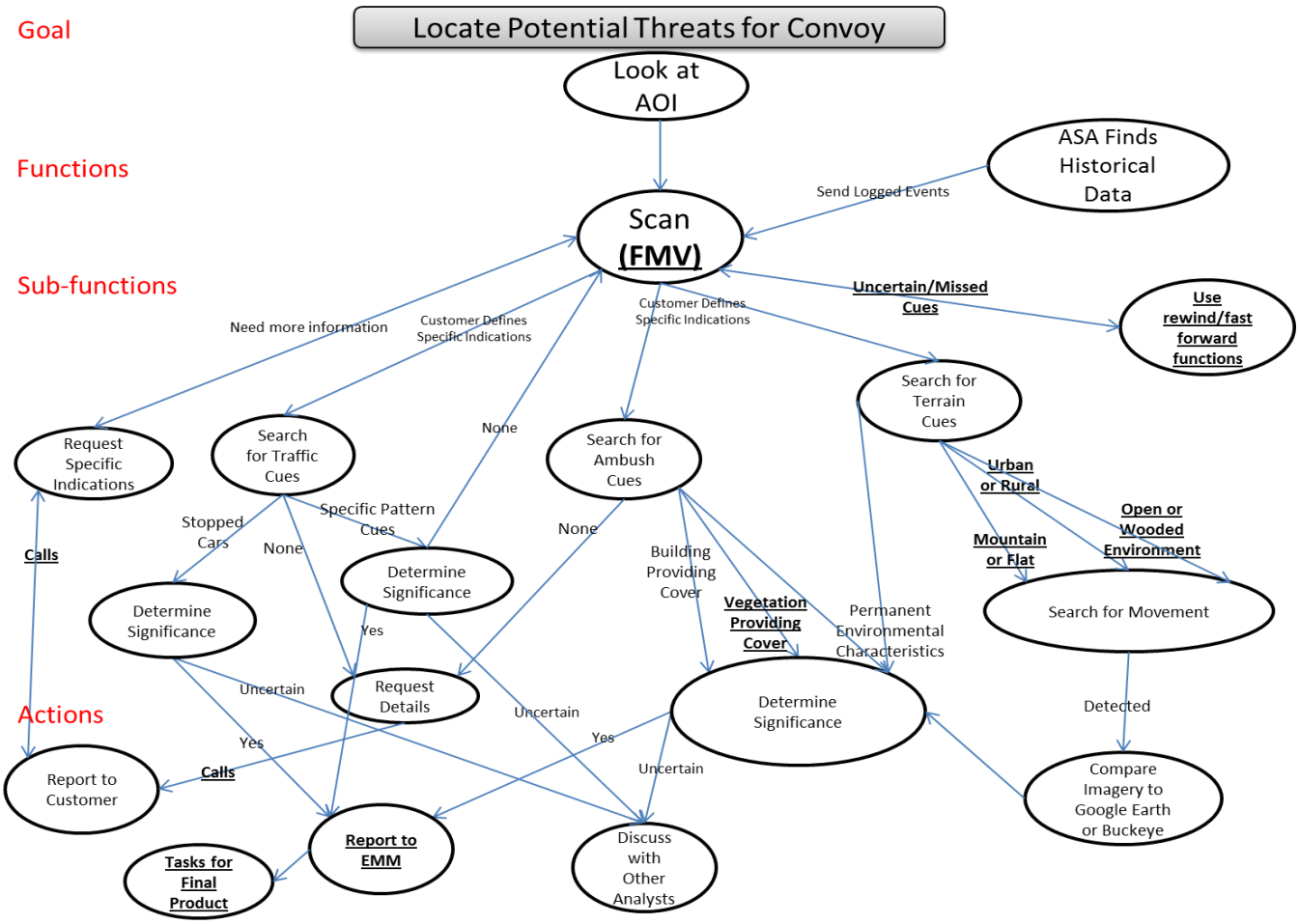

Figure 10. Validated OFM for Convoy Threat Scan

5.1.2.4 POL OFM

Changes to the POL OFM:

- Add speed of movement (adults running) in conjunction with military vehicle before or after next to body language in cultural norms
- When scanning IA always needs to understand the context
- Rewind to find origin of a vehicle when tracking

Figures 11 and 12 reflect these changes by bolded and underlined text.

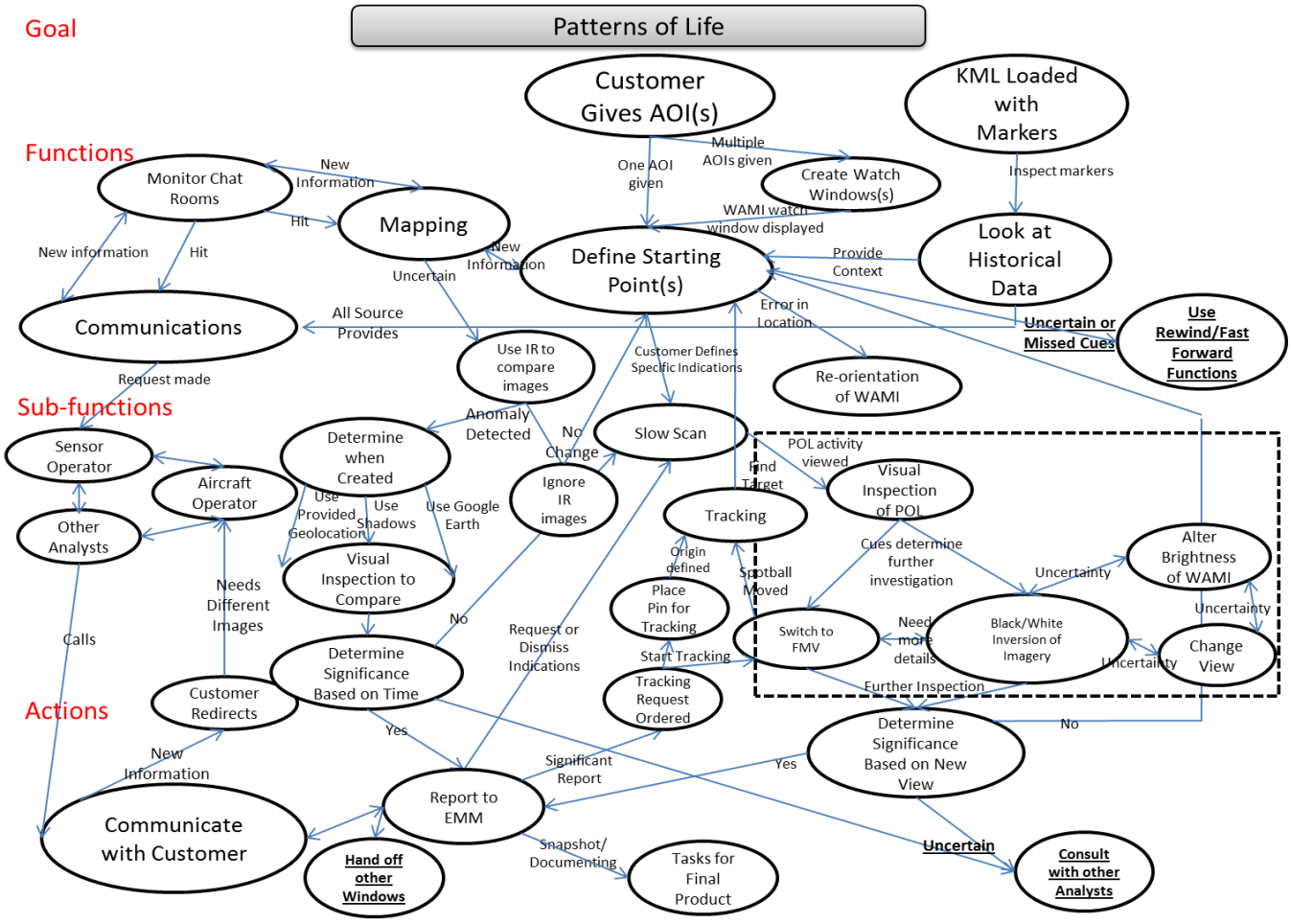

Figure 11. Final OFM for Patterns of Life Mission

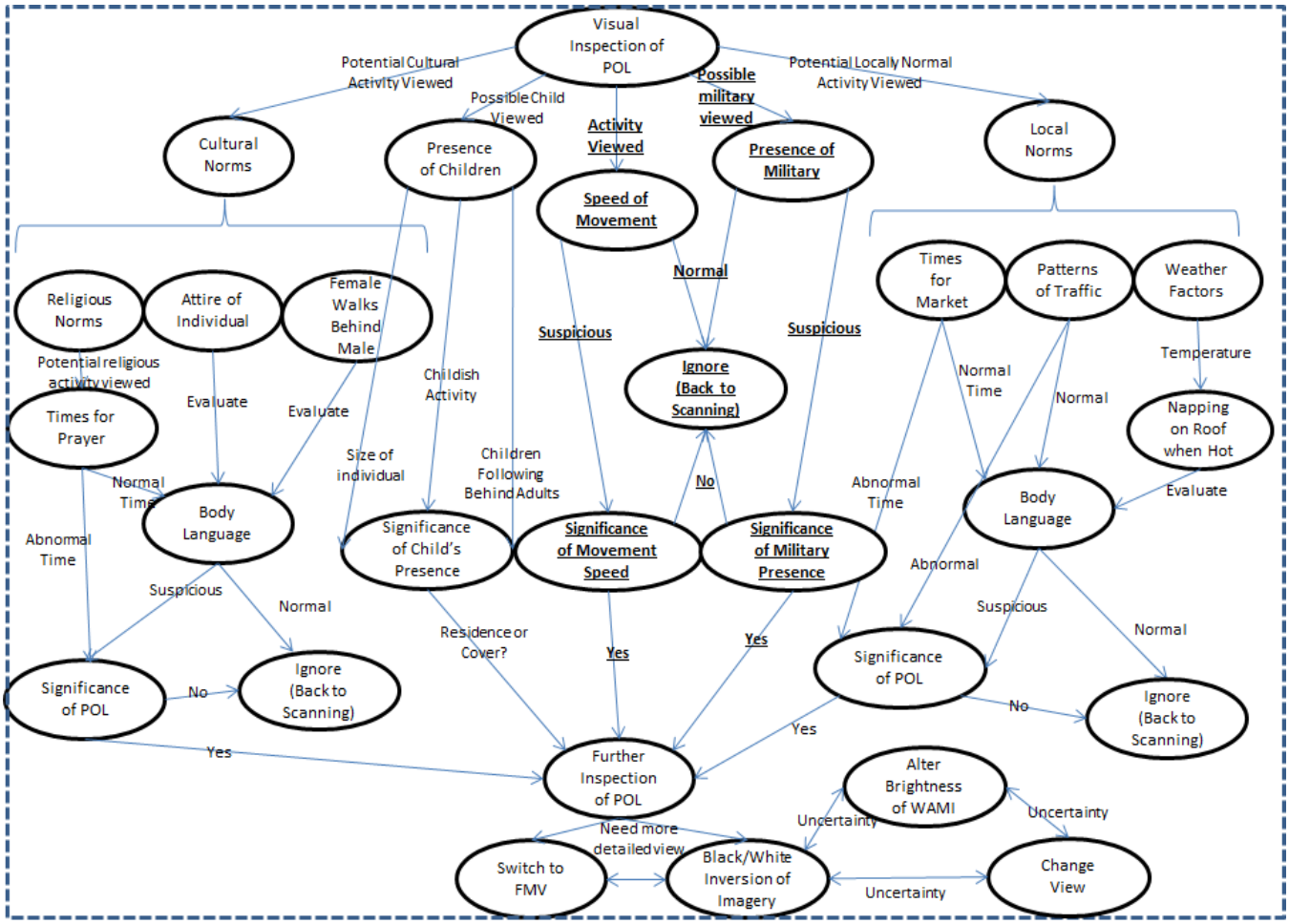

Figure 12. Detailed portion of OFM for Patterns of Life Mission

Figures 11 and 12 show the final validated Operator Function Model for the Patterns of Life mission.

5.1.3 COG Table Synthesis

All of the OFM-COG tables were edited due to SMEs validation interviews. Because of the additions in the OFMs, there were supplementary OFM-COG tables needed to complete analysis. Corrections in OFMs resulted in changes in the OFM-COG

tables as well. As a result of the modifications to the OFMs, the OFM-COG tables were updated.

In addition to edits to inputs, steps, and outputs in the OFM-COG tables the SMEs identified additional Task and Environmental Demands that are key factors in imagery analysis.

Reported additional Task and Environmental Demands:

- Cloud cover/weather conditions
- Stress/anxiety from fear of missing something
- Mental demands
- Personal judgment
- Edge of FOV-makes tracking difficult
- On the job training
- Sensor availability

The final list of validated Task and Environmental Demands is shown in Table 6. Additions to the list are represented with bolded text.

Table 6. *Final Validated Task & Environmental Demands for OFM-COG Tables*

Task & Environmental Demands
Rates of Change (in feeds)
Visibility
Number of Targets
Salience
Quality of Image

Quality of Communication Feed
Time Constraints
Computational Aid
Display Representation
Landmarks
Shadows
Patterns/Shapes
Activity Levels
Competing Watch Windows/NAIs/EEIs
Competing Chat Rooms
Number of Sensor Cues
Expertise
Knowledge
Vigilance
Situation Awareness
Expectations
Competing Transmissions
Physical Task
Visual Competition
Stress from Fear of Missing Information
Mental Demands
Weather
Personal Judgment
Edge of FOV
On the Job Training
Sensor Availability

SMEs also reported that general stress plays a key role in performance because analysts are put into tense environments when conducting missions. The analysts are relocated to a completely new and different atmosphere, in which they endure dramatic lifestyle changes. This can affect IA performance overall.

5.2 Summary

This section outlined the results of the thesis, mainly the data validation and the final development of the cognitive models. The next section will dive into a more detailed explanation of the final models and how measures of imagery analysis performance can be obtained from these.

VI. DISCUSSION

6.1 Detailed Explanation of Models

The models developed help to answer the research questions stated in Section 3.1. These questions were; 'What are the cognitive challenges associated with imagery analysis?', 'How do we measure the challenges of the tasks associated with imagery analysis?' and 'Can we develop a model that addresses these challenges and identifies potential aids in the process?' The OFM represented the independent and dependent tasks associated with IA missions and the OFM-COG was used to compare the cognitive challenges for those tasks. Furthermore, the OFM-COG was not only able to identify, but also track the cognitive load of the IA. By creating the OFM and OFM-COG specific to the IA, the tasks performed and cognitive resources utilized to complete those tasks are directly linked in an easily understood format. This process was described by Lee & Sanquist (2000) as "…bridging the gap between an engineering model of the system and a psychological model of the operator…"

Through examination of the OFM-COG tables, the cognitive load can be assessed for the specific mission type. The analysis of the OFM-COG began with determining the frequency of occurrences of the information processing resources for each of the main functions (Communication, Mapping, Patterns of Life Scanning, Scanning, and Tracking) within each of the OFMs. Table 7 shows the results for the sub-functions under the Tracking function of the Patterns of Life OFM-COG.

Table 7. *Frequency of Information Processing Resource*

Human Information Processing Resources	# of occurrences
Long-term Memory	18
Working Memory	15
Processing Strategy	15
Selective Attention	12
Perceptual Sensitivity	8
Response Precision	6
Sustained attention	5
Perceptual Discrimination	4
Distributed Attention	1

This demonstrates the most frequent, and in turn most significant, processing resources used by the IA. Resource utilization analysis was part of the strategy for identifying cognitive challenges and detecting critical decision points. These points are where biases and heuristics may be used unintentionally by IAs for analytic judgment. From this analysis, it is clear that memory, strategy and selective attention are key resources. Design recommendations on potential aids in managing these resources are discussed in Section 8.1.

An additional analysis on the Task and Environmental Demands within the OFM-COG tables was conducted. Table 8 below shows the frequency breakdown of these demands within the sub-functions of the Tracking function from the Patten of Life OFM-COG.

Table 8. *Occurrences of Task and Environmental Demands*

Task and Environmental Demands	# of occurrences
Expertise	41
Rate of Change in Feed	20
Activity Levels	20
Number of Cues	19
Visibility	18
Expectations	16
Salience	13
Knowledge	13
Quality of Feed	12
Competing Watch Windows or Feeds	8
Time Constraints	8
Number of Competing Feeds	6
Situation Awareness	4
Computational Aid	4

This table points to the most significant task and environmental demands (based on frequency) placed upon the IA. The most frequent demand is expertise, which is to be expected, but the other more frequent demands relate to the feed content. This is an indicator of management for the volume of information collected by imagery sensors. However, analysts' reports were in terms of levels of human activity, not in terms of the sensors. Focus should be placed on capturing, manipulating, and exploiting observations of human activity and complex events unfolding within the imagery. Other important concepts that can be derived from this analysis are geospatial and motion imagery

manipulation capabilities, which are present in current systems but not utilized (as based on analyst reports).

The cognitive models developed were analyzed to identify different cognitive demands in FMV and WAMI analysis. Further analysis has been conducted of the OFM and OFM-COG tables, which provides the basis for producing cognitive measures in persistent surveillance.

6.2 Measures of Performance & Effectiveness

The main product through the analysis of the cognitive models is the generation of possible measures that impact IA performance.

Initial metrics that have been acknowledged include:

a. Area of AOI
b. Density of AOI
c. Specificity of target (if mission is target search)
    i. Number of features given by customer
    ii. Amount of historical data available
d. Number of repetitions of information processing resources in OFM cycle that are not aided
e. Confidence in what the IA is reporting
f. Level of detail in reporting (i.e. does the IA have the support to store all the cues and information needed or do they have to filter and purge prematurely)

A concept for a Decision Support System (DSS) that alleviates the cognitive demands for IA decision making processes is discussed in the following section.

VII. RECOMMENDATIONS

The design recommendations and concepts in the following sections were a result of a collaborative effort with Radiance Technologies in Dayton, Ohio.

7.1 Design Recommendations

Through analysis of the cognitive models the most significant demands were memory and strategy. This can be applied to all of the functions that were represented in the OFMs, for example the Communication or Tracking functions.

Some missions requiring real-time support will place the processing, exploitation and dissemination (PED) cell in direct contact with the customer. In these cases, the intelligence team must be able to collaborate in real-time. Because of this, there will be an increased need to provide informal information sharing. Current informal methods favor broadcast "shout outs" over peer-to-peer chat rooms. However, untargeted broadcast methods are not scalable to large teams with distinct objectives.

This vision of distributed ISR operations gives us some concepts of the requirements for a WAMI exploitation tool that can be integrated into an ISR system:

- Facilitation of real-time reporting.
- Aggregation of multiple individual event reports to present "big picture" issues
- Structuring data to be useful in further analysis.

The requirement to structure observations of WAMI data is in conflict with the requirement to provide real-time reporting. In interviews, all FMV analysts reported that during real-time operations, they would provide informal, unstructured reports via voice

or chat message, and then created a structured report after the mission was over. This is not a plausible approach during WAMI exploitation. Therefore, a concept for capturing a minimal set of structured data in a way that requires as little input from the analyst as possible is proposed.

Elements of information for the construction of an event report include the geospatial and temporal data that can be entered via a single user action within the data viewer (i.e. cursor on target). However, FMV analysts interviewed in support of this effort indicated that they used a semi-structured language in making chat room call outs. This served to structure event reports in a uniform way using agreed-upon terms from operations verbiage. This jargon does not establish a complete semantic definition of the elements of reporting, but it does point to the fact that specific requested EEIs are answered in standardized ways by the analysts. Thus, a user-centered display interface could provide templates for reporting against specific EEIs such as potential convoy ambush locations, suspicious vehicles, potential IED threats, etc. Figure 13 shows the notional User Interface (UI) for event management with callouts to relate design aspects to the results of the cognitive task analysis described earlier.

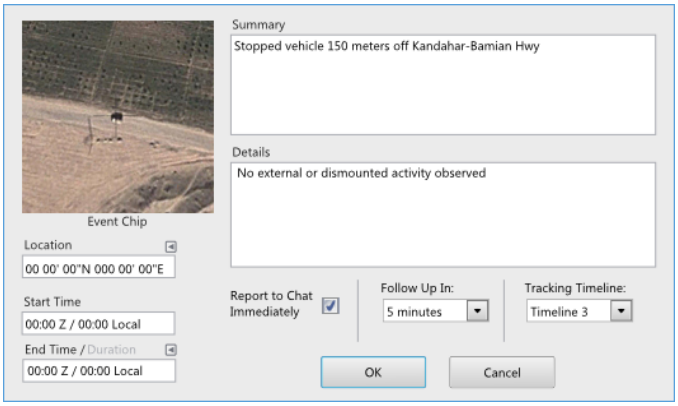

Figure 13. Notional User Interface for event "call-out"

The proposed concept provides decision support for the IA in various forms. The OFM-COG table shows the cognitive agent tasks that the IA engages in, utilizing high levels of cognitive resources, which can be alleviated through this concept. More specifically, the IA is required to temporarily save information in their short-term memory (*Store in Buffer* cognitive agent). This information varies in message size and type, and when patterns emerge, this information is used with the cognitive heuristics to make decisions. The UI reduces the load on short-term memory, frees up cognitive resources and thereby reduces the likelihood cognitive biases impacting the decision making process of the IA.

The UI concept in Figure 13 also aids in the *Code* task, in which the IA translates what is seen or read into a format for reporting. As seen from the interviews, this translation is an expected process and can distinguish a novice from a more experienced analyst. The UI would aid in keeping meaning intact and may eliminate redundancy in

the information that could cause the IA to incorrectly make a judgment based on frequency. The UI concept also reduces the sustained attention required to perform the *Search* cognitive task by sequencing the set of entities, which may include an image, part of an image, other databases, or other interface elements, for inquiry.

In interviews FMV analysts accustomed to doing "call out" reporting for real-time operations did not filter their reports; if they observed activity that might be relevant to their EEIs, they reported immediately and supported their report with reasons why the activity might be relevant. Again, this is not an approach that is applicable to WAMI exploitation. Tools are needed to allow analysts to multitask, monitor multiple events within the AOI, and to track events over time, allowing the initial detection to be captured along with subsequent observations to confirm or deny significance. Some EEIs such as imminent threats will always require immediate reporting though. Therefore, a system of dual event stacks is proposes to separate events by their reporting status as shown below in Figure 14.

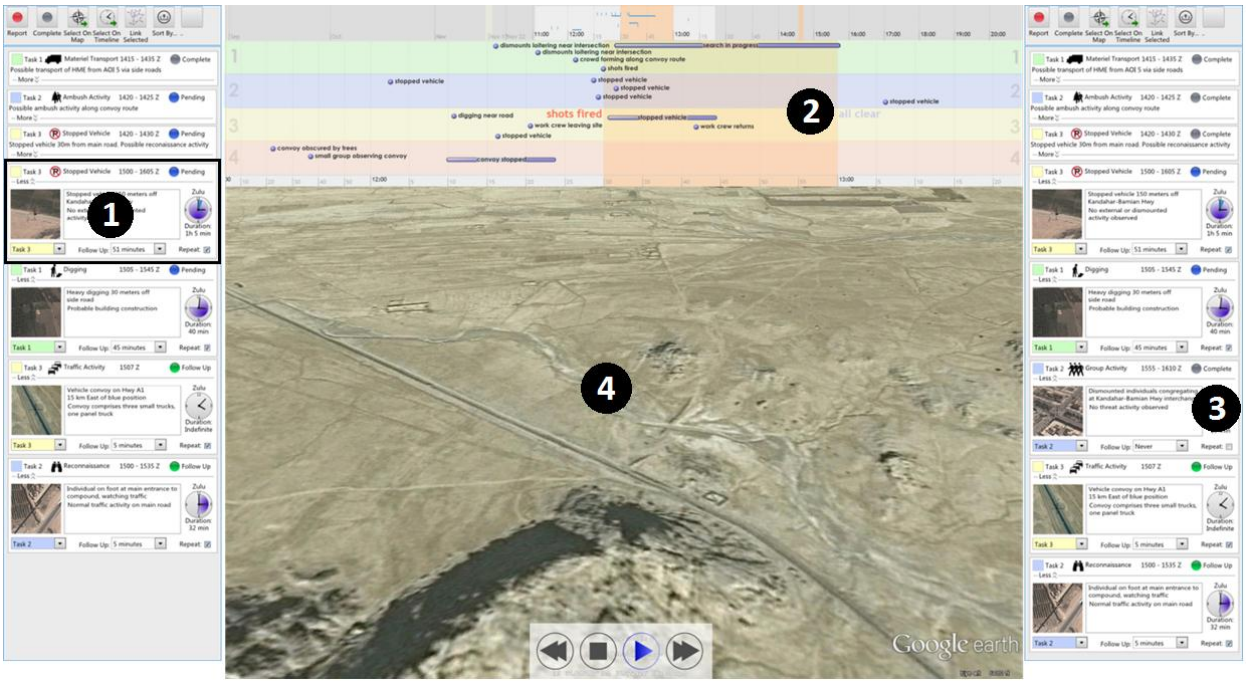

Figure 14. Notional Decision Support System Relating to Results of Cognitive Modeling

The left stack is intended to hold new and emerging events that require monitoring but that the analysts is not ready to report. The right stack is planned to hold already reported (in real-time chat form) emerging events that have higher operational priority. Also, completed events can be deleted from the stacks and inactive events can be collapsed until needed.

In Figure 14 the timeline of events is given a significant portion of the display area. This timeline is not just a summary of the existence of events; it is a part of the exploitation environment. During interviews, FMV analysts reported that they did not multitask. This is because as FMV analysts they do not support multiple simultaneous

missions or view multiple fields of view. Again, WAMI exploitation requires a different approach. A timeline view divided into swim-lanes is more applicable to WAMI analysis; allowing analysts to organize events into categories or sequences. This will allow analysts to construct streams of indicator events for pattern of life analysis and facilitate analyst awareness of events across multiple exploitation tasks.

A few examples of how an event-centered UI concept reduces load on cognitive resources using load profile information extracted from the operator function model and associated OFM-COG table is outlined here. Table 9 provides further details on the design rationale for individual elements of the display. The numbers depicted within the circles in Figure 15 map to the description in Table 9.

Table 9. *Cognitive Features of Decision Support System*

Area on Decision Support System	Cognitive Features Addressed	Explanation
Area 1	Working memory	• Recognition instead of recall frees working memory for other tasks
	Expertise	• Novices and experts can share examples for advice seeking or advice giving purposes
	Saliency	• Visually logs events on the sides (cluttering on screen reduced) • Location coordinates entered automatically • Organization of events is automatic
	Communication	• Includes graphic, text, and all pertinent details • Effectively manages time by reducing

		the need for "requesting additional eyes" • Promotes TeamSpeak for follow-up
	Vigilance	• Other AOIs may be referenced when vigilance is low • Real world interactions to promote vigilance
Area 2	Aesthetic Design	• Takes into account habit of analysts placing mIRC next to AOIs
	Queue to Channel	• Timeline aggregates relevant events allowing for "mental travel" across events • Limits time bias by establishing order for later reference • Spatial orientations create visual handles for fast recognition and follow-up
Area 3	Situational Awareness	• Reference to time, within the timeline and the clock, reinforces situational awareness
	Long Term Memory	• Decision aids in helping to prioritize long-standing events
Area 4	Standardization	• GUI is standardized for future studies of novice vs. expert behavior
	Ease of Use	• Intuitiveness leverages mental models of existing GUIs

7.2 Future Work

Further research and concept development can lead to a notional UI for event management among FMV and WAMI analysts. Building on this study, future work includes taking additional measures to increase the fidelity of information included in the

OFM-COG tables and existing OFM models. Next steps would include further investigation to develop and implement a test plan in validating the proposed measures.

To further develop the proposed conceptual user interface, additional technical development is required. A comparative cognitive task analysis study of analyst performance with and without the tool would validate the utility and effectiveness of the concept for analyst use.

VIII. CONCLUSION

8.1 Summary

This research has focused on studying how real-time motion imagery intelligence missions are performed, and what cognitive demands arise from persistent surveillance. The models presented here work together to identify cues and cognitive demands of the IA. These models and associated OFM-COG tables allow us to visualize cognitive heuristics that the IA uses and their associated biases that directly impact decision making. The models also identify decision points in the mission that directly leads to errors that can occur. And lastly these cognitive models enable designation of metrics by which success can be measured. Based on this analysis metrics can be identified for success/errors and these metrics can be applied directly to IA performance and training.

APPENDIX A: OFM Cognitive Operations Tables Supporting Documents

A.1 Mapping of Information Processing Task Functions to Imagery Analyst Tasks

The table below represents a mapping of Miller's (1974) task functions involved in a generic information-processing system to the tasks conducted by an IA. This mapping is utilized in the OFM-COG tables presented below.

Task Function	Definition and Relationship to IA tasking
Input Select	Selecting what to pay attention to within the image, interface, other analyst a. What are the rules: i. Auditory, visual ii. symbols and vocabulary iii. syntax – combination of cues that creates meaning iv. size of chink of information acceptable: threshold for input detection
Filter	Procedure for reducing or eliminating irrelevant messages (heuristics for determining relevancy of cue) a. Filtering device i. Human filter ii. Automated machine filter - *design element*
Detect	Discrimination of a cue requiring attention or action from background "noise" a. Response lag for detection b. Reliability of detection as relates to discriminability c. Scan patterns (which are more effective) d. (Cognitive) heuristics for detection
Search	Selecting set of entities for inquiry (image, part of image, other

	databases, decision support system, other interface elements) a. Sequencing the set of entities
Identify	Methods for characterizing a message"; "recognize and apply label" a. Reference outside processing system (where it comes from) and physical location (functional) within – how does the IA cross-reference these? b. Principles i. Need additional information beyond what is required for detection ii. Once object/entity is identified, then IA tends to ignore information that is inconsistent with this – confirmation bias iii. Expectancies – recent events (recency bias) impact how cues are identified iv. How to assign identity labels?
Message	Collection of meaningful symbols; features are elements and pattern a. Elements: what are the defined terms? b. Patterns: how does the IA 'organize' the elements in an image/video? (for both elements and pattern) c. Visual (symbol) & Audio (written words) d. "smallest conceptual unit of action that produces a system response"
Queue to Channel	How to organize processing of messages a. Can priority be assigned without having to process all message? i. Take advantage of underutilized channels a. If get many chats & few spoken messages, switch format
Code	Translating what is seen/read into format for reporting a. Intent to not lose meaning b. Recoding may eliminate redundancy i. May lose relevant frequency of message from number

	of cues
Transmit	Moving message from one place to another. Example: taking cues from image and writing in chat or transmitting over headset a. Generally follows parallel (all messages sent at once) transmission b. Bandwidth – channel capacity to send signals i. Human information processing resources ii. Number of chat windows iii. Space available in the interface iv. Sensor bandwidth
Store	Keeping something intact for future use a. Labeling content, determining units required (text, image), locating spacing (where?); loading (how to copy to storage; safeguarding b. Memory required for identifying where information stored may become greater than that needed for the information itself **i.** Label for associative memory
Store in Buffer	Saving temporarily a. Reduced load on short-term memory b. Considerations: variations in message size and type **i.** Patterns with impact heuristics in use of information to make decisions
Compute	Figuring out logical answer to a defined problem a. Use cues to process and answer EEI b. Uses short term (from aids) and long term (learned patterns) memory
Edit	Arranging information into a message according to prescribed formats a. According to IA: need to use military jargon i. Use formatting of accepted reports
Display	"Showing something that makes sense," Recording information for reporting out a. When to use images versus text

	b. When to use raw data versus applying an algorithm c. Manipulate format to aid heuristics d. When to use symbols versus full content in text
Purge	Getting rid of unwanted information a. When timeline fills up or IA has used all available cognitive resources, how to eliminate unneeded information for more effective decision making.
Reset	Identifying new contexts to "reset" (pattern of search or what searching for) a. Update in EEI b. Customer requests new set of information c. New information from intelligence changes course of decision making
Count	Keeping track of how many a. Simple as counting for slash count (how to store and display) b. Tracking cues that build to a decision i. Adding elements of the pattern to build decision support or heuristic pattern ii. How do we use this concept in the timeline?
Control	"Changing an action according to plan" a. Physical: manipulating tools the IA uses b. Symbolic: source of instruction for what happens next i. "function of coordination in time and space according to plan" ii. Signal of status iii. Decision
Decide/Select	Selecting an appropriate response to fit the situation" a. Input condition matches response alternative and strategic rules for selection
Plan	Matching resources to expectations a. Rules for predicting future sets of conditions, responses needed, and order of steps i. Comes directly from interviews and should become

	apparent through OFM
Test	Rules for determining the integrity of the signals, messages a. Signal test – comparing attributes of a test signal with a set of reference values i. Compare structures/activities/etc. with known or expected
Interpret	What meaning can be attributed a. Requires response to a pattern of cues b. What are the learned 'rules' for determining the significance/value of a cue – how does the IA 'test' these for determination thereof. c. Do they hold these references in memory, databases or other decision aid/tool? i. How much tolerance do they allow for determining whether a cue is discarded, stored for future use, or applied immediately? d. Automatic recognition of a pattern i. Heuristics IA use ii. Inferences made from input data and other known information iii. Variables in interpretation a. Degree of statistical certainty (in correct decision) b. Redundancy in context available c. Range in variability of elements in pattern d. Proportion of irrelevant "noise" e. Number of alternative meanings f. Opportunity for interpreter (IA) to query the source and test hypothesis
Categorize	Defining and naming a. Rules for classifying intel according to: source, format, purpose or content b. Structures for information retrieval i. Information storage, decision aid, or memory?

Adapt/Learn	Remembering and formulating new responses to a known, repetitive situation a. Modifying *system* behavior as a result of experience i. IA heuristics ii. Learning algorithm within the decision aid b. Are information handling requirements and process paradigms relevant?
Goal Image	Picture of a task done well a. Criteria for ending a task b. Serves as a steering reference for moving through a "route of action" (i.e. Steps through the OFM) c. Meaningful operationally when system has options i. Less experienced IA may follow procedures and operations rather than goals (and goal variables) a. Stress, fatigue and repetition impacts goal image 1. Training for tolerance in goal variables and to make operator cognitively active

A.2 Information Processing Resources for IA Cognitive Agent Task Definitions

Cognitive Agent Task	Definition	Human Information Processing Resources
Input Select	selecting what to pay attention to within the image, interface, other analyst	Selective attention Perceptual sensitivity
Filter	reducing or eliminating irrelevant messages	Selective attention
Detect	discrimination of a cue requiring attention or action from background "noise"	Perceptual sensitivity Distributed attention
Search	selecting set of entities for inquiry	Sustained attention Perceptual sensitivity
Identify	methods for characterizing a message recognize and apply label	Perceptual discrimination Long-term memory Working memory
Message	collection of meaningful symbols	Response precision

Queue to channel	how to organize processing of messages	Working memory Processing strategy
Code	translating what is seen/heard into format for reporting	Response precision Working memory Long-term memory
Transmit	moving message from one place to another	Response precision
Store	keeping something intact for future use	Working memory Long-term memory
Store in Buffer	saving temporarily	Working memory Processing strategy
Compute	figuring out logical answer to a defined problem	Processing strategy Working memory
Edit	arranging information into a message according to prescribed formats	Long-term memory Selective attention
Display	showing something that makes sense	Response precision
Purge	getting rid of unwanted information empty' their minds of something they determine not important	Selective attention
Reset	identifying new contexts to "reset" procedure	Selective attention Response precision
Count	keeping track of how many	Sustained attention Working memory
Control	changing an action according to plan	Response precision
Decide/ Select	choose a response to fit the situation	Long-term memory Processing strategy
Plan	matching resources to expectations expecting to see something happening based on time or location	Working memory Processing strategy
Test	rules for determining the integrity of the signal or message determining if the signal is there determining if the signal is real or deception	Perceptual sensitivity Working memory Long-term memory
Interpret	what does it mean requires response to a pattern of cues	Long-term memory Sustained attention

	automatic recognition of a pattern	
Categorize	defining and naming on a conscious level (may be verbal or written into the report)	Long-term memory Perceptual sensitivity
Adapt/Learn	making and remembering new responses to a repeated situation may be determinant upon the strength and integrity of the signal/info	Long-term memory
Goal image	picture of a task well done	Long-term memory Processing strategy

APPENDIX B: OFM Cognitive Operations Tables

B.1 CIED: Route Scan OFM-COG Tables

Monitor Chat Rooms/ Communication				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to communication feed	Selective Attention	new information requires written or verbal communication (through chat room or TeamSpeak) to confirm	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	visually pay attention to chat rooms instead of video feed	Perceptual Sensitivity		
Detect	new information requires written or verbal communication (through chat room or TeamSpeak) to confirm	Perceptual Sensitivity	recognize and label new information	Expertise, Expectations, Salience, Rate of Change in Feed
		Distributed Attention		
Identify	recognize and label new information	Perceptual Discrimination	written or verbal communication (through chat room or TeamSpeak)	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness, Time Constraints
		Long-term Memory		
		Working Memory		
Message	written or verbal communication (through chat room or TeamSpeak)	Response Precision	requires communication to confirm new information then	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room

			visual inspection	
Queue to channel	requires communication to confirm new information then visual inspection	Working Memory	determine form of communication needed (written or verbal)	Time Constraints, Computational aid, Activity Levels, Expertise, Knowledge, Vigilance, Situation Awareness, Expectations
		Processing Strategy		
Code	determine form of communication needed (written or verbal)	Response Precision	communicating in correct format to appropriate correspondent(s)	Aid, Expertise, Knowledge, Expectations
		Working Memory		
		Long-term Memory		
Transmit	communicating in correct format to appropriate correspondent(s)	Response Precision	keep new information until mission complete	Quality of Communication Feed, Physical Action, Time Constraints, Display Representation, Competing Transmissions, Expertise, Knowledge
Store in Buffer	keep new information until mission complete	Working Memory	plan for if new information is confirmed or not	Time Constraints, Activity Levels
		Processing Strategy		
Edit	use military jargon	Long-term Memory	accurate account of information in message	Expertise, Knowledge, Expectations
		Selective Attention		
Display	accurate account of information in message	Response Precision	respond to new information by communication	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
Decide/Select	respond to new information by communication	Long-term Memory	plan for if new information is confirmed or not	Expertise, Knowledge, Situation Awareness, Expectations
		Processing Strategy		
Plan	plan for new	Working	processing new	Expertise, Knowledge,

	information	Memory	information	Expectations
		Processing Strategy		
Adapt/Learn	processing new information for the mission	Long-term Memory	investigate new information with communication	Expertise, Knowledge, Time Constraints, Competing Transmissions, Activity Levels
Goal image	investigate new information with communication	Long-term Memory	using communication to confirm new information	Quality of Communication, Activity Levels, Competing Transmissions, Expertise, Expectations, Knowledge
		Processing Strategy		

Mapping/ Change Sensor to IR

Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to visual feed	Selective attention	filter out rest of possible visual distractions	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of possible visual distractions	Selective attention	determining if mapping can be accomplished using current visual feed	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if mapping can be accomplished using current visual feed	Perceptual sensitivity	recognize cues for accurate mapping	Expertise, Expectations
		Distributed attention		
Search	search for cues for accurate mapping	Sustained attention	recognize cues for accurate mapping	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity	recognize uncertainty	

Identify	recognize cues for accurate mapping	Perceptual discrimination	change to different visual feed format	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize uncertainty	Long-term memory	change to different visual feed sensor	
		Working memory		
Control	change to different visual feed sensor	Response precision	choose IR sensor	Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
Decide/Select	choose IR sensor	Long-term memory	expectations of IR format	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Plan	expectations of IR format	Working memory	responding to uncertainty in mapping	Expectations, Expertise
		Processing strategy		
Adapt/Learn	responding to uncertainty in mapping	Long-term memory	efficient mapping to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			using all resources to accurately map visual feed	
Goal image	efficient mapping to complete mission	Long-term memory	use IR sensor for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	using all resources to accurately map visual feed	Processing strategy		

Mapping/Determine Time Created

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demands
Input Select	pay attention to IR sensor data	Selective attention	filter out irrelevant visual distractions	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out irrelevant visual distractions	Selective attention	search for anomalies within data	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Search	search for anomalies within data	Sustained attention	recognize and label anomaly	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label anomaly	Perceptual discrimination	process anomaly information	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory	process of anomaly time detection	
		Working memory		
Queue to channel	process anomaly information	Working memory	save anomaly information for time detection	Time Constraints, Computational aid, Activity Levels, Expertise, Knowledge, Vigilance, Situation Awareness, Expectations
	process of anomaly time detection	Processing strategy		
Store in Buffer	save anomaly information for time detection	Working memory	figure out timing of creation	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out timing of creation	Processing strategy	focus on time of creation only	Computational Aid, Time Constraints, Expertise
		Working	determine time	

		memory	of creation	
Purge	focus on timing of anomaly only	Selective attention	efficient data analysis of time of creation of data to complete mission	Expertise
	focus on anomaly information			
Decide/Select	determine time of creation	Long-term memory	plan on how to determine time of creation based on available resources	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Plan	plan on how to determine time of creation based on available resources	Working memory	response to anomaly detection in IR data	Expectations, Expertise
		Processing strategy		
Adapt/Learn	response to anomaly detection in IR data	Long-term memory	efficient data analysis of time of creation of data to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			using all resources to accurately determine time of creation in data	
Goal image	efficient determination of time creation of data to	Long-term memory	determine time of creation for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise,

	complete mission			Expectations, Knowledge
	using all resources to accurately determine time of creation in data	Processing strategy		

Mapping/ Visual Inspection to Compare				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to visual feed	Selective attention	filter out rest of possible visual distractions	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of possible visual distractions	Selective attention	determining time of creation	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	use cues to determine time of creation	Perceptual sensitivity	search for provided geolocation	Expertise, Expectations
		Distributed attention	search shadow cues to determine time	
			search google earth	
Search	search for provided geolocation	Sustained attention	recognize and label provided geolocation	Salience, Visibility, Activity Levels, Expertise, Number of Cues
	search shadow cues to determine time	Perceptual sensitivity	recognize and label shadow cues	
	search google earth		recognize and label google earth cues	

Identify	recognize and label provided geolocation	Perceptual discrimination	view symbols from provided geolocation	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize and label shadow cues	Long-term memory	view shadow cues	
	recognize and label google earth cues	Working memory	view google earth cues	
Message	view symbols from provided geolocation	Response precision	processing of provided geolocation	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
	view shadow cues		processing of shadow cues	
	view google earth cues		processing of google earth cues	
Queue to channel	processing of provided geolocation	Working memory	translating provided geolocation	Time Constraints, Computational aid, Activity Levels, Expertise, Knowledge, Vigilance, Situation Awareness, Expectations
	processing of shadow cues	Processing strategy	translating shadow cues	
	processing of google earth cues		translating google earth cues	
Code	translating provided geolocation	Response precision	saving provided geolocation	Computational Aid, Expertise, Knowledge, Expectations
	translating shadow cues	Working memory	saving shadow cues	
	translating google earth cues	Long-term memory	saving google earth cues	
Store in Buffer	saving provided geolocation	Working memory	compare images based on selected cue	Computational Aid, Time Constraints
	saving shadow cues	Processing strategy		
	saving google earth cues			

Decide/Select	compare images based on selected cue	Long-term memory	response to which cue to use in visual inspection	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Adapt/Learn	response to which cue to use in visual inspection	Long-term memory	efficient visual inspection of past data to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			using all resources to accurately determine creation time of data	
Goal image	efficient visual inspection of past data to complete mission	Long-term memory	determine time of creation for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	using all resources to accurately determine creation time of data	Processing strategy		

Mapping/ Determine Significance Based on Time				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Identify	recognize and label comparison of data	Perceptual discrimination	keep relevant information saved	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize and label time of creation	Long-term memory	store information on time of creation	

		Working memory		
Store in Buffer	keep relevant information saved	Working memory	figure out if comparison is significant	Computational Aid, Time Constraints
	store information on time of creation	Processing strategy		
Compute	figure out if comparison is significant	Processing strategy	normal or abnormal comparison	Computational Aid, Time Constraints, Expertise
		Working memory		
Decide/Select	normal or abnormal comparison	Long-term memory	continue to match to normal comparison	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy	continue to match to abnormal comparison	
Plan	match to normal comparison	Working memory	test current behavior being observed to normal	Expectations, Expertise
	match to abnormal comparison	Processing strategy	test current behavior being observed to abnormal	
Test	test comparison to knowledge of normal	Perceptual sensitivity	no significance of comparison	Knowledge, Expertise
	test comparison to knowledge of abnormality	Working memory	significance of comparison	
		Long-term memory		
Interpret	no significance of comparison	Long-term memory	ignore if no significance	Expertise, Knowledge, Number of Cues
	significance of comparison	Sustained attention	contact customer if determined significant	

Categorize	ignore if no significance	Long-term memory	continue scanning for POL activity	Expertise, Knowledge, Number of Cues
	contact customer if determined significant	Perceptual sensitivity	communicate with customer	
			document for final product report	
Adapt/Learn	appropriate response if determined non-significant	Long-term memory	efficient visual inspection of significance to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
	appropriate response if determined significant		efficient mapping to complete mission	
Goal image	efficient visual inspection of significance to complete mission	Long-term memory	continue scanning for POL activity	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	efficient mapping to complete mission	Processing strategy	communicate with customer	
			document for final product report	

KML Loaded with Markers/Look at Historical Data				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**
Input Select	visually pay attention to KML data	Selective attention	filter out irrelevant markers	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to	Perceptual		

	markers	sensitivity		
Filter	filter out irrelevant markers	Selective attention	determine cues to help with current mission	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determine cues to help with current mission	Perceptual sensitivity	recognize and label relevant markers	Expertise, Expectations
		Distributed attention		
Identify	recognize and label relevant markers	Perceptual discrimination	save relevant information for future use	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store	save relevant information for future use	Working memory	response to KML data	Aid, Time Constraints
		Long-term memory		
Adapt/Learn	response to KML data	Long-term memory	efficient visual inspection of KML data to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			efficient determination of relevancy of markers to complete mission	
Goal image	efficient visual inspection of KML data to complete mission	Long-term memory		Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	efficient determination	Processing strategy	review historical data	

	of relevancy of markers to complete mission			

Look at Historical Data/Look in Local Image Base				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**
Input Select	visually pay attention to KML data	Selective attention	filter out irrelevant activity	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to local images	Perceptual sensitivity		
Filter	filter out irrelevant activity	Selective attention	determine cues to help with current mission	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determine cues to help with current mission	Perceptual sensitivity	recognize and label relevant activity	Expertise, Expectations
		Distributed attention		
Identify	recognize and label relevant activity	Perceptual discrimination	save relevant information for future use	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store	save relevant information for future use	Working memory	response to local image data	Aid, Time Constraints
		Long-term memory		
Adapt/Learn	response to local image data	Long-term memory	efficient visual inspection of local image data to complete	Expertise, Knowledge, Number of Cues, Time Constraints

			mission	
			efficient determination of relevancy of local image data activity to complete mission	
Goal image	efficient visual inspection of local image data to complete mission	Long-term memory		Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	efficient determination of relevancy of local image data activity to complete mission	Processing strategy	review local historical data	

Look at Historical Data/ID Permanent Environmental Structures				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to permanent environmental structures in local historical data	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if structure requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if structure requires attention	Perceptual sensitivity	search for permanent environmental	Expertise, Expectations

			structures within visual data	
		Distributed attention		
Search	search for permanent environmental structures within visual data	Sustained attention	recognize and label structures	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label structures	Perceptual discrimination	store information on structures	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on structures	Working memory	track number of structures	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of structures	Sustained attention	expectations of structures	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of structures	Working memory	define structure	Expectations, Expertise
		Processing strategy		
Categorize	define religious structure	Long-term memory	appropriate and optimal reaction to permanent environmental structures	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to	Long-term memory	efficient visual inspection of	Expertise, Knowledge, Number of Cues, Time Constraints

	permanent environmental structures in local image data base		local images to complete mission	
Goal image	efficient visual inspection of local images to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Look at Historical Data/ID Structures				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to structures in local historical data	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if structure requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if structure requires attention	Perceptual sensitivity	search for structures within visual data	Expertise, Expectations
		Distributed attention		
Search	search for structures within visual data	Sustained attention	recognize and label structures	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		

Identify	recognize and label structures	Perceptual discrimination	store information on structures	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on structures	Working memory	track number of structures	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of structures	Sustained attention	expectations of structures	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of structures	Working memory	define structure	Expectations, Expertise
		Processing strategy		
Categorize	define religious structure	Long-term memory	appropriate and optimal reaction to structures in local images	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to structures in local image data base	Long-term memory	efficient visual inspection of local images to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of local images to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Customer Gives AOI(s)/ Define Starting Point(s)

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demands
Input Select	pay attention to AOI given	Selective attention	recognize AOI	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to new CIED activity	Perceptual sensitivity	recognize CIED activity	
Identify	recognize AOI	Perceptual discrimination	keep location of AOI for future use	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize CIED activity	Long-term memory	keep CIED activity for future use	
		Working memory		
Store	keep location of AOI for future use	Working memory	compute starting point for scanning watch windows based on location of AOI	Computational Aid, Time Constraints
	keep CIED activity for future use	Long-term memory	compute starting point for scanning watch windows based on CIED activity	
Compute	compute starting point for scanning watch windows	Processing strategy	choose starting point	Computational Aid, Time Constraints, Expertise
		Working memory	if starting scan for new CIED activity get rid of old CIED activity details	
Purge	if starting scan for new CIED activity get rid of old CIED activity details	Selective attention	choose starting point	Expertise
Decide/Select	choose starting point	Long-term memory	to efficiently inspect CIED activity to complete mission	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		

Goal image	ability to efficiently inspect CIED activity to complete mission	Long-term memory	define starting points to inspect CIED activity	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Define Starting Point(s)/ Slow Scan				
Cognitive Agent Task	**Example**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to potential CIED activities	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to target	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determine if activity requires attention	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determine if activity requires attention	Perceptual sensitivity	slowly search for only CIED activities	Expertise, Expectations
		Distributed attention		
Search	slowly search for only CIED activities	Sustained attention	recognize and label activities	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label activities	Perceptual discrimination	store relevant information on activity	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		

Store in Buffer	store relevant information on activity	Working memory	figure out if activity is CIED	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out if activity is CIED	Processing strategy	expectations of a CIED activity	Computational Aid, Time Constraints, Expertise
		Working memory		
Count	keep track of number of individual's performing activity	Sustained attention	expectations of a CIED activity	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of a CIED activity	Working memory	determine meaning of activity observed	Expectations, Expertise
		Processing strategy		
Interpret	determine meaning of activity observed	Long-term memory	define and name activity as CIED	Expertise, Knowledge, Number of Cues
		Sustained attention		
Categorize	define and name activity as CIED	Long-term memory	inspect CIED activity	Expertise, Knowledge, Number of Cues, Quality of Feed, Expectations
		Perceptual sensitivity	communicate with customer	
Adapt/Learn	responses to certain activity	Long-term memory	confirming CIED activity	Expertise, Knowledge, Number of Cues, Time Constraints
			reason to communicate	
Goal image	inspect CIED activity	Long-term memory	further scanning for inspection of CIED activity	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	communicate	Processing		

	with customer	strategy		

Define Starting Point(s)/Scan Around Point				
Cognitive Agent Task	**Example**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to potential CIED activities	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to target	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determine if activity requires attention	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determine if activity requires attention	Perceptual sensitivity	slowly search for only CIED activities	Expertise, Expectations
		Distributed attention		
Search	slowly search for only CIED activities	Sustained attention	recognize and label activities	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label activities	Perceptual discrimination	store relevant information on activity	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store relevant information on activity	Working memory	figure out if activity is CIED	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out if	Processing	expectations of a	Computational Aid, Time

	activity is CIED	strategy	CIED activity	Constraints, Expertise
		Working memory		
Count	keep track of number of individual's performing activity	Sustained attention	expectations of a CIED activity	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of a CIED activity	Working memory	determine meaning of activity observed	Expectations, Expertise
		Processing strategy		
Interpret	determine meaning of activity observed	Long-term memory	define and name activity as CIED	Expertise, Knowledge, Number of Cues
		Sustained attention		
Categorize	define and name activity as CIED	Long-term memory	inspect CIED activity	Expertise, Knowledge, Number of Cues, Quality of Feed, Expectations
		Perceptual sensitivity	communicate with customer	
Adapt/Learn	responses to certain activity	Long-term memory	confirming CIED activity	Expertise, Knowledge, Number of Cues, Time Constraints
			reason to communicate	
Goal image	inspect CIED activity	Long-term memory	further scanning for inspection of CIED activity	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	communicate with customer	Processing strategy		

Scanning/Check Terrain					
Cognitive Agent Task	**Input**	**Human Information**	**Output**	**Task and Environmental Demands**	**Cognit Bias**

		Processing Resources			
Input Select	pay attention to terrain cues	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise	
		Perceptual sensitivity			
Filter	filter out rest of activity in watch window	Selective attention	determining if cue requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations	
Detect	determining if cue requires attention	Perceptual sensitivity	search for cues within visual data	Expertise, Expectations	
		Distributed attention			
Search	search for cues within visual data	Sustained attention	recognize and label cues	Salience, Visibility, Activity Levels, Expertise, Number of Cues	
		Perceptual sensitivity			
Identify	recognize and label cues	Perceptual discrimination	store information on cues	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness	
		Long-term memory			
		Working memory			
Store in Buffer	store information on cues	Working memory	track number of cues	Computational Aid, Time Constraints	
		Processing strategy			
Count	track number of cues	Sustained attention	expectations of cues	Number of Competing Feeds, Amount of Activity	
		Working memory			
Plan	expectations of cues	Working memory	define cues	Expectations, Expertise	
		Processing strategy			
Categorize	define cues	Long-term	appropriate and	Expertise, Knowledge, Number of	

		memory	optimal reaction to terrain cues	Cues	
		Perceptual sensitivity			
Adapt/Learn	appropriate and optimal reaction to terrain cues	Long-term memory	efficient visual inspection of terrain cues to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints	
Goal image	efficient visual inspection of terrain cues to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge	
		Processing strategy			

Scanning/Check for Ambush Cues				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to ambush cues	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if cue requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if cue requires attention	Perceptual sensitivity	search for cues within visual data	Expertise, Expectations
		Distributed attention		
Search	search for cues within visual data	Sustained attention	recognize and label cues	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		

Identify	recognize and label cues	Perceptual discrimination	store information on cues	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on cues	Working memory	track number of cues	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of cues	Sustained attention	expectations of cues	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of cues	Working memory	define cues	Expectations, Expertise
		Processing strategy		
Categorize	define cues	Long-term memory	appropriate and optimal reaction to ambush cues	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to ambush cues	Long-term memory	efficient visual inspection of ambush cues to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of ambush cues to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Check Traffic Pattern				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**

Input Select	pay attention to traffic pattern cues	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if cue requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if cue requires attention	Perceptual sensitivity	search for cues within visual data	Expertise, Expectations
		Distributed attention		
Search	search for cues within visual data	Sustained attention	recognize and label cues	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label cues	Perceptual discrimination	store information on cues	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on cues	Working memory	track number of cues	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of cues	Sustained attention	expectations of cues	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of cues	Working memory	define cues	Expectations, Expertise
		Processing strategy		
Categorize	define cues	Long-term memory	appropriate and optimal reaction to traffic pattern cues	Expertise, Knowledge, Number of Cues
		Perceptual		

		sensitivity		
Adapt/Learn	appropriate and optimal reaction to traffic pattern cues	Long-term memory	efficient visual inspection of traffic pattern cues to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of traffic pattern cues to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Check Human Activity				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to human activity cues	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if cue requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if cue requires attention	Perceptual sensitivity	search for cues within visual data	Expertise, Expectations
		Distributed attention		
Search	search for cues within visual data	Sustained attention	recognize and label cues	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label cues	Perceptual discrimination	store information on cues	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term		

		memory		
		Working memory		
Store in Buffer	store information on cues	Working memory	track number of cues	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of cues	Sustained attention	expectations of cues	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of cues	Working memory	define cues	Expectations, Expertise
		Processing strategy		
Categorize	define cues	Long-term memory	appropriate and optimal reaction to human activity cues	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to human activity cues	Long-term memory	efficient visual inspection of human activity cues to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of human activity cues to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Check Entrances				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to	Selective	filter out rest of	Salience, Rate of Change in Feed,

	entrance to buildings activity cues	attention	activity in watch window	Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if cue requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if cue requires attention	Perceptual sensitivity	search for cues within visual data	Expertise, Expectations
		Distributed attention		
Search	search for cues within visual data	Sustained attention	recognize and label cues	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label cues	Perceptual discrimination	store information on cues	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on cues	Working memory	track number of cues	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of cues	Sustained attention	expectations of cues	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of cues	Working memory	define cues	Expectations, Expertise
		Processing strategy		
Categorize	define cues	Long-term memory	appropriate and optimal reaction to entrance to buildings activity cues	Expertise, Knowledge, Number of Cues

		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to entrance to buildings activity cues	Long-term memory	efficient visual inspection of entrance to buildings activity cues to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of entrance to buildings activity cues to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Determine Significance				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Identify	recognize and label CIED activity under inspection in FMV	Perceptual discrimination	keep relevant actions saved	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	keep relevant actions saved	Working memory	figure out if activity is significant	Computational Aid, Time Constraints
		Processing strategy	figure out if activity is non-significant	
Compute	figure out if activity is significant	Processing strategy	track people performing activity	Computational Aid, Time Constraints, Expertise
	figure out if activity is non-	Working memory		

	significant			
Count	track people under inspection	Sustained attention	people performing normal or abnormal activity	Number of Competing Feeds, Amount of Activity
		Working memory		
Decide/Select	normal or abnormal actions	Long-term memory	continue to match to normal observed behavior	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy	continue to match to abnormal observed behavior	
Plan	match to normal observed activities	Working memory	test current behavior being observed to normal	Expectations, Expertise
	match to abnormal observed activities	Processing strategy	test current behavior being observed to abnormal	
Test	test activity being performed to knowledge of a normal activity	Perceptual sensitivity	potential need for further investigation	Knowledge, Expertise
	test activity being performed to knowledge of an abnormal activity	Working memory		
		Long-term memory		
Interpret	potential need for further investigation based on interpretation	Long-term memory	reason for action	Expertise, Knowledge, Number of Cues
		Sustained attention		
Categorize	reason for action	Long-term	efficient visual	Expertise, Knowledge, Number of

		memory	inspection of actions to complete mission	Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to actions performed	Long-term memory	efficient significance of activity determined to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient significance of activity determined to complete mission	Long-term memory	determined significant	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy	determined non-significant	
			document for final product report	

Tracking/ Tracking Request Made				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to customer's request to track target	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	visually pay attention to target for tracking	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	recognize and label target	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	customer	Perceptual	recognize and	Expertise, Expectations

	requires tracking of target	sensitivity	label target	
		Distributed attention		
Identify	recognize and label target	Perceptual discrimination	requires the visual inspection process to track target	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Queue to channel	requires the visual inspection process to track target	Working memory	store information on target to carry out tracking request	Expertise, Knowledge, Number of Cues, Time Constraints
		Processing strategy		
Store in Buffer	store information on target to carry out tracking request	Working memory	figuring out if WAMI is sufficient for tracking	Computational Aid, Time Constraints
		Processing strategy		
Compute	figuring out if WAMI is sufficient for tracking	Processing strategy	follow process for following out a tracking request	Computational Aid, Time Constraints, Expertise
		Working memory		
Purge	follow process for following out a tracking request	Selective attention	reset to track target	Expertise

Reset	reset to track target	Selective attention	reacting to customer's tracking request	Expertise
		Response precision		
Control	reacting to customer's tracking request	Response precision	start visual inspection process to track target	Expertise, Knowledge, Number of Cues, Time Constraints
Decide/Select	start visual inspection process to track target	Long-term memory	plan for tracking target	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Plan	plan for tracking target	Working memory	processing tracking requests for targets	Expectations, Expertise
		Processing strategy		
Adapt/Learn	processing tracking requests for targets	Long-term memory	follow out tracking request to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	follow out tracking request to complete mission	Long-term memory	switch to FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy	place pin for tracking	

Tracking/ Switch to FMV				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**

Input Select	switch to FMV feed	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to target	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	search for target	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Search	search for target	Sustained attention	recognize and label target	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity	recognize and label movement of target	
Identify	recognize and label target	Perceptual discrimination	message to have spotball moved due to movement of target	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize and label movement of target	Long-term memory		
		Working memory		
Message	message to have spotball moved due to movement of target	Response precision	use military jargon in message	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Code	use military jargon in message	Response precision	verbal or written message on movement of target	Expertise, Knowledge

		Working memory		
		Long-term memory		
Transmit	message is written or verbal	Response precision	verbal or written message on movement of target	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Reset	FMV feed changes due to spotball repositioning	Selective attention	track target	Expertise
		Response precision		
Count	keep track of targets if more than one	Sustained attention	search and identify target	Number of Competing Feeds, Amount of Activity
		Working memory		
Decide/Select	track target	Long-term memory	track target using new spotball position	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Plan	track target using new spotball position	Working memory	test if target can be tracked with new spotball position	Expectations, Expertise
		Processing strategy		
Test	test if target can be tracked with new spotball position	Perceptual sensitivity	spotball in correct position	Knowledge, Expertise
		Working memory	spotball in incorrect position	

		Long-term memory		
Interpret	spotball in correct position	Long-term memory	start tracking target	Expertise, Knowledge, Number of Cues
	spotball in incorrect position	Sustained attention	new message to get correct positioning of spotball	
Adapt/Learn	responding to target movement	Long-term memory	efficient repositioning of spotball to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
	responding to need for new spotball position		efficient tracking of target using FMV to complete mission	
Goal image	efficient repositioning of spotball to complete mission	Long-term memory	track target for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	efficient tracking of target using FMV to complete mission	Processing strategy		

Tracking/ Track Target				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to	Selective attention	filter out rest of activity in	Salience, Rate of Change in Feed, Visibility, Activity Levels,

	target		watch window	Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	search for target	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Search	search for target	Sustained attention	recognize and label target	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity	recognize and label movement of target	
Identify	recognize and label target	Perceptual discrimination	keep track of targets if more than one	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize and label movement of target	Long-term memory	track target	
		Working memory		
Count	keep track of targets if more than one	Sustained attention	track target	Number of Competing Feeds, Amount of Activity
		Working memory		
Decide/Select	track target	Long-term memory	plan for tracking target	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Plan	plan for tracking target	Working memory	efficient tracking of target at starting	Expectations, Expertise

			position to complete mission	
		Processing strategy		
Goal image	efficient tracking of target at starting position to complete mission	Long-term memory	track target for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Tracking/ Define Starting Point(s)

Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to target for tracking	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	recognize target	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Identify	recognize target	Perceptual discrimination	keep identification of target for future use	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		

Store	keep identification of target for future use	Working memory	compute starting point for scanning watch windows based on location of AOI	Computational Aid, Time Constraints
		Long-term memory	compute starting point for scanning watch windows based on target	
			compute starting point for scanning watch windows based on POL activity	
Compute	compute starting point for scanning watch windows	Processing strategy	choose starting point	Computational Aid, Time Constraints, Expertise
		Working memory		
Purge	get rid of old information	Selective attention	choose starting point	Expertise
	get rid of other watch windows		give other AOIs to other analyst	
Reset	give other AOIs to other analyst	Selective attention	choose starting point to start scanning for target	Expertise
		Response precision		
Decide/Select	choose	Long-term	to efficiently	Number of Competing Feeds,

	starting point	memory	track a target to complete mission	Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Goal image	ability to efficiently track a target to complete mission	Long-term memory	define starting points to track a target for a successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

B.2 CIED: Rural Scan OFM-COG Table

Communication/ Sensor Operator

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demand
Input Select	visually pay attention to chat rooms	Selective attention	ignore messages to other correspondent(s)	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to verbal communication through TeamSpeak or locally	Perceptual sensitivity	ignore unnecessary visual data	
Filter	ignore messages to other correspondent(s)	Selective attention	determine which messages require attention or action	Expertise, Activity Levels, Quality of Communication Feed
Detect	determine which messages require attention or action	Perceptual sensitivity	recognize important or relevant messages and label them	Expertise, Expectations, Salience, Rate of Change in Feed
		Distributed attention		
Identify	recognize important or	Perceptual discrimination	written or verbal communication	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness,

	relevant messages and label them		(through chat room or TeamSpeak)	Time Constraints
		Long-term memory		
		Working memory		
Message	written or verbal communication (through chat room or TeamSpeak)	Response precision	determine form of communication needed (written or verbal)	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Code	determine form of communication needed (written or verbal)	Response precision	communicating in correct format to appropriate person	Aid, Expertise, Knowledge, Expectations
		Working memory		
		Long-term memory		
Transmit	communicating in correct format to appropriate person	Response precision	understanding messages	Quality of Communication Feed, Physical Action, Time Constraints, Display Representation, Competing Transmissions, Expertise, Knowledge
Compute	understanding messages	Processing strategy	use military jargon	Computational Aid, Quality of Communication Feed, Time Constraints, Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance
		Working memory		
Edit	use military jargon	Long-term memory	accurate communication and method	Expertise, Knowledge, Expectations
		Selective attention		
Display	accurate communication and method	Response precision	response needed or not	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
			respond to whom	

Decide/Select	response needed or not	Long-term memory	communication meets expectations of sensor operator	Expertise, Knowledge, Situation Awareness, Expectations
	respond to whom	Processing strategy		
Plan	communication meets expectations of sensor operator	Working memory	determining accurate communications	Expertise, Knowledge, Expectations
		Processing strategy		
Test	determining accurate communications	Perceptual sensitivity	interpret communication and sensor operator's needs	Expertise, Knowledge, Expectations
		Working memory		
		Long-term memory		
Interpret	interpret communication and sensor operator's needs	Long-term memory	appropriate and optimal responses to communication with sensor operator	Quality of Communication Feed, Expertise, Knowledge, Expectations
		Sustained attention		
Adapt/Learn	appropriate and optimal responses to communication with sensor operator	Long-term memory	efficient communication with sensor operator to complete mission	Expertise, Knowledge, Time Constraints, Competing Transmissions, Activity Levels
Goal image	efficient communication with sensor operator to complete mission	Long-term memory		Quality of Communication, Activity Levels, Competing Transmissions, Expertise, Expectations, Knowledge
		Processing strategy		

Communication/ Aircraft Operator				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demand**
Input Select	pay attention to verbal communication through TeamSpeak	Selective attention	ignore messages to other correspondent(s)	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	ignore messages to other correspondent(s)	Selective attention	determine which messages require attention or action	Expertise, Activity Levels, Quality of Communication Feed
Detect	determine which messages require attention or action	Perceptual sensitivity	recognize important or relevant messages and label them	Expertise, Expectations, Salience, Rate of Change in Feed
		Distributed attention		
Identify	recognize important or relevant messages and label them	Perceptual discrimination	message is verbal	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness, Time Constraints
		Long-term memory		
		Working memory		
Message	message is verbal	Response precision	understanding messages	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Compute	understanding messages	Processing strategy	use military jargon	Computational Aid, Quality of Communication Feed, Time Constraints, Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance
		Working memory		

Edit	verbal communication in military jargon	Long-term memory	accurate communication and method	Expertise, Knowledge, Expectations
		Selective attention		
Display	accurate communication and method	Response precision	response needed or not	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
			respond to whom	
Decide/Select	response needed or not	Long-term memory	communication meets expectations of aircraft operator	Expertise, Knowledge, Situation Awareness, Expectations
	respond to whom	Processing strategy		
Plan	communication meets expectations of aircraft operator	Working memory	determining accurate communications	Expertise, Knowledge, Expectations
		Processing strategy		
Test	determining accurate communications	Perceptual sensitivity	interpret communication and aircraft operator's needs	Expertise, Knowledge, Expectations
		Working memory		
		Long-term memory		
Interpret	interpret communication and aircraft operator's needs	Long-term memory	appropriate and optimal responses to communication with aircraft operator	Quality of Communication Feed, Expertise, Knowledge, Expectations
		Sustained attention		
Adapt/Learn	appropriate and optimal responses to communication	Long-term memory	efficient communication with aircraft operator to	Expertise, Knowledge, Time Constraints, Competing Transmissions, Activity Levels

	with aircraft operator		complete mission	
Goal image	efficient communication with aircraft operator to complete mission	Long-term memory		Quality of Communication, Activity Levels, Competing Transmissions, Expertise, Expectations, Knowledge
		Processing strategy		

Communication/ Other Analyst				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demand**
Input Select	visually pay attention to chat rooms	Selective attention	ignore messages to other analyst(s)	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to verbal communication through TeamSpeak or locally	Perceptual sensitivity		
Filter	ignore messages to other analyst(s)	Selective attention	determine which messages require attention or action	Expertise, Activity Levels, Quality of Communication Feed
Detect	determine which messages require attention or action	Perceptual sensitivity	label relevant messages	Expertise, Expectations, Salience, Rate of Change in Feed
		Distributed attention		
Identify	label relevant messages	Perceptual discrimination	written or verbal communication (through chat room or TeamSpeak)	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness, Time Constraints
		Long-term memory		

		Working memory		
Message	written or verbal communication (through chat room or TeamSpeak)	Response precision	determine form of communication needed (written or verbal)	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Code	determine form of communication needed (written or verbal)	Response precision	communicating in correct format to appropriate person	Aid, Expertise, Knowledge, Expectations
		Working memory		
		Long-term memory		
Transmit	communicating in correct format to appropriate person	Response precision	understanding incoming message	Quality of Communication Feed, Physical Action, Time Constraints, Display Representation, Competing Transmissions, Expertise, Knowledge
Compute	understanding incoming message	Processing strategy	use military jargon	Computational Aid, Quality of Communication Feed, Time Constraints, Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance
		Working memory		
Edit	written or verbal communication (through chat room or TeamSpeak) in military jargon	Long-term memory	accurate communication and method	Expertise, Knowledge, Expectations
		Selective attention		
Display	accurate communication and method	Response precision	response needed or not	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
			respond to whom	
Decide/Select	response needed or not	Long-term memory	communication meets	Expertise, Knowledge, Situation Awareness, Expectations

			expectations of sensor operator	
	respond to whom	Processing strategy		
Plan	communication meets expectations of sensor operator	Working memory	determining accurate communications	Expertise, Knowledge, Expectations
		Processing strategy		
Test	determining accurate communications	Perceptual sensitivity	interpret communication and analyst(s)'s needs	Expertise, Knowledge, Expectations
		Working memory		
		Long-term memory		
Interpret	interpret communication and analyst(s)'s needs	Long-term memory	appropriate and optimal responses to communication with other analyst(s)	Quality of Communication Feed, Expertise, Knowledge, Expectations
		Sustained attention		
Adapt/Learn	appropriate and optimal responses to communication with other analyst(s)	Long-term memory	efficient communication with other analyst(s) to complete mission	Expertise, Knowledge, Time Constraints, Competing Transmissions, Activity Levels
Goal image	efficient communication with other analyst(s) to complete mission	Long-term memory		Quality of Communication, Activity Levels, Competing Transmissions, Expertise, Expectations, Knowledge
		Processing strategy		

Communication/ Customer Redirects

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demand
Input Select	pay attention to new information message from customer	Selective attention	determine if new information requires attention or action	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Detect	determine if new information requires attention or action	Perceptual sensitivity	recognize and apply label to new information	Expertise, Expectations, Salience, Rate of Change in Feed
		Distributed attention		
Identify	recognize and apply label to new information	Perceptual discrimination	receive message from customer	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness, Time Constraints
		Long-term memory		
		Working memory		
Message	receive message from customer	Response precision	start process to handle new information	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Queue to channel	start process to handle new information	Working memory	translate the written or verbal new information message to mentally create a visual for inspection	Time Constraints, Computational aid, Activity Levels, Expertise, Knowledge, Vigilance, Situation Awareness, Expectations
		Processing strategy		
Code	translate the written or verbal new information message to mentally create a	Response precision	keep new information for future visual inspections	Aid, Expertise, Knowledge, Expectations

	visual for inspection			
		Working memory		
		Long-term memory		
Store	keep new information for future visual inspections	Working memory	determine what to do with new information	Time Constraints, Activity Levels, Expertise
		Long-term memory		
Compute	determine what to do with new information	Processing strategy	get rid of all past data unrelated to new information	Computational Aid, Quality of Communication Feed, Time Constraints, Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance
		Working memory		
Purge	get rid of all past data unrelated to new information	Selective attention	reacting to new information according to plan	Expertise
Control	reacting to new information according to plan	Response precision	respond to new information	Expertise, Knowledge, Situation Awareness
Decide/Select	respond to new information	Long-term memory	follow process when new information is given	Expertise, Knowledge, Situation Awareness, Expectations
		Processing strategy		
Plan	follow process when new information is given	Working memory	interpret new information	Expertise, Knowledge, Expectations
		Processing strategy	determining what the customer needs	
Interpret	interpret new information	Long-term memory	appropriate and optimal reaction to customer with new information	Quality of Communication Feed, Expertise, Knowledge, Expectations

	determining what the customer needs	Sustained attention		
Adapt/Learn	appropriate and optimal reaction to customer with new information	Long-term memory	efficient use of new information to complete mission	Expertise, Knowledge, Time Constraints, Competing Transmissions, Activity Levels
Goal image	efficient use of new information to complete mission	Long-term memory		Quality of Communication, Activity Levels, Competing Transmissions, Expertise, Expectations, Knowledge
		Processing strategy		

Communication/Customer Redirects/Aircraft Operator				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmen**
Input Select	pay attention to visual needs due to customer's redirection	Selective attention	determine if redirection requires different visual data	Salience, Rate of Cha Visibility, Activity Lev
		Perceptual sensitivity		
Detect	determine if redirection requires different visual data	Perceptual sensitivity	select visual data needed based on customer redirection	Expertise, Expectatio Rate of Change in Fe
		Distributed attention		
Search	select visual data needed based on customer redirection	Sustained attention	recognize and apply label to customer redirection	Display Representati Activity Levels, Qualit Communication Feed
		Perceptual sensitivity		
Identify	recognize and apply label to customer redirection	Perceptual discrimination	receive redirection message from customer	Expertise, Number of Change in Feed, Situa Awareness, Time Con
		Long-term memory		
		Working		

		memory		
Message	receive redirection message from customer	Response precision	start process to get correct visual data	Expertise, Knowledge Oral Communication, Chat Room
Queue to channel	start process to get correct visual data	Working memory	translate the written or verbal message to mentally create a visual for inspection	Time Constraints, Cor aid, Activity Levels, Ex Knowledge, Vigilance Awareness, Expectati
		Processing strategy		
Code	translate the written or verbal message to mentally create a visual for inspection	Response precision	transfer redirection message to aircraft operator for new visual data	Aid, Expertise, Knowl Expectations
		Working memory		
		Long-term memory		
Transmit	transfer redirection message to aircraft operator for new visual data	Response precision	keep redirection information for future visual inspections	Quality of Communic Physical Action, Time Display Representatio Transmissions, Expert Knowledge
Store	keep redirection information for future visual inspections	Working memory	keep redirection information for aircraft operator's needs	Time Constraints, Act Expertise
		Long-term memory		
Store in Buffer	keep redirection information for aircraft operator's needs	Working memory	determine what to do with customer's redirection	Time Constraints, Act
		Processing strategy		
Compute	determine what to do with customer's redirection	Processing strategy	verbal communication of customer redirection in military jargon to aircraft operator	Computational Aid, C Communication Feed Constraints, Competi Rooms, Competing Tr Expertise, Knowledge
		Working memory		
Edit	verbal communication of	Long-term	get rid of all past data	Expertise, Knowledge

	customer redirection in military jargon to aircraft operator	memory	unrelated to new information	
		Selective attention		
Purge	get rid of all past data unrelated to new information	Selective attention	reacting to customer's redirection according to plan	Expertise
Control	reacting to customer's redirection according to plan	Response precision	respond to customer's redirection	Expertise, Knowledge Awareness
			request different visual data	
Decide/Select	respond to customer's redirection	Long-term memory	requests of aircraft operator made based on past experiences/expectations	Expertise, Knowledge Awareness, Expectati
	request different visual data	Processing strategy		
Plan	requests of aircraft operator made based on past experiences/expectations	Working memory	interpret customer's redirection and wants	Expertise, Knowledge
		Processing strategy	determining what the aircraft operator can do	
Interpret	interpret customer's redirection and wants	Long-term memory	appropriate and optimal reaction to customer redirection for different images	Quality of Communic Expertise, Knowledge
	determining what the aircraft operator can do	Sustained attention		
Adapt/Learn	appropriate and optimal reaction to customer redirection for different images	Long-term memory	efficient use of aircraft operator's abilities to complete mission	Expertise, Knowledge Constraints, Competi Transmissions, Activit
Goal image	efficient use of aircraft operator's abilities to complete mission	Long-term memory	receive different images from aircraft operator	Quality of Communic Levels, Competing Tra Expertise, Expectatio
		Processing strategy		

Mapping/ Change Sensor to IR				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to visual feed	Selective attention	filter out rest of possible visual distractions	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of possible visual distractions	Selective attention	determining if mapping can be accomplished using current visual feed	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if mapping can be accomplished using current visual feed	Perceptual sensitivity	recognize cues for accurate mapping	Expertise, Expectations
		Distributed attention		
Search	search for cues for accurate mapping	Sustained attention	recognize cues for accurate mapping	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity	recognize uncertainty	
Identify	recognize cues for accurate mapping	Perceptual discrimination	change to different visual feed format	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize uncertainty	Long-term memory	change to different visual feed sensor	
		Working memory		
Control	change to different visual feed sensor	Response precision	choose IR sensor	Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
Decide/Select	choose IR sensor	Long-term memory	expectations of IR format	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations

		Processing strategy		
Plan	expectations of IR format	Working memory	responding to uncertainty in mapping	Expectations, Expertise
		Processing strategy		
Adapt/Learn	responding to uncertainty in mapping	Long-term memory	efficient mapping to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			using all resources to accurately map visual feed	
Goal image	efficient mapping to complete mission	Long-term memory	use IR sensor for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	using all resources to accurately map visual feed	Processing strategy		

Scanning/ Ignore IR Data (Continue Scanning)

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demands
Identify	recognize and label normal activity	Perceptual discrimination	dispose information on inspected IR data	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize and label normal IR data	Long-term memory		
	recognize and label activity as non-significant based on	Working memory		

	comparison			
Purge	dispose information on inspected IR data	Selective attention	ignore past activity observed	Expertise
Decide/Select	ignore past activity observed	Long-term memory	begin new scan	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Control	begin new scan	Response Precision	need for further investigation of other CIED activities within watch window	Expertise, Knowledge, Number of Cues, Time Constraints
Interpret	need for further investigation of other CIED activities within watch window	Long-term memory	thorough inspection of all possible CIED activities to complete mission	Expertise, Knowledge, Number of Cues
		Sustained attention		
Goal image	thorough inspection of all possible CIED activities to complete mission	Long-term memory	make judgment on IR data to complete mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Mapping/Determine Time Created				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to IR sensor data	Selective attention	filter out irrelevant visual distractions	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise

		Perceptual sensitivity		
Filter	filter out irrelevant visual distractions	Selective attention	search for anomalies within data	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Search	search for anomalies within data	Sustained attention	recognize and label anomaly	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label anomaly	Perceptual discrimination	process anomaly information	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory	process of anomaly time detection	
		Working memory		
Queue to channel	process anomaly information	Working memory	save anomaly information for time detection	Time Constraints, Computational aid, Activity Levels, Expertise, Knowledge, Vigilance, Situation Awareness, Expectations
	process of anomaly time detection	Processing strategy		
Store in Buffer	save anomaly information for time detection	Working memory	figure out timing of creation	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out timing of creation	Processing strategy	focus on time of creation only	Computational Aid, Time Constraints, Expertise
		Working memory	determine time of creation	
Purge	focus on timing of anomaly only	Selective attention	efficient data analysis of time of creation of data to complete mission	Expertise

	focus on anomaly information			
Decide/Select	determine time of creation	Long-term memory	plan on how to determine time of creation based on available resources	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Plan	plan on how to determine time of creation based on available resources	Working memory	response to anomaly detection in IR data	Expectations, Expertise
		Processing strategy		
Adapt/Learn	response to anomaly detection in IR data	Long-term memory	efficient data analysis of time of creation of data to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			using all resources to accurately determine time of creation in data	
Goal image	efficient determination of time creation of data to complete mission	Long-term memory	determine time of creation for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	using all resources to accurately determine time of creation in	Processing strategy		

	data

Mapping/ Visual Inspection to Compare				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to visual feed	Selective attention	filter out rest of possible visual distractions	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of possible visual distractions	Selective attention	determining time of creation	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	use cues to determine time of creation	Perceptual sensitivity	search for provided geolocation	Expertise, Expectations
		Distributed attention	search shadow cues to determine time	
			search google earth	
Search	search for provided geolocation	Sustained attention	recognize and label provided geolocation	Salience, Visibility, Activity Levels, Expertise, Number of Cues
	search shadow cues to determine time	Perceptual sensitivity	recognize and label shadow cues	
	search google earth		recognize and label google earth cues	
Identify	recognize and label provided geolocation	Perceptual discrimination	view symbols from provided geolocation	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize and label shadow cues	Long-term memory	view shadow cues	

	recognize and label google earth cues	Working memory	view google earth cues	
Message	view symbols from provided geolocation	Response precision	processing of provided geolocation	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
	view shadow cues		processing of shadow cues	
	view google earth cues		processing of google earth cues	
Queue to channel	processing of provided geolocation	Working memory	translating provided geolocation	Time Constraints, Computational aid, Activity Levels, Expertise, Knowledge, Vigilance, Situation Awareness, Expectations
	processing of shadow cues	Processing strategy	translating shadow cues	
	processing of google earth cues		translating google earth cues	
Code	translating provided geolocation	Response precision	saving provided geolocation	Computational Aid, Expertise, Knowledge, Expectations
	translating shadow cues	Working memory	saving shadow cues	
	translating google earth cues	Long-term memory	saving google earth cues	
Store in Buffer	saving provided geolocation	Working memory	compare images based on selected cue	Computational Aid, Time Constraints
	saving shadow cues	Processing strategy		
	saving google earth cues			
Decide/Select	compare images based on selected cue	Long-term memory	response to which cue to use in visual inspection	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		

Adapt/Learn	response to which cue to use in visual inspection	Long-term memory	efficient visual inspection of past data to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			using all resources to accurately determine creation time of data	
Goal image	efficient visual inspection of past data to complete mission	Long-term memory	determine time of creation for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	using all resources to accurately determine creation time of data	Processing strategy		

Mapping/ Determine Significance Based on Time				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Identify	recognize and label comparison of data	Perceptual discrimination	keep relevant information saved	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize and label time of creation	Long-term memory	store information on time of creation	
		Working memory		
Store in Buffer	keep relevant information saved	Working memory	figure out if comparison is significant	Computational Aid, Time Constraints
	store	Processing		

	information on time of creation	strategy		
Compute	figure out if comparison is significant	Processing strategy	normal or abnormal comparison	Computational Aid, Time Constraints, Expertise
		Working memory		
Decide/Select	normal or abnormal comparison	Long-term memory	continue to match to normal comparison	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy	continue to match to abnormal comparison	
Plan	match to normal comparison	Working memory	test current behavior being observed to normal	Expectations, Expertise
	match to abnormal comparison	Processing strategy	test current behavior being observed to abnormal	
Test	test comparison to knowledge of normal	Perceptual sensitivity	no significance of comparison	Knowledge, Expertise
	test comparison to knowledge of abnormality	Working memory	significance of comparison	
		Long-term memory		
Interpret	no significance of comparison	Long-term memory	ignore if no significance	Expertise, Knowledge, Number of Cues
	significance of comparison	Sustained attention	contact customer if determined significant	
Categorize	ignore if no significance	Long-term memory	continue scanning for POL activity	Expertise, Knowledge, Number of Cues
	contact customer if determined	Perceptual sensitivity	communicate with customer	

	significant			
			document for final product report	
Adapt/Learn	appropriate response if determined non-significant	Long-term memory	efficient visual inspection of significance to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
	appropriate response if determined significant		efficient mapping to complete mission	
Goal image	efficient visual inspection of significance to complete mission	Long-term memory	continue scanning for POL activity	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	efficient mapping to complete mission	Processing strategy	communicate with customer	
			document for final product report	

KML Loaded with Markers/Look at Historical Data				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**
Input Select	visually pay attention to KML data	Selective attention	filter out irrelevant markers	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to markers	Perceptual sensitivity		
Filter	filter out irrelevant markers	Selective attention	determine cues to help with current mission	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations

Detect	determine cues to help with current mission	Perceptual sensitivity	recognize and label relevant markers	Expertise, Expectations
		Distributed attention		
Identify	recognize and label relevant markers	Perceptual discrimination	save relevant information for future use	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store	save relevant information for future use	Working memory	response to KML data	Aid, Time Constraints
		Long-term memory		
Adapt/Learn	response to KML data	Long-term memory	efficient visual inspection of KML data to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			efficient determination of relevancy of markers to complete mission	
Goal image	efficient visual inspection of KML data to complete mission	Long-term memory		Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	efficient determination of relevancy of markers to complete mission	Processing strategy	review historical data	

Look at Historical Data/Communication

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task & Environmental Demands
Input Select	visually pay attention to historical data	Selective attention	filter out irrelevant data	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	focus on defining starting point for scanning AOI	Perceptual sensitivity		
Filter	filter out irrelevant data	Selective attention	determine relevant data	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determine relevant data	Perceptual sensitivity	search for relevant data	Expertise, Expectations
		Distributed attention		
Search	search for relevant data	Sustained attention	recognize and label relevant data	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label relevant data	Perceptual discrimination	create message based on relevant data	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Message	create message based on relevant data	Response precision	translate relevant data into wriiten or verbal message	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Code	translate relevant data into wriiten or verbal message	Response precision	type message into chatroom	Aid, Expertise, Knowledge, Expectations
		Working memory	use teamspeak for verbal	

			message	
		Long-term memory		
Transmit	type message into chatroom	Response precision	arrange message into military jargon	Quality of Communication Feed, Physical Action, Time Constraints, Display Representation, Competing Transmissions, Expertise, Knowledge
	use teamspeak for verbal message			
Store in Buffer	save relevant data	Working memory	arrange message into military jargon	Computational Aid, Time Constraints
		Processing strategy		
Edit	arrange message into military jargon	Long-term memory	create an accurate message that can be understood by recipient	Expertise, Knowledge, Expectations
		Selective attention		
Display	create an accurate message that can be understood by recipient	Response precision	communicate with recipient	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
Decide/Select	communicate with recipient	Long-term memory	response to relevant historical data	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Adapt/Learn	response to relevant historical data	Long-term memory	efficient determination of historical data relevancy to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints

			efficient determination of starting point for scanning to complete mission	
Goal image	efficient determination of historical data relevancy to complete mission	Long-term memory	communication with recipient	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	efficient determination of starting point for scanning to complete mission	Processing strategy		

Look at Historical Data/Look in Local Image Base				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**
Input Select	visually pay attention to KML data	Selective attention	filter out irrelevant activity	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to local images	Perceptual sensitivity		
Filter	filter out irrelevant activity	Selective attention	determine cues to help with current mission	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determine cues to help with current mission	Perceptual sensitivity	recognize and label relevant activity	Expertise, Expectations
		Distributed attention		
Identify	recognize and label relevant	Perceptual discrimination	save relevant information for	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness

	activity		future use	
		Long-term memory		
		Working memory		
Store	save relevant information for future use	Working memory	response to local image data	Aid, Time Constraints
		Long-term memory		
Adapt/Learn	response to local image data	Long-term memory	efficient visual inspection of local image data to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			efficient determination of relevancy of local image data activity to complete mission	
Goal image	efficient visual inspection of local image data to complete mission	Long-term memory		Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	efficient determination of relevancy of local image data activity to complete mission	Processing strategy	review local historical data	

Look at Historical Data/ID Permanent Environmental Structures				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**

Input Select	pay attention to permanent environmental structures in local historical data	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if structure requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if structure requires attention	Perceptual sensitivity	search for permanent environmental structures within visual data	Expertise, Expectations
		Distributed attention		
Search	search for permanent environmental structures within visual data	Sustained attention	recognize and label structures	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label structures	Perceptual discrimination	store information on structures	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on structures	Working memory	track number of structures	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of structures	Sustained attention	expectations of structures	Number of Competing Feeds, Amount of Activity
		Working memory		

Plan	expectations of structures	Working memory	define structure	Expectations, Expertise
		Processing strategy		
Categorize	define religious structure	Long-term memory	appropriate and optimal reaction to permanent environmental structures	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to permanent environmental structures in local image data base	Long-term memory	efficient visual inspection of local images to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of local images to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Look at Historical Data/ID Structures				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to structures in local historical data	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if structure requires	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds,

			attention	Number of Cues, Expertise, Expectations
Detect	determining if structure requires attention	Perceptual sensitivity	search for structures within visual data	Expertise, Expectations
		Distributed attention		
Search	search for structures within visual data	Sustained attention	recognize and label structures	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label structures	Perceptual discrimination	store information on structures	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on structures	Working memory	track number of structures	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of structures	Sustained attention	expectations of structures	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of structures	Working memory	define structure	Expectations, Expertise
		Processing strategy		
Categorize	define religious structure	Long-term memory	appropriate and optimal reaction to structures in local images	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and	Long-term	efficient visual	Expertise, Knowledge, Number of

	optimal reaction to structures in local image data base	memory	inspection of local images to complete mission	Cues, Time Constraints
Goal image	efficient visual inspection of local images to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Customer Gives AOI(s)/ Define Starting Point(s)				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to AOI given	Selective attention	recognize AOI	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to new CIED activity	Perceptual sensitivity	recognize CIED activity	
Identify	recognize AOI	Perceptual discrimination	keep location of AOI for future use	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize CIED activity	Long-term memory	keep CIED activity for future use	
		Working memory		
Store	keep location of AOI for future use	Working memory	compute starting point for scanning watch windows based on location of AOI	Computational Aid, Time Constraints
	keep CIED activity for future use	Long-term memory	compute starting point for scanning watch windows based on CIED activity	
Compute	compute starting point for scanning watch windows	Processing strategy	choose starting point	Computational Aid, Time Constraints, Expertise

		Working memory	if starting scan for new CIED activity get rid of old CIED activity details	
Purge	if starting scan for new CIED activity get rid of old CIED activity details	Selective attention	choose starting point	Expertise
Decide/Select	choose starting point	Long-term memory	to efficiently inspect CIED activity to complete mission	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Goal image	ability to efficiently inspect CIED activity to complete mission	Long-term memory	define starting points to inspect CIED activity	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Define Starting Point(s)/ Slow Scan				
Cognitive Agent Task	**Example**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to potential CIED activities	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to target	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determine if activity requires attention	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determine if activity requires attention	Perceptual sensitivity	slowly search for only CIED activities	Expertise, Expectations

		Distributed attention		
Search	slowly search for only CIED activities	Sustained attention	recognize and label activities	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label activities	Perceptual discrimination	store relevant information on activity	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store relevant information on activity	Working memory	figure out if activity is CIED	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out if activity is CIED	Processing strategy	expectations of a CIED activity	Computational Aid, Time Constraints, Expertise
		Working memory		
Count	keep track of number of individual's performing activity	Sustained attention	expectations of a CIED activity	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of a CIED activity	Working memory	determine meaning of activity observed	Expectations, Expertise
		Processing strategy		
Interpret	determine meaning of activity observed	Long-term memory	define and name activity as CIED	Expertise, Knowledge, Number of Cues
		Sustained attention		

Categorize	define and name activity as CIED	Long-term memory	inspect CIED activity	Expertise, Knowledge, Number of Cues, Quality of Feed, Expectations
		Perceptual sensitivity	communicate with customer	
Adapt/Learn	responses to certain activity	Long-term memory	confirming CIED activity	Expertise, Knowledge, Number of Cues, Time Constraints
			reason to communicate	
Goal image	inspect CIED activity	Long-term memory	further scanning for inspection of CIED activity	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	communicate with customer	Processing strategy		

Define Starting Point(s)/Scan Left to Right				
Cognitive Agent Task	**Example**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to potential CIED activities	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to target	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determine if activity requires attention	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determine if activity requires attention	Perceptual sensitivity	slowly search for only CIED activities	Expertise, Expectations
		Distributed attention		
Search	slowly search for only CIED activities	Sustained attention	recognize and label activities	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual		

		sensitivity		
Identify	recognize and label activities	Perceptual discrimination	store relevant information on activity	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store relevant information on activity	Working memory	figure out if activity is CIED	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out if activity is CIED	Processing strategy	expectations of a CIED activity	Computational Aid, Time Constraints, Expertise
		Working memory		
Count	keep track of number of individual's performing activity	Sustained attention	expectations of a CIED activity	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of a CIED activity	Working memory	determine meaning of activity observed	Expectations, Expertise
		Processing strategy		
Interpret	determine meaning of activity observed	Long-term memory	define and name activity as CIED	Expertise, Knowledge, Number of Cues
		Sustained attention		
Categorize	define and name activity as CIED	Long-term memory	inspect CIED activity	Expertise, Knowledge, Number of Cues, Quality of Feed, Expectations
		Perceptual sensitivity	communicate with customer	
Adapt/Learn	responses to certain activity	Long-term memory	confirming CIED activity	Expertise, Knowledge, Number of Cues, Time Constraints

			reason to communicate	
Goal image	inspect CIED activity	Long-term memory	further scanning for inspection of CIED activity	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	communicate with customer	Processing strategy		

Scanning/Check Terrain				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to terrain cues	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if cue requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if cue requires attention	Perceptual sensitivity	search for cues within visual data	Expertise, Expectations
		Distributed attention		
Search	search for cues within visual data	Sustained attention	recognize and label cues	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label cues	Perceptual discrimination	store information on cues	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		

Store in Buffer	store information on cues	Working memory	track number of cues	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of cues	Sustained attention	expectations of cues	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of cues	Working memory	define cues	Expectations, Expertise
		Processing strategy		
Categorize	define cues	Long-term memory	appropriate and optimal reaction to terrain cues	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to terrain cues	Long-term memory	efficient visual inspection of terrain cues to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of terrain cues to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Check for Patterns of Life				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to POL activity	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of	Selective	determining if	Quality of Feed, Visibility, Salience,

	activity in watch window	attention	cue requires attention	Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if cue requires attention	Perceptual sensitivity	search for cues within visual data	Expertise, Expectations
		Distributed attention		
Search	search for cues within visual data	Sustained attention	recognize and label cues	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label cues	Perceptual discrimination	store information on cues	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on cues	Working memory	track number of cues	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of cues	Sustained attention	expectations of cues	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of cues	Working memory	define cues	Expectations, Expertise
		Processing strategy		
Categorize	define cues	Long-term memory	appropriate and optimal reaction to POL activity	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to POL activity	Long-term memory	efficient visual inspection of POL activity to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual	Long-term	further inspection	Quality of Feed, Salience, Visibility,

	inspection of POL activity to complete mission	memory	needed to determine significance with FMV feed	Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Determine Significance				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Identify	recognize and label POL activity under inspection in FMV	Perceptual discrimination	keep relevant actions saved	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize and label cues under inspection in WAMI	Long-term memory		
		Working memory		
Store in Buffer	keep relevant actions saved	Working memory	figure out if activity is significant	Computational Aid, Time Constraints
		Processing strategy	figure out if activity is non-significant	
Compute	figure out if activity is significant	Processing strategy	track people performing activity	Computational Aid, Time Constraints, Expertise
	figure out if activity is non-significant	Working memory		
Count	track people under inspection	Sustained attention	people performing normal or abnormal activity	Number of Competing Feeds, Amount of Activity
		Working memory		

Decide/Select	normal or abnormal actions	Long-term memory	continue to match to normal observed behavior	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy	continue to match to abnormal observed behavior	
Plan	match to normal observed activities	Working memory	test current behavior being observed to normal	Expectations, Expertise
	match to abnormal observed activities	Processing strategy	test current behavior being observed to abnormal	
Test	test activity being performed to knowledge of a normal activity	Perceptual sensitivity	potential need for further investigation	Knowledge, Expertise
	test activity being performed to knowledge of an abnormal activity	Working memory		
		Long-term memory		
Interpret	potential need for further investigation based on interpretation	Long-term memory	reason for action	Expertise, Knowledge, Number of Cues
		Sustained attention		
Categorize	reason for action	Long-term memory	efficient visual inspection of actions to complete mission	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction	Long-term memory	efficient significance of	Expertise, Knowledge, Number of Cues, Time Constraints

	to actions performed		activity determined to complete mission	
Goal image	efficient significance of activity determined to complete mission	Long-term memory	determined significant	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy	determined non-significant	
			document for final product report	

B.3 Threat to Convoy OFM-COG Table

Communication/Request Specific Indications

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demands
Input Select	pay attention to communication feed	Selective Attention	specific indications requires written or verbal communication (through chat room or TeamSpeak) to confirm	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	visually pay attention to chat rooms instead of video feed	Perceptual Sensitivity		
Detect	specific indications requires written or verbal communication (through chat room or TeamSpeak) to confirm	Perceptual Sensitivity	recognize and label specific indications	Expertise, Expectations, Salience, R of Change in Feed

		Distributed Attention		
Identify	recognize and label specific indications	Perceptual Discrimination	written or verbal communication (through chat room or TeamSpeak)	Expertise, Number of Cues, Rates o Change in Feed, Situation Awarene Time Constraints
		Long-term Memory		
		Working Memory		
Message	written or verbal communication (through chat room or TeamSpeak)	Response Precision	requires communication to confirm specific indications then visual inspection	Expertise, Knowledge, Quality of O Communication, Quality of Chat Ro
Queue to channel	requires communication to confirm specific indications then visual inspection	Working Memory	determine form of communication needed (written or verbal)	Time Constraints, Computational ai Activity Levels, Expertise, Knowledg Vigilance, Situation Awareness, Expectations
		Processing Strategy		
Code	determine form of communication needed (written or verbal)	Response Precision	communicating in correct format to appropriate correspondent(s)	Aid, Expertise, Knowledge, Expecta
		Working Memory		
		Long-term Memory		
Transmit	communicating in correct format to appropriate correspondent(s)	Response Precision	keep specific indications until mission complete	Quality of Communication Feed, Physical Action, Time Constraints, Display Representation, Competing Transmissions, Expertise, Knowledg
Store in Buffer	keep specific indications until mission complete	Working Memory	plan for if specific indications is confirmed or not	Time Constraints, Activity Levels

		Processing Strategy		
Edit	use military jargon	Long-term Memory	accurate account of information in message	Expertise, Knowledge, Expectations
		Selective Attention		
Display	accurate account of information in message	Response Precision	respond to specific indications by communication	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
Decide/Select	respond to specific indications by communication	Long-term Memory	plan for if specific indications is confirmed or not	Expertise, Knowledge, Situation Awareness, Expectations
		Processing Strategy		
Plan	plan for specific indications	Working Memory	processing specific indications	Expertise, Knowledge, Expectations
		Processing Strategy		
Adapt/Learn	processing specific indications for the mission	Long-term Memory	investigate specific indications with communication	Expertise, Knowledge, Time Constra Competing Transmissions, Activity Levels
Goal image	investigate specific indications with communication	Long-term Memory	using communication to confirm specific indications	Quality of Communication, Activity Levels, Competing Transmissions, Expertise, Expectations, Knowledge
		Processing Strategy		

Define Starting Point(s)/ Slow Scan				
Cognitive Agent Task	**Example**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to potential	Selective attention	filter out rest of activity in	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise

	convoy activities		watch window	
	pay attention to target	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determine if activity requires attention	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determine if activity requires attention	Perceptual sensitivity	slowly search for only convoy activities	Expertise, Expectations
		Distributed attention		
Search	slowly search for only convoy activities	Sustained attention	recognize and label activities	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label activities	Perceptual discrimination	store relevant information on activity	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store relevant information on activity	Working memory	figure out if activity is convoy	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out if activity is convoy	Processing strategy	expectations of a convoy activity	Computational Aid, Time Constraints, Expertise
		Working memory		
Count	keep track of number of individual's performing	Sustained attention	expectations of a convoy activity	Number of Competing Feeds, Amount of Activity

	activity			
		Working memory		
Plan	expectations of a convoy activity	Working memory	determine meaning of activity observed	Expectations, Expertise
		Processing strategy		
Interpret	determine meaning of activity observed	Long-term memory	define and name activity as convoy	Expertise, Knowledge, Number of Cues
		Sustained attention		
Categorize	define and name activity as convoy	Long-term memory	inspect convoy activity	Expertise, Knowledge, Number of Cues, Quality of Feed, Expectations
		Perceptual sensitivity	communicate with customer	
Adapt/Learn	responses to certain activity	Long-term memory	confirming convoy activity	Expertise, Knowledge, Number of Cues, Time Constraints
			reason to communicate	
Goal image	inspect convoy activity	Long-term memory	further scanning for inspection of convoy activity	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	communicate with customer	Processing strategy		

Scanning/Check Terrain

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demands
Input Select	pay attention to terrain cues	Selective attention	filter out rest of activity in	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise

			watch window	
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if cue requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if cue requires attention	Perceptual sensitivity	search for cues within visual data	Expertise, Expectations
		Distributed attention		
Search	search for cues within visual data	Sustained attention	recognize and label cues	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label cues	Perceptual discrimination	store information on cues	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on cues	Working memory	track number of cues	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of cues	Sustained attention	expectations of cues	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of cues	Working memory	define cues	Expectations, Expertise
		Processing strategy		
Categorize	define cues	Long-term memory	appropriate and optimal reaction to	Expertise, Knowledge, Number of Cues

			terrain cues	
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to terrain cues	Long-term memory	efficient visual inspection of terrain cues to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of terrain cues to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Check for Ambush Cues				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to ambush cues	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if cue requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if cue requires attention	Perceptual sensitivity	search for cues within visual data	Expertise, Expectations
		Distributed attention		
Search	search for cues within visual data	Sustained attention	recognize and label cues	Salience, Visibility, Activity Levels, Expertise, Number of Cues

		Perceptual sensitivity		
Identify	recognize and label cues	Perceptual discrimination	store information on cues	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on cues	Working memory	track number of cues	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of cues	Sustained attention	expectations of cues	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of cues	Working memory	define cues	Expectations, Expertise
		Processing strategy		
Categorize	define cues	Long-term memory	appropriate and optimal reaction to ambush cues	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to ambush cues	Long-term memory	efficient visual inspection of ambush cues to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of ambush cues to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Check Traffic Pattern				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to traffic pattern cues	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if cue requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if cue requires attention	Perceptual sensitivity	search for cues within visual data	Expertise, Expectations
		Distributed attention		
Search	search for cues within visual data	Sustained attention	recognize and label cues	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label cues	Perceptual discrimination	store information on cues	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on cues	Working memory	track number of cues	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of cues	Sustained attention	expectations of cues	Number of Competing Feeds, Amount of Activity
		Working memory		

Plan	expectations of cues	Working memory	define cues	Expectations, Expertise
		Processing strategy		
Categorize	define cues	Long-term memory	appropriate and optimal reaction to traffic pattern cues	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to traffic pattern cues	Long-term memory	efficient visual inspection of traffic pattern cues to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of traffic pattern cues to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Determine Significance				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Identify	recognize and label convoy activity under inspection in FMV	Perceptual discrimination	keep relevant actions saved	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		

Store in Buffer	keep relevant actions saved	Working memory	figure out if activity is significant	Computational Aid, Time Constraints
		Processing strategy	figure out if activity is non-significant	
Compute	figure out if activity is significant	Processing strategy	track people performing activity	Computational Aid, Time Constraints, Expertise
	figure out if activity is non-significant	Working memory		
Count	track people under inspection	Sustained attention	people performing normal or abnormal activity	Number of Competing Feeds, Amount of Activity
		Working memory		
Decide/Select	normal or abnormal actions	Long-term memory	continue to match to normal observed behavior	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy	continue to match to abnormal observed behavior	
Plan	match to normal observed activities	Working memory	test current behavior being observed to normal	Expectations, Expertise
	match to abnormal observed activities	Processing strategy	test current behavior being observed to abnormal	
Test	test activity being performed to knowledge of a normal activity	Perceptual sensitivity	potential need for further investigation	Knowledge, Expertise

	test activity being performed to knowledge of an abnormal activity	Working memory		
		Long-term memory		
Interpret	potential need for further investigation based on interpretation	Long-term memory	reason for action	Expertise, Knowledge, Number of Cues
		Sustained attention		
Categorize	reason for action	Long-term memory	efficient visual inspection of actions to complete mission	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to actions performed	Long-term memory	efficient significance of activity determined to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient significance of activity determined to complete mission	Long-term memory	determined significant	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy	determined non-significant	
			document for final product report	

Scanning/Search for Movement

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demands
Input Select	pay attention to movement	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if cue requires attention	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if cue requires attention	Perceptual sensitivity	search for movement within visual data	Expertise, Expectations
		Distributed attention		
Search	search for movement within visual data	Sustained attention	recognize and label movement	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label movement	Perceptual discrimination	store information on movement	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on movement	Working memory	track number of movement	Computational Aid, Time Constraints
		Processing strategy		
Count	track number of movement	Sustained attention	expectations of movement	Number of Competing Feeds, Amount of Activity
		Working		

		memory		
Plan	expectations of movement	Working memory	define movement	Expectations, Expertise
		Processing strategy		
Categorize	define movement	Long-term memory	appropriate and optimal reaction to traffic pattern movement	Expertise, Knowledge, Number of Cues
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to movement	Long-term memory	efficient visual inspection of movement to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of movement to complete mission	Long-term memory	further inspection needed to determine significance with FMV feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/ Use Google Earth of Buckeye to Compar3				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to visual feed	Selective attention	filter out rest of possible visual distractions	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of possible visual distractions	Selective attention	perform comparison	Quality of Feed, Visibility, Salience, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise,

				Expectations
Detect	use Google Eath to compare	Perceptual sensitivity	search for comparisons/cues	Expertise, Expectations
	use Buckeye to compare	Distributed attention		
Search	search for comparisons/cues	Sustained attention	recognize and label relevant comparison information	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label relevant comparison information	Perceptual discrimination	view Google Earth	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory	view Buckeye	
		Working memory		
Message	view Google Earth	Response precision	processing using Google Earth	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
	view Buckeye		processing using Buckeye	
Queue to channel	processing using Google Earth	Working memory	translating Google Earth cues	Time Constraints, Computational aid, Activity Levels, Expertise, Knowledge, Vigilance, Situation Awareness, Expectations
	processing using Buckeye	Processing strategy	translating Buckeye cues	
Code	translating Google Earth cues	Response precision	saving Google Earth cues	Computational Aid, Expertise, Knowledge, Expectations
	translating Buckeye cues	Working memory	saving Buckeye cues	
		Long-term memory		
Store in Buffer	saving Google Earth cues	Working memory	compare images based on selected program	Computational Aid, Time Constraints

	saving Buckeye cues	Processing strategy		
Decide/Select	compare images based on selected program	Long-term memory	response to which cue to use in visual inspection	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Adapt/Learn	response to which cue to use in visual inspection	Long-term memory	efficient visual comparison to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
			using all resources to accurately compare data	
Goal image	efficient visual comparison to complete mission	Long-term memory	perform comparison of data for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	using all resources to accurately compare data	Processing strategy		

B.4 Patterns of Life OFM-COG Table

Monitor Chat Rooms/ Communication				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to potential hits or hits	Selective Attention	hit requires written or verbal communication (through chat room	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise

	discovered by other analysts		or TeamSpeak) to confirm	
	visually pay attention to chat rooms instead of video feed	Perceptual Sensitivity		
	pay attention to confirming hit and next steps needed			
Detect	hit requires written or verbal communication (through chat room or TeamSpeak) to confirm	Perceptual Sensitivity	recognize and label possible hit	Expertise, Expectations, Salience, Rate of Change in Feed
		Distributed Attention		
Identify	recognize and label possible hit	Perceptual Discrimination	written or verbal communication (through chat room or TeamSpeak)	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness, Time Constraints
		Long-term Memory		
		Working Memory		
Message	written or verbal communication (through chat room or TeamSpeak)	Response Precision	requires communication to confirm hit then visual inspection	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room

Queue to channel	requires communication to confirm hit then visual inspection	Working Memory	determine form of communication needed (written or verbal)	Time Constraints, Computational aid, Activity Levels, Expertise, Knowledge, Vigilance, Situation Awareness, Expectations
		Processing Strategy		
Code	determine form of communication needed (written or verbal)	Response Precision	communicating in correct format to appropriate correspondent(s)	Aid, Expertise, Knowledge, Expectations
		Working Memory		
		Long-term Memory		
Transmit	communicating in correct format to appropriate correspondent(s)	Response Precision	keep hit until confirmed	Quality of Communication Feed, Physical Action, Time Constraints, Display Representation, Competing Transmissions, Expertise, Knowledge
Store in Buffer	keep hit until confirmed	Working Memory	figuring out if hit is confirmed	Time Constraints, Activity Levels
		Processing Strategy		
Compute	figuring out if hit is confirmed	Processing Strategy	written or verbal communication (through chat room or TeamSpeak) in military jargon	Computational Aid, Quality of Communication Feed, Time Constraints, Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance
		Working Memory		
Edit	use military	Long-	accurate account of	Expertise, Knowledge,

	jargon	term Memory	hit	Expectations
		Selective Attention		
Display	accurate account of hit	Response Precision	respond to hit message by communication	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
Decide/Select	respond to hit message by communication	Long-term Memory	plan for if hit is confirmed or not	Expertise, Knowledge, Situation Awareness, Expectations
		Processing Strategy		
Plan	plan for if hit is confirmed or not	Working Memory	processing hits in chat rooms	Expertise, Knowledge, Expectations
		Processing Strategy		
Adapt/Learn	processing hits in chat rooms	Long-term Memory	investigate hits with communication	Expertise, Knowledge, Time Constraints, Competing Transmissions, Activity Levels
Goal image	investigate hits with communication	Long-term Memory	using communication to confirm hits	Quality of Communication, Activity Levels, Competing Transmissions, Expertise, Expectations, Knowledge
		Processing Strategy		

Monitor Chat Rooms/ Mapping				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demand**
Input Select	pay attention to potential hits or hits discovered	Selective attention	hit requires visual inspection to confirm	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise

	by other analysts			
	visually pay attention to chat rooms instead of video feed	Perceptual sensitivity		
	pay attention to confirming hit and next steps needed			
Detect	hit requires visual inspection to confirm	Perceptual sensitivity	selecting area of interest to inspect	Expertise, Expectations, Salience, Rate Change in Feed
		Distributed attention		
Search	selecting area of interest to inspect	Sustained attention	recognize and label hit to inspect for	Display Representation, Expertise, Act Levels, Quality of Communication Fee
		Perceptual sensitivity		
Identify	recognize and label hit to inspect for	Perceptual discriminatio n	requires the visual inspection process to confirm hit	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness, Time Constraints
		Long-term memory		
		Working memory		
Queue to channel	requires the visual inspection process to confirm hit	Working memory	translate the written or verbal hit message to mentally create a visual for inspection	Time Constraints, Computational aid, Levels, Expertise, Knowledge, Vigilanc Situation Awareness, Expectations
		Processing strategy		
Code	translate the written or verbal hit message to mentally create a visual for inspection	Response precision	visually inspect for hit until confirmed or not	Aid, Expertise, Knowledge, Expectatio
		Working memory		
		Long-term		

		memory		
Store in Buffer	visually inspect for hit until confirmed or not	Working memory	figuring out if hit is confirmed	Time Constraints, Activity Levels
		Processing strategy		
Compute	figuring out if hit is confirmed	Processing strategy	show visual data to confirm hit	Computational Aid, Quality of Communication Feed, Time Constraint Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance, Visibility, Quality of Image, D Representation
		Working memory		
Display	show visual data to confirm hit	Response precision	follow process for new hit information	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
Purge	follow process for new hit information	Selective attention	reset to confirm hit	Expertise
Reset	reset to confirm hit	Selective attention	reacting to possible new hit	
		Response precision		
Control	reacting to possible new hit	Response precision	start visual inspection process to confirm hit	Expertise, Knowledge, Stituation Awar
Decide/Select	start visual inspection process to confirm hit	Long-term memory	plan for if hit is confirmed or not	Expertise, Knowledge, Situation Aware Expectations
		Processing strategy		
Plan	plan for if hit is confirmed or not	Working memory	confirm hit with visual inspection	Expertise, Knowledge, Expectations
		Processing strategy		
Test	confirm hit with visual inspection	Perceptual sensitivity	processing hits in chat rooms	Expertise, Knowledge, Expectations
		Working memory		
		Long-term		

		memory		
Adapt/Learn	processing hits in chat rooms	Long-term memory	investigate hits with visual inspection	Expertise, Knowledge, Time Constraint Competing Transmissions, Activity Lev
Goal image	investigate hits with visual inspection	Long-term memory	mapping to identify/confirm hits	Quality of Communication, Activity Lev Competing Transmissions, Expertise, Expectations, Knowledge
		Processing strategy		

Communication/ Sensor Operator				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demand**
Input Select	visually pay attention to chat rooms	Selective attention	ignore messages to other correspondent(s)	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
	pay attention to verbal communication through TeamSpeak or locally	Perceptual sensitivity	ignore unnecessary visual data	
Filter	ignore messages to other correspondent(s)	Selective attention	determine which messages require attention or action	Expertise, Activity Levels, Quality of Communication Feed
Detect	determine which messages require attention or action	Perceptual sensitivity	recognize important or relevant messages and label them	Expertise, Expectations, Salience, Rate Change in Feed
		Distributed attention		
Identify	recognize important or relevant messages and label them	Perceptual discriminatio n	written or verbal communication (through chat room or TeamSpeak)	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness, Time Constraints
		Long-term memory		
		Working		

		memory		
Message	written or verbal communication (through chat room or TeamSpeak)	Response precision	determine form of communication needed (written or verbal)	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Code	determine form of communication needed (written or verbal)	Response precision	communicating in correct format to appropriate person	Aid, Expertise, Knowledge, Expectation
		Working memory		
		Long-term memory		
Transmit	communicating in correct format to appropriate person	Response precision	understanding messages	Quality of Communication Feed, Physi Action, Time Constraints, Display Representation, Competing Transmiss Expertise, Knowledge
Compute	understanding messages	Processing strategy	use military jargon	Computational Aid, Quality of Communication Feed, Time Constraint Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance
		Working memory		
Edit	use military jargon	Long-term memory	accurate communication and method	Expertise, Knowledge, Expectations
		Selective attention		
Display	accurate communication and method	Response precision	response needed or not	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
			respond to whom	
Decide/Select	response needed or not	Long-term memory	communication meets expectations of sensor operator	Expertise, Knowledge, Situation Aware Expectations
	respond to whom	Processing strategy		
Plan	communication meets	Working memory	determining accurate communications	Expertise, Knowledge, Expectations

	expectations of sensor operator			
		Processing strategy		
Test	determining accurate communications	Perceptual sensitivity	interpret communication and sensor operator's needs	Expertise, Knowledge, Expectations
		Working memory		
		Long-term memory		
Interpret	interpret communication and sensor operator's needs	Long-term memory	appropriate and optimal responses to communication with sensor operator	Quality of Communication Feed, Exper Knowledge, Expectations
		Sustained attention		
Adapt/Learn	appropriate and optimal responses to communication with sensor operator	Long-term memory	efficient communication with sensor operator to complete mission	Expertise, Knowledge, Time Constraint Competing Transmissions, Activity Lev
Goal image	efficient communication with sensor operator to complete mission	Long-term memory		Quality of Communication, Activity Lev Competing Transmissions, Expertise, Expectations, Knowledge
		Processing strategy		

Communication/ Aircraft Operator				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demand**
Input Select	pay attention to verbal communication through TeamSpeak	Selective attention	ignore messages to other correspondent(s)	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise

		Perceptual sensitivity		
Filter	ignore messages to other correspondent(s)	Selective attention	determine which messages require attention or action	Expertise, Activity Levels, Quality of Communication Feed
Detect	determine which messages require attention or action	Perceptual sensitivity	recognize important or relevant messages and label them	Expertise, Expectations, Salience, Rate Change in Feed
		Distributed attention		
Identify	recognize important or relevant messages and label them	Perceptual discriminatio n	message is verbal	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness, Time Constraints
		Long-term memory		
		Working memory		
Message	message is verbal	Response precision	understanding messages	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Compute	understanding messages	Processing strategy	use military jargon	Computational Aid, Quality of Communication Feed, Time Constraint Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance
		Working memory		
Edit	verbal communication in military jargon	Long-term memory	accurate communication and method	Expertise, Knowledge, Expectations
		Selective attention		
Display	accurate communication and method	Response precision	response needed or not	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
			respond to whom	
Decide/Select	response needed or not	Long-term memory	communication meets expectations of aircraft operator	Expertise, Knowledge, Situation Aware Expectations

	respond to whom	Processing strategy		
Plan	communication meets expectations of aircraft operator	Working memory	determining accurate communications	Expertise, Knowledge, Expectations
		Processing strategy		
Test	determining accurate communications	Perceptual sensitivity	interpret communication and aircraft operator's needs	Expertise, Knowledge, Expectations
		Working memory		
		Long-term memory		
Interpret	interpret communication and aircraft operator's needs	Long-term memory	appropriate and optimal responses to communication with aircraft operator	Quality of Communication Feed, Exper Knowledge, Expectations
		Sustained attention		
Adapt/Learn	appropriate and optimal responses to communication with aircraft operator	Long-term memory	efficient communication with aircraft operator to complete mission	Expertise, Knowledge, Time Constraint Competing Transmissions, Activity Lev
Goal image	efficient communication with aircraft operator to complete mission	Long-term memory		Quality of Communication, Activity Lev Competing Transmissions, Expertise, Expectations, Knowledge
		Processing strategy		

Communication/ Other Analyst				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demand**

Input Select	visually pay attention to chat rooms	Selective attention	ignore messages to other analyst(s)	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
	pay attention to verbal communication through TeamSpeak or locally	Perceptual sensitivity		
Filter	ignore messages to other analyst(s)	Selective attention	determine which messages require attention or action	Expertise, Activity Levels, Quality of Communication Feed
Detect	determine which messages require attention or action	Perceptual sensitivity	label relevant messages	Expertise, Expectations, Salience, Rate Change in Feed
		Distributed attention		
Identify	label relevant messages	Perceptual discriminatio n	written or verbal communication (through chat room or TeamSpeak)	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness, Time Constraints
		Long-term memory		
		Working memory		
Message	written or verbal communication (through chat room or TeamSpeak)	Response precision	determine form of communication needed (written or verbal)	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Code	determine form of communication needed (written or verbal)	Response precision	communicating in correct format to appropriate person	Aid, Expertise, Knowledge, Expectation
		Working memory		
		Long-term memory		
Transmit	communicating in correct format to appropriate	Response precision	understanding incoming message	Quality of Communication Feed, Physi Action, Time Constraints, Display Representation, Competing Transmiss

	person			Expertise, Knowledge
Compute	understanding incoming message	Processing strategy	use military jargon	Computational Aid, Quality of Communication Feed, Time Constraint Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance
		Working memory		
Edit	written or verbal communication (through chat room or TeamSpeak) in military jargon	Long-term memory	accurate communication and method	Expertise, Knowledge, Expectations
		Selective attention		
Display	accurate communication and method	Response precision	response needed or not	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
			respond to whom	
Decide/Select	response needed or not	Long-term memory	communication meets expectations of sensor operator	Expertise, Knowledge, Situation Aware Expectations
	respond to whom	Processing strategy		
Plan	communication meets expectations of sensor operator	Working memory	determining accurate communications	Expertise, Knowledge, Expectations
		Processing strategy		
Test	determining accurate communications	Perceptual sensitivity	interpret communication and analyst(s)'s needs	Expertise, Knowledge, Expectations
		Working memory		
		Long-term memory		
Interpret	interpret communication and analyst(s)'s	Long-term memory	appropriate and optimal responses to communication with other	Quality of Communication Feed, Exper Knowledge, Expectations

	needs		analyst(s)	
		Sustained attention		
Adapt/Learn	appropriate and optimal responses to communication with other analyst(s)	Long-term memory	efficient communication with other analyst(s) to complete mission	Expertise, Knowledge, Time Constraint Competing Transmissions, Activity Lev
Goal image	efficient communication with other analyst(s) to complete mission	Long-term memory		Quality of Communication, Activity Le Competing Transmissions, Expertise, Expectations, Knowledge
		Processing strategy		

Communication/ Customer Redirects				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demand**
Input Select	pay attention to new information message from customer	Selective attention	determine if new information requires attention or action	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
		Perceptual sensitivity		
Detect	determine if new information requires attention or action	Perceptual sensitivity	recognize and apply label to new information	Expertise, Expectations, Salience, Rate Change in Feed
		Distributed attention		
Identify	recognize and apply label to new information	Perceptual discriminatio n	receive message from customer	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness, Time Constraints
		Long-term memory		

		Working memory		
Message	receive message from customer	Response precision	start process to handle new information	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Queue to channel	start process to handle new information	Working memory	translate the written or verbal new information message to mentally create a visual for inspection	Time Constraints, Computational aid, A Levels, Expertise, Knowledge, Vigilanc Situation Awareness, Expectations
		Processing strategy		
Code	translate the written or verbal new information message to mentally create a visual for inspection	Response precision	keep new information for future visual inspections	Aid, Expertise, Knowledge, Expectatio
		Working memory		
		Long-term memory		
Store	keep new information for future visual inspections	Working memory	determine what to do with new information	Time Constraints, Activity Levels, Expe
		Long-term memory		
Compute	determine what to do with new information	Processing strategy	get rid of all past data unrelated to new information	Computational Aid, Quality of Communication Feed, Time Constraint Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance
		Working memory		
Purge	get rid of all past data unrelated to new information	Selective attention	reacting to new information according to plan	Expertise
Control	reacting to new information according to plan	Response precision	respond to new information	Expertise, Knowledge, Situation Aware

Decide/Select	respond to new information	Long-term memory	follow process when new information is given	Expertise, Knowledge, Situation Aware Expectations
		Processing strategy		
Plan	follow process when new information is given	Working memory	interpret new information	Expertise, Knowledge, Expectations
		Processing strategy	determining what the customer needs	
Interpret	interpret new information	Long-term memory	appropriate and optimal reaction to customer with new information	Quality of Communication Feed, Exper Knowledge, Expectations
	determining what the customer needs	Sustained attention		
Adapt/Learn	appropriate and optimal reaction to customer with new information	Long-term memory	efficient use of new information to complete mission	Expertise, Knowledge, Time Constraint Competing Transmissions, Activity Lev
Goal image	efficient use of new information to complete mission	Long-term memory		Quality of Communication, Activity Lev Competing Transmissions, Expertise, Expectations, Knowledge
		Processing strategy		

Communication/Customer Redirects/Aircraft Operator				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demand**
Input Select	pay attention to visual needs due to customer's redirection	Selective attention	determine if redirection requires different visual data	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
		Perceptual sensitivity		
Detect	determine if redirection requires different	Perceptual sensitivity	select visual data needed based on customer redirection	Expertise, Expectations, Salience, Rate Change in Feed

	visual data			
		Distributed attention		
Search	select visual data needed based on customer redirection	Sustained attention	recognize and apply label to customer redirection	Display Representation, Expertise, Act Levels, Quality of Communication Feed
		Perceptual sensitivity		
Identify	recognize and apply label to customer redirection	Perceptual discriminatio n	receive redirection message from customer	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness, Time Constraints
		Long-term memory		
		Working memory		
Message	receive redirection message from customer	Response precision	start process to get correct visual data	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Queue to channel	start process to get correct visual data	Working memory	translate the written or verbal message to mentally create a visual for inspection	Time Constraints, Computational aid, A Levels, Expertise, Knowledge, Vigilanc Situation Awareness, Expectations
		Processing strategy		
Code	translate the written or verbal message to mentally create a visual for inspection	Response precision	transfer redirection message to aircraft operator for new visual data	Aid, Expertise, Knowledge, Expectatio
		Working memory		
		Long-term memory		
Transmit	transfer redirection message to aircraft operator	Response precision	keep redirection information for future visual inspections	Quality of Communication Feed, Physi Action, Time Constraints, Display Representation, Competing Transmiss Expertise, Knowledge

	for new visual data			
Store	keep redirection information for future visual inspections	Working memory	keep redirection information for aircraft operator's needs	Time Constraints, Activity Levels, Expe
		Long-term memory		
Store in Buffer	keep redirection information for aircraft operator's needs	Working memory	determine what to do with customer's redirection	Time Constraints, Activity Levels
		Processing strategy		
Compute	determine what to do with customer's redirection	Processing strategy	verbal communication of customer redirection in military jargon to aircraft operator	Computational Aid, Quality of Communication Feed, Time Constraint Competing Chat Rooms, Competing Transmissions, Expertise, Knowledge, Vigilance
		Working memory		
Edit	verbal communication of customer redirection in military jargon to aircraft operator	Long-term memory	get rid of all past data unrelated to new information	Expertise, Knowledge, Expectations
		Selective attention		
Purge	get rid of all past data unrelated to new information	Selective attention	reacting to customer's redirection according to plan	Expertise
Control	reacting to customer's redirection according to plan	Response precision	respond to customer's redirection	Expertise, Knowledge, Situation Aware
			request different visual data	
Decide/Select	respond to customer's redirection	Long-term memory	requests of aircraft operator made based on past experiences/expectations	Expertise, Knowledge, Situation Aware Expectations

	request different visual data	Processing strategy		
Plan	requests of aircraft operator made based on past experiences/expectations	Working memory	interpret customer's redirection and wants	Expertise, Knowledge, Expectations
		Processing strategy	determining what the aircraft operator can do	
Interpret	interpret customer's redirection and wants	Long-term memory	appropriate and optimal reaction to customer redirection for different images	Quality of Communication Feed, Exper Knowledge, Expectations
	determining what the aircraft operator can do	Sustained attention		
Adapt/Learn	appropriate and optimal reaction to customer redirection for different images	Long-term memory	efficient use of aircraft operator's abilities to complete mission	Expertise, Knowledge, Time Constraint Competing Transmissions, Activity Lev
Goal image	efficient use of aircraft operator's abilities to complete mission	Long-term memory	receive different images from aircraft operator	Quality of Communication, Activity Lev Competing Transmissions, Expertise, Expectations, Knowledge
		Processing strategy		

Mapping/ Change Sensor to IR				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to visual feed	Selective attention	filter out rest of possible visual distractions	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of possible visual	Selective attention	determining if mapping can be accomplished using	Quality of Feed, Visibility, Salience, Vis Rate of Change, Activity Levels, Compe

	distractions		current visual feed	Watch Window or Feeds, Number of C Expertise, Expectations
Detect	determining if mapping can be accomplished using current visual feed	Perceptual sensitivity	recognize cues for accurate mapping	Expertise, Expectations
		Distributed attention		
Search	search for cues for accurate mapping	Sustained attention	recognize cues for accurate mapping	Salience, Visibility, Activity Levels, Exp Number of Cues
		Perceptual sensitivity	recognize uncertainty	
Identify	recognize cues for accurate mapping	Perceptual discriminatio n	change to different visual feed format	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
	recognize uncertainty	Long-term memory	change to different visual feed sensor	
		Working memory		
Control	change to different visual feed sensor	Response precision	choose IR sensor	Expertise, Visibility, Quality of Feed, Ra Change, Expectations
Decide/Select	choose IR sensor	Long-term memory	expectations of IR format	Number of Competing Feeds, Amount Activity, Expertise, Visibility, Quality of Rate of Change, Expectations
		Processing strategy		
Plan	expectations of IR format	Working memory	responding to uncertainty in mapping	Expectations, Expertise
		Processing strategy		
Adapt/Learn	responding to uncertainty in mapping	Long-term memory	efficient mapping to complete mission	Expertise, Knowledge, Number of Cues Constraints
			using all resources to accurately map visual feed	
Goal image	efficient mapping to complete mission	Long-term memory	use IR sensor for successful mission	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex

				Expectations, Knowledge
	using all resources to accurately map visual feed	Processing strategy		

Mapping/Determine Time Created				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to IR sensor data	Selective attention	filter out irrelevant visual distractions	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out irrelevant visual distractions	Selective attention	search for anomalies within data	Quality of Feed, Visibility, Salience, Vis Rate of Change, Activity Levels, Compe Watch Window or Feeds, Number of C Expertise, Expectations
Search	search for anomalies within data	Sustained attention	recognize and label anomaly	Salience, Visibility, Activity Levels, Exp Number of Cues
		Perceptual sensitivity		
Identify	recognize and label anomaly	Perceptual discriminatio n	process anomaly information	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
		Long-term memory	process of anomaly time detection	
		Working memory		
Queue to channel	process anomaly information	Working memory	save anomaly information for time detection	Time Constraints, Computational aid, A Levels, Expertise, Knowledge, Vigilanc Situation Awareness, Expectations
	process of anomaly time detection	Processing strategy		
Store in Buffer	save anomaly information for time detection	Working memory	figure out timing of creation	Computational Aid, Time Constraints

		Processing strategy		
Compute	figure out timing of creation	Processing strategy	focus on time of creation only	Computational Aid, Time Constraints, Expertise
		Working memory	determine time of creation	
Purge	focus on timing of anomaly only	Selective attention	efficient data analysis of time of creation of data to complete mission	Expertise
	focus on anomaly information			
Decide/Select	determine time of creation	Long-term memory	plan on how to determine time of creation based on available resources	Number of Competing Feeds, Amount Activity, Expertise, Visibility, Quality of Rate of Change, Expectations
		Processing strategy		
Plan	plan on how to determine time of creation based on available resources	Working memory	response to anomaly detection in IR data	Expectations, Expertise
		Processing strategy		
Adapt/Learn	response to anomaly detection in IR data	Long-term memory	efficient data analysis of time of creation of data to complete mission	Expertise, Knowledge, Number of Cues Constraints
			using all resources to accurately determine time of creation in data	
Goal image	efficient determination of time creation of data to complete mission	Long-term memory	determine time of creation for successful mission	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
	using all resources to accurately determine time of creation in data	Processing strategy		

Mapping/ Visual Inspection to Compare				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to visual feed	Selective attention	filter out rest of possible visual distractions	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of possible visual distractions	Selective attention	determining time of creation	Quality of Feed, Visibility, Salience, Vis Rate of Change, Activity Levels, Compe Watch Window or Feeds, Number of C Expertise, Expectations
Detect	use cues to determine time of creation	Perceptual sensitivity	search for provided geolocation	Expertise, Expectations
		Distributed attention	search shadow cues to determine time	
			search google earth	
Search	search for provided geolocation	Sustained attention	recognize and label provided geolocation	Salience, Visibility, Activity Levels, Exp Number of Cues
	search shadow cues to determine time	Perceptual sensitivity	recognize and label shadow cues	
	search google earth		recognize and label google earth cues	
Identify	recognize and label provided geolocation	Perceptual discriminatio n	view symbols from provided geolocation	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
	recognize and label shadow cues	Long-term memory	view shadow cues	
	recognize and label google earth cues	Working memory	view google earth cues	
Message	view symbols from provided geolocation	Response precision	processing of provided geolocation	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
	view shadow cues		processing of shadow cues	

	view google earth cues		processing of google earth cues	
Queue to channel	processing of provided geolocation	Working memory	translating provided geolocation	Time Constraints, Computational aid, A Levels, Expertise, Knowledge, Vigilanc Situation Awareness, Expectations
	processing of shadow cues	Processing strategy	translating shadow cues	
	processing of google earth cues		translating google earth cues	
Code	translating provided geolocation	Response precision	saving provided geolocation	Computational Aid, Expertise, Knowle Expectations
	translating shadow cues	Working memory	saving shadow cues	
	translating google earth cues	Long-term memory	saving google earth cues	
Store in Buffer	saving provided geolocation	Working memory	compare images based on selected cue	Computational Aid, Time Constraints
	saving shadow cues	Processing strategy		
	saving google earth cues			
Decide/Select	compare images based on selected cue	Long-term memory	response to which cue to use in visual inspection	Number of Competing Feeds, Amount Activity, Expertise, Visibility, Quality of Rate of Change, Expectations
		Processing strategy		
Adapt/Learn	response to which cue to use in visual inspection	Long-term memory	efficient visual inspection of past data to complete mission	Expertise, Knowledge, Number of Cue Constraints
			using all resources to accurately determine creation time of data	
Goal image	efficient visual inspection of past data to complete mission	Long-term memory	determine time of creation for successful mission	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
	using all resources to accurately	Processing strategy		

	determine creation time of data			

Mapping/ Determine Significance Based on Time				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Identify	recognize and label comparison of data	Perceptual discriminatio n	keep relevant information saved	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
	recognize and label time of creation	Long-term memory	store information on time of creation	
		Working memory		
Store in Buffer	keep relevant information saved	Working memory	figure out if comparison is significant	Computational Aid, Time Constraints
	store information on time of creation	Processing strategy		
Compute	figure out if comparison is significant	Processing strategy	normal or abnormal comparison	Computational Aid, Time Constraints, Expertise
		Working memory		
Decide/Select	normal or abnormal comparison	Long-term memory	continue to match to normal comparison	Number of Competing Feeds, Amount Activity, Expertise, Visibility, Quality of Rate of Change, Expectations
		Processing strategy	continue to match to abnormal comparison	
Plan	match to normal comparison	Working memory	test current behavior being observed to normal	Expectations, Expertise
	match to abnormal comparison	Processing strategy	test current behavior being observed to abnormal	
Test	test comparison to knowledge of	Perceptual sensitivity	no significance of comparison	Knowledge, Expertise

	normal			
	test comparison to knowledge of abnormality	Working memory	significance of comparison	
		Long-term memory		
Interpret	no significance of comparison	Long-term memory	ignore if no significance	Expertise, Knowledge, Number of Cue
	significance of comparison	Sustained attention	contact customer if determined significant	
Categorize	ignore if no significance	Long-term memory	continue scanning for POL activity	Expertise, Knowledge, Number of Cue
	contact customer if determined significant	Perceptual sensitivity	communicate with customer	
			document for final product report	
Adapt/Learn	appropriate response if determined non-significant	Long-term memory	efficient visual inspection of significance to complete mission	Expertise, Knowledge, Number of Cue Constraints
	appropriate response if determined significant		efficient mapping to complete mission	
Goal image	efficient visual inspection of significance to complete mission	Long-term memory	continue scanning for POL activity	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
	efficient mapping to complete mission	Processing strategy	communicate with customer	
			document for final product report	

KML Loaded with Markers/Look at Historical Data				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**

Input Select	visually pay attention to KML data	Selective attention	filter out irrelevant markers	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
	pay attention to markers	Perceptual sensitivity		
Filter	filter out irrelevant markers	Selective attention	determine cues to help with current mission	Quality of Feed, Visibility, Salience, Vis Rate of Change, Activity Levels, Compe Watch Window or Feeds, Number of C Expertise, Expectations
Detect	determine cues to help with current mission	Perceptual sensitivity	recognize and label relevant markers	Expertise, Expectations
		Distributed attention		
Identify	recognize and label relevant markers	Perceptual discriminatio n	save relevant information for future use	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store	save relevant information for future use	Working memory	response to KML data	Aid, Time Constraints
		Long-term memory		
Adapt/Learn	response to KML data	Long-term memory	efficient visual inspection of KML data to complete mission	Expertise, Knowledge, Number of Cues Constraints
			efficient determination of relevancy of markers to complete mission	
Goal image	efficient visual inspection of KML data to complete mission	Long-term memory		Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
	efficient determination of relevancy of markers to complete mission	Processing strategy	review historical data	

Look at Historical Data/Communication				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**
Input Select	visually pay attention to historical data	Selective attention	filter out irrelevant data	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
	focus on defining starting point for scanning AOI	Perceptual sensitivity		
Filter	filter out irrelevant data	Selective attention	determine relevant data	Quality of Feed, Visibility, Salience, Vis Rate of Change, Activity Levels, Compe Watch Window or Feeds, Number of C Expertise, Expectations
Detect	determine relevant data	Perceptual sensitivity	search for relevant data	Expertise, Expectations
		Distributed attention		
Search	search for relevant data	Sustained attention	recognize and label relevant data	Salience, Visibility, Activity Levels, Exp Number of Cues
		Perceptual sensitivity		
Identify	recognize and label relevant data	Perceptual discriminatio n	create message based on relevant data	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Message	create message based on relevant data	Response precision	translate relevant data into written or verbal message	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Code	translate relevant data into written or verbal message	Response precision	type message into chatroom	Aid, Expertise, Knowledge, Expectatio
		Working memory	use teamspeak for verbal message	
		Long-term memory		

Transmit	type message into chatroom	Response precision	arrange message into military jargon	Quality of Communication Feed, Physi Action, Time Constraints, Display Representation, Competing Transmiss Expertise, Knowledge
	use teamspeak for verbal message			
Store in Buffer	save relevant data	Working memory	arrange message into military jargon	Computational Aid, Time Constraints
		Processing strategy		
Edit	arrange message into military jargon	Long-term memory	create an accurate message that can be understood by recipient	Expertise, Knowledge, Expectations
		Selective attention		
Display	create an accurate message that can be understood by recipient	Response precision	communicate with recipient	Expertise, Knowledge, Quality of Communication Feed, Competing Transmissions
Decide/Select	communicate with recipient	Long-term memory	response to relevant historical data	Number of Competing Feeds, Amount Activity, Expertise, Visibility, Quality of Rate of Change, Expectations
		Processing strategy		
Adapt/Learn	response to relevant historical data	Long-term memory	efficient determination of historical data relevancy to complete mission	Expertise, Knowledge, Number of Cue Constraints
			efficient determination of starting point for scanning to complete mission	
Goal image	efficient determination of historical data relevancy to complete mission	Long-term memory	communication with recipient	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
	efficient determination of starting point for	Processing strategy		

	scanning to complete mission			

Patterns of Life/ Cultural Norms Religious Norms				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to cultural norms in visual data feed	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
	pay attention to religious activity in visual data feed	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if religious activity requires attention	Quality of Feed, Visibility, Salience, Vis Rate of Change, Activity Levels, Compe Watch Window or Feeds, Number of C Expertise, Expectations
Detect	determining if religious activity requires attention	Perceptual sensitivity	search for religious norms within visual data	Expertise, Expectations
		Distributed attention		
Search	search for religious norms within visual data	Sustained attention	recognize and label religious activity	Salience, Visibility, Activity Levels, Exp Number of Cues
		Perceptual sensitivity		
Identify	recognize and label religious activity	Perceptual discriminatio n	store information on current religious actions	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on current religious actions	Working memory	figure out if activity is a religious norm	Computational Aid, Time Constraints

		Processing strategy		
Compute	figure out if activity is a religious norm	Processing strategy	tracking people performing religious activity	Computational Aid, Time Constraints, Expertise
		Working memory		
Count	tracking people performing religious activity	Sustained attention	expectations of religious activity	Number of Competing Feeds, Amount Activity
		Working memory		
Plan	expectations of religious activity	Working memory	determine meaning behind religious activity pattern	Expectations, Expertise
		Processing strategy		
Interpret	determine meaning behind religious activity pattern	Long-term memory	define religious activity	Expertise, Knowledge, Number of Cue
		Sustained attention		
Categorize	define religious activity	Long-term memory	appropriate and optimal reaction to religious activity	Expertise, Knowledge, Number of Cue
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to religious activity	Long-term memory	efficient visual inspection of religious activity to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient visual inspection of religious activity to complete mission	Long-term memory	further inspection needed to determine significance of religious activity within visual data feed	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
		Processing strategy		

Patterns of Life/ Times for Prayer

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demands
Search	prayer activities	Sustained attention	recognize and label actions as prayer related	Salience, Visibility, Activity Levels, Exp Number of Cues
		Perceptual sensitivity	recognize and label timing	
Identify	recognize and label actions as prayer related	Perceptual discriminatio n	keep relevant prayer related actions saved	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness
	recognize and label timing	Long-term memory	keep timing of prayer activities saved	
		Working memory		
Store in Buffer	keep relevant prayer related actions saved	Working memory	deviation between normal and abnormal action	Computational Aid, Time Constraints
	keep timing of prayer activities saved	Processing strategy	deviation between normal and abnormal timing of action	
Count	track amount of people performing prayer activities	Sustained attention	deviation between actual number of people accounted for entering and exiting place of prayer	Number of Competing Feeds, Amount Activity
		Working memory		
Decide/Select	normal or abnormal behavior	Long-term memory	match prayer time to normal prayer time	Number of Competing Feeds, Amount Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
	normal or abnormal timing of behavior	Processing strategy	match prayer time to abnormal prayer time	
	amount of people accounted for in performing activity		match amount of people accounted for from start to finish	
Plan	match prayer time to normal prayer time	Working memory	actual behavior performed	Expectations, Expertise

	match prayer time to abnormal prayer time	Processing strategy	actual number of people accounted for	
	match amount of people accounted for from start to finish			
Test	actual behavior performed	Perceptual sensitivity	potential need for further investigation	Knowledge, Expertise
	actual number of people accounted for	Working memory		
		Long-term memory		
Interpret	potential need for further investigation	Long-term memory	reason for behavior	Expertise, Knowledge, Number of Cue
		Sustained attention	estimate of unaccounted for people	
			reason for unaccounted for people	
Categorize	reason for behavior	Long-term memory	efficient visual inspection of related prayer activity to complete mission	Expertise, Knowledge, Number of Cue
	estimate of unaccounted for people	Perceptual sensitivity		
	reason for unaccounted for people			
Goal image	efficient visual inspection of related prayer activity to complete mission	Long-term memory	further inspection needed to determine significance of activity	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
		Processing strategy	further inspection needed to determine significance of time	
			further inspection needed to determine significance of unaccountable people	

			or person	

Patterns of Life/ Cultural Norms Attire of Individual				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to cultural norms	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
	pay attention to attire of individuals	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if attire of individual requires attention	Quality of Feed, Visibility, Salience, Vis Rate of Change, Activity Levels, Compe Watch Window or Feeds, Number of C Expertise, Expectations
Detect	determining if attire of individual requires attention	Perceptual sensitivity	search for abnormal attire within visual data	Expertise, Expectations
		Distributed attention		
Search	search for abnormal attire within visual data	Sustained attention	recognize and attire of individual	Salience, Visibility, Activity Levels, Exp Number of Cues
		Perceptual sensitivity		
Identify	recognize and label attire of individuals	Perceptual discriminatio n	store information on the attire of people	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on the attire of people	Working memory	figure out if attire is normal	Computational Aid, Time Constraints
		Processing		

		strategy		
Compute	figure out if attire is normal	Processing strategy	expectations of attire	Computational Aid, Time Constraints, Expertise
		Working memory		
Plan	expectations of people's attire	Working memory	determine meaning behind pattern of attire worn by people	Expectations, Expertise
		Processing strategy		
Interpret	determine meaning behind pattern of attire worn by individuals	Long-term memory	define normal behavior based on attire	Expertise, Knowledge, Number of Cue
		Sustained attention	define abnormal behavior based on attire	
Categorize	define normal attire	Long-term memory	appropriate and optimal reaction to attire	Expertise, Knowledge, Number of Cue
	define abnormal attire	Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to individual's attire	Long-term memory	efficient visual inspection of attire to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient visual inspection of individual's attire to complete mission	Long-term memory	further inspection needed to determine significance of an individual's attire within visual feed	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
		Processing strategy		

Patterns of Life/ Cultural Norms **Female Walks Behind Male**				
Cognitive Agent Task	**Input**	**Human Information Processing Resource**	**Output**	**Task and Environmental Demands**

		s		
Input Select	pay attention to cultural norms in visual data feed	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to discriminations in gender within visual data feed	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determining if gender roles requires attention	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Detect	determining if gender roles requires attention	Perceptual sensitivity	search for abnormal gender roles are prominent within visual data	Expertise, Expectations
		Distributed attention		
Search	search for abnormal gender roles are prominent within visual data	Sustained attention	recognize and label gender	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity		
Identify	recognize and label gender	Perceptual discrimin	store information on the gender of individual's for	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness

		ation	later use	
		Long-term memory		
		Working memory		
Store in Buffer	store information on the gender of individual's for later use	Working memory	figure out if gender role is normal	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out if gender role is normal	Processing strategy	tracking people based on gender	Computational Aid, Time Constraints, Expertise
		Working memory		
Count	tracking people based on gender	Sustained attention	expectations of gender	Number of Competing Feeds, Amount of Activity
		Working memory		
Plan	expectations of gender	Working memory	determine meaning behind pattern of gender actions	Expectations, Expertise
		Processing strategy		
Interpret	determine meaning behind pattern of gender actions	Long-term memory	define normal behavior based on gender	Expertise, Knowledge, Number of Cues
		Sustained	define abnormal behavior based on	

		attention	gender	
Categorize	define normal behavior based on gender	Long-term memory	appropriate and optimal reaction to gender	Expertise, Knowledge, Number of Cues
	define abnormal behavior based on gender	Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to gender	Long-term memory	efficient visual inspection of gender roles to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
Goal image	efficient visual inspection of gender roles to complete mission	Long-term memory	further inspection needed to determine significance of gender within visual feed	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Patterns of Life/ Examine Body Language				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Search	look for individual's under inspection	Sustained attention	recognize and label the individual(s)	Salience, Visibility, Activity Levels, Exp Number of Cues
		Perceptual sensitivity	recognize and label the individual(s) body language	
			recognize and label the individual(s)'s activity	
Identify	recognize and label the	Perceptual discrimination	keep relevant actions saved	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness

	individual(s)			
	recognize and label the individual(s)'s body language	Long-term memory		
	recognize and label the individual(s)'s activity	Working memory		
Store in Buffer	keep relevant actions saved	Working memory	track amount of people under inspection	Computational Aid, Time Constraints
		Processing strategy		
Count	track amount of people under inspection	Sustained attention	normal or abnormal body language	Number of Competing Feeds, Amount Activity
		Working memory		
Decide/Select	normal or abnormal body language	Long-term memory	match to normal observed behavior	Number of Competing Feeds, Amount Activity, Expertise, Visibility, Quality of Rate of Change, Expectations
		Processing strategy	match to abnormal observed behavior	
Plan	match to normal observed body language	Working memory	test actual behavior being observed to normal	Expectations, Expertise
	match to abnormal observed body language	Processing strategy	test actual behavior being observed to abnormal	
Test	test body language being observed to normal	Perceptual sensitivity	potential need for further investigation	Knowledge, Expertise
	test body language being observed to abnormal	Working memory		
		Long-term memory		
Interpret	potential need	Long-term	reason for body language	Expertise, Knowledge, Number of Cue

	for further investigation based on body language	memory		
		Sustained attention		
Categorize	reason for body language	Long-term memory	efficient visual inspection of body language to complete mission	Expertise, Knowledge, Number of Cue
		Perceptual sensitivity		
Goal image	efficient visual inspection of body language to complete mission	Long-term memory	further inspection needed to determine significance of body language	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
		Processing strategy	continue scanning if body language normal	

Patterns of Life/Significance of Cultural Norm

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demands
Identify	recognize and label cultural norm under inspection as suspicious behavior	Perceptual discrimination	keep relevant actions saved	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
	recognize and label abnormal timing of cultural events	Long-term memory	store information on current cultural norms for selected AOI	
		Working memory		
Store in Buffer	keep relevant actions saved	Working memory	figure out if activity is a cultural norm	Computational Aid, Time Constraints
	store information on current	Processing strategy		

	cultural norms for selected AOI			
Compute	figure out if activity is a cultural norm	Processing strategy	track people performing cultural activity	Computational Aid, Time Constraints, Expertise
		Working memory		
Count	track people under inspection	Sustained attention	people performing normal or abnormal activity	Number of Competing Feeds, Amount Activity
		Working memory		
Decide/Select	normal or abnormal actions	Long-term memory	continue to match to normal observed behavior	Number of Competing Feeds, Amount Activity, Expertise, Visibility, Quality of Rate of Change, Expectations
		Processing strategy	continue to match to abnormal observed behavior	
Plan	match to normal observed activities	Working memory	test current behavior being observed to normal	Expectations, Expertise
	match to abnormal observed activities	Processing strategy	test current behavior being observed to abnormal	
Test	test activity being performed to knowledge of a normal activity	Perceptual sensitivity	potential need for further investigation	Knowledge, Expertise
	test activity being performed to knowledge of an abnormal activity	Working memory		
		Long-term memory		
Interpret	potential need for further investigation based on interpretation	Long-term memory	reason for action	Expertise, Knowledge, Number of Cue
		Sustained attention		

Categorize	reason for action	Long-term memory	efficient visual inspection of actions to complete mission	Expertise, Knowledge, Number of Cue
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to cultural actions performed	Long-term memory	efficient visual inspection of cultural activity to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient visual inspection of cultural activities to complete mission	Long-term memory	further inspection with FMV	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Ex Expectations, Knowledge
		Processing strategy	further inspection with WAMI	
			stop inspection of current cultural norm and continue scanning for other patterns of life activities	

Patterns of Life/ Ignore Cultural Norms				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Identify	recognize and label normal behavior of cultural activity	Perceptual discrimination	dispose information on inspected cultural activity	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness
	recognize and label normal timing of cultural events	Long-term memory		
	recognize and label cultural activity as non-significant based on pattern of life	Working memory		

Purge	dispose information on inspected cultural activity	Selective attention	ignore past activity observed	Expertise
Decide/Select	ignore past activity observed	Long-term memory	begin new scan	Number of Competing Feeds, Amount Activity, Expertise, Visibility, Quality of Rate of Change, Expectations
		Processing strategy		
Control	begin new scan	Response Precision	need for further investigation of other cultural activities within watch window	Expertise, Knowledge, Number of Cues Constraints
Interpret	need for further investigation of other cultural activities within watch window	Long-term memory	thorough inspection of all cultural norms to complete mission	Expertise, Knowledge, Number of Cues
		Sustained attention		
Goal image	thorough inspection of all cultural norms to complete mission	Long-term memory	make judgment on cultural norms to complete mission	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
		Processing strategy		

Patterns of Life/ Presence of Children				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to cultural norms in visual data feed	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visib Activity Levels, Expertise
	pay attention to discriminations in age within visual data feed	Perceptual sensitivity		
Filter	filter out rest of activity in watch	Selective attention	determining if age of individual(s) requires	Quality of Feed, Visibility, Salience, Vis Rate of Change, Activity Levels, Compe

	window		attention	Watch Window or Feeds, Number of C Expertise, Expectations
Detect	determining if age of individual(s) requires attention	Perceptual sensitivity	search for indicators of age of individual(s)	Expertise, Expectations
		Distributed attention		
Search	search for indicators of age of individual(s)	Sustained attention	recognize and label individual(s) as child(ren)	Salience, Visibility, Activity Levels, Exp Number of Cues
		Perceptual sensitivity		
Identify	recognize and label individual(s) as child(ren)	Perceptual discrimination	store information on the age of the individual(s) for later use	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store information on the age of the individual(s) for later use	Working memory	figure out if age of individual(s) is correct	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out if age of individual(s) is correct	Processing strategy	tracking people based on age	Computational Aid, Time Constraints, Expertise
		Working memory		
Count	tracking people based on age	Sustained attention	expectations of child(ren)	Number of Competing Feeds, Amount Activity
		Working memory		
Plan	expectations of child(ren)	Working memory	determine meaning behind actions of child(ren)	Expectations, Expertise
		Processing strategy		
Interpret	determine meaning behind	Long-term memory	define normal behavior based on age	Expertise, Knowledge, Number of Cue

	actions of child(ren)			
		Sustained attention	define abnormal behavior based on age	
Categorize	define normal behavior based on age	Long-term memory	appropriate and optimal reaction to age	Expertise, Knowledge, Number of Cue
	define abnormal behavior based on age	Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to age	Long-term memory	efficient visual inspection of age discrimination to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient visual inspection of age discrimination to complete mission	Long-term memory	further inspection needed to determine significance of child(ren) within visual feed	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
		Processing strategy		

Patterns of Life/ Significance of Child's Presence				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Identify	recognize and label size of individual	Perceptual discrimination	keep relevant actions of child(ren) saved	Expertise, Number of Cues, Rates of Cl in Feed, Situation Awareness
	recognize and label activity of individual	Long-term memory		
	recognize and label placement of individual in group	Working memory		
Store in Buffer	keep relevant actions of child(ren) saved	Working memory	figure out if activity for child(ren) is normal	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out if	Processing	track child(ren)	Computational Aid, Time Constraints,

	activity for child(ren) is normal	strategy		Expertise
		Working memory		
Count	track child(ren)	Sustained attention	child(ren) performing normal or abnormal activity	Number of Competing Feeds, Amount Activity
		Working memory		
Decide/Select	normal or abnormal actions	Long-term memory	match to normal observed behavior	Number of Competing Feeds, Amount Activity, Expertise, Visibility, Quality of Rate of Change, Expectations
		Processing strategy	match to abnormal observed behavior	
Plan	match to normal observed activities	Working memory	test current behavior being observed to normal	Expectations, Expertise
	match to abnormal observed activities	Processing strategy	test current behavior being observed to abnormal	
Test	test activity being performed by child(ren) to knowledge of a normal activity	Perceptual sensitivity	potential need for further investigation	Knowledge, Expertise
	test activity being performed by child(ren) to knowledge of an abnormal activity	Working memory		
		Long-term memory		
Interpret	potential need for further investigation based on interpretation	Long-term memory	reason for action	Expertise, Knowledge, Number of Cue
		Sustained attention		
Categorize	reason for action	Long-term memory	efficient visual inspection of actions to complete mission	Expertise, Knowledge, Number of Cue

		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to child(ren) actions performed	Long-term memory	efficient visual inspection of child(ren) activity to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient visual inspection of child(ren) activities to complete mission	Long-term memory	further inspection with FMV	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Ex Expectations, Knowledge
		Processing strategy	further inspection with WAMI	
			stop inspection of current cultural norm and continue scanning for other patterns of life activities	

Patterns of Life/Local Norms
Market Times

Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to local norms in visual data feed	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility Activity Levels, Expertise
	pay attention to market activity in visual data feed	Perceptual sensitivity		
	pay attention to timing of market activity in visual data feed			
Filter	filter out rest of activity in watch window	Selective attention	determining if market activity requires attention	Quality of Feed, Visibility, Salience, Visibil Rate of Change, Activity Levels, Competin Watch Window or Feeds, Number of Cue Expertise, Expectations
			determining if timing of market activity	

			requires attention	
Detect	determining if market activity requires attention	Perceptual sensitivity	search for market activity within visual data	Expertise, Expectations
	determining if timing of market activity requires attention	Distributed attention		
Search	search for market activity within visual data	Sustained attention	recognize and label market activity	Salience, Visibility, Activity Levels, Experti Number of Cues
		Perceptual sensitivity	recognize and label timing of market activity	
Identify	recognize and label market activity	Perceptual discrimination	store information on current market activities	Expertise, Number of Cues, Rates of Chan Feed, Situation Awareness
	recognize and label timing of market activity	Long-term memory	store information on timing of market activities (pins used for this)	
		Working memory		
Store in Buffer	store information on current market activities	Working memory	figure out if activity is normal	Computational Aid, Time Constraints
	store information on timing of market activities (placed pin)	Processing strategy	figure out if timing is normal	
Compute	figure out if activity is normal for market	Processing strategy	tracking people at the market	Computational Aid, Time Constraints, Exp
	figure out if timing is normal for market	Working memory	tracking timing of people at the market	
Count	tracking people at market	Sustained attention	expectations of amount of people at the market	Number of Competing Feeds, Amount of
	tracking timing of people at the	Working memory	expectations of timing of people at	

	market		the market	
			expectations of people at the market	
			expectations of people's actions at the market	
Plan	expectations of amount of people at the market	Working memory	determine meaning behind amount of people	Expectations, Expertise
	expectations of timing of people at the market	Processing strategy	determine meaning behind timing of market	
	expectations of people at the market		determine meaning of who attends market	
	expectations of people's actions at the market		determine meaning behind people's actions	
Interpret	determine meaning behind amount of people	Long-term memory	define market activity	Expertise, Knowledge, Number of Cues
	determine meaning behind timing of market	Sustained attention	define timing of market	
	determine meaning of who attends market		categorize people in attendance	
	determine meaning behind people's actions		define people's actions	
Categorize	define market activity	Long-term memory	appropriate and optimal reaction to market activity	Expertise, Knowledge, Number of Cues
	define timing of market	Perceptual sensitivity	appropriate and optimal reaction to timing of market	
	categorize people in attendance		appropriate and optimal reaction to type of people in attendance	
	define people's		appropriate and	

	actions		optimal reaction to people's actions at market	
Adapt/Learn	appropriate and optimal reaction to market activity	Long-term memory	efficient visual inspection of market activity to complete mission	Expertise, Knowledge, Number of Cues, T Constraints
	appropriate and optimal reaction to timing of market		efficient visual inspection of market timing to complete mission	
	appropriate and optimal reaction to type of people in attendance			
	appropriate and optimal reaction to people's actions at market			
Goal image	efficient visual inspection of market activity to complete mission	Long-term memory	further inspection needed to determine significance of market activity within visual data feed	Quality of Feed, Salience, Visibility, Rate c Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Exper Expectations, Knowledge
	efficient visual inspection of market timing to complete mission	Processing strategy	further inspection needed to determine significance of market timing within visual data feed	

Patterns of Life/ Local Norms
Patterns of Traffic

Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to local norms in visual data feed	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility Activity Levels, Expertise
	pay attention to	Perceptual		

	traffic patterns in visual data feed	sensitivity		
	pay attention to timing of traffic patterns in visual data feed			
Filter	filter out rest of activity in watch window	Selective attention	determining if traffic pattern requires attention	Quality of Feed, Visibility, Salience, Visibili of Change, Activity Levels, Competing Wa Window or Feeds, Number of Cues, Exper Expectations
			determining if timing of traffic requires attention	
Detect	determining if traffic pattern requires attention	Perceptual sensitivity	search for traffic patterns within visual data	Expertise, Expectations
	determining if timing of traffic activity requires attention	Distributed attention		
Search	search for traffic patterns within visual data	Sustained attention	recognize and label traffic patterns	Salience, Visibility, Activity Levels, Experti Number of Cues
		Perceptual sensitivity	recognize and label timing of traffic activity	
Identify	recognize and label traffic patterns	Perceptual discrimination	store information on current traffic patterns	Expertise, Number of Cues, Rates of Chan Feed, Situation Awareness
	recognize and label timing of traffic activity	Long-term memory	store information on timing of traffic activities	
		Working memory		
Store in Buffer	store information on current traffic patterns	Working memory	figure out if activity is normal	Computational Aid, Time Constraints
	store information on timing of traffic activities	Processing strategy	figure out if timing is normal	
Compute	figure out if traffic pattern is normal	Processing strategy	tracking vehicles	Computational Aid, Time Constraints, Exp

	figure out if timing is normal for traffic pattern	Working memory	tracking timing of vehicles	
Count	tracking vehicles	Sustained attention	expectations of amount of vehicles	Number of Competing Feeds, Amount of A
	tracking timing of vehicles	Working memory	expectations of timing of traffic	
			expectations of type of vehicles	
			expectations of traffic pattern	
Plan	expectations of amount of vehicles	Working memory	determine meaning behind amount of vehicles	Expectations, Expertise
	expectations of timing of traffic	Processing strategy	determine meaning behind timing of traffic	
	expectations of type of vehicles		determine meaning of types of vehicles	
	expectations of traffic pattern		determine meaning behind traffic pattern	
Interpret	determine meaning behind amount of vehicles	Long-term memory	define amount of vehicles	Expertise, Knowledge, Number of Cues
	determine meaning behind timing of traffic	Sustained attention	define timing of traffic	
	determine meaning of types of vehicles		categorize vehicles	
	determine meaning behind traffic pattern		define traffic pattern	
Categorize	define amount of vehicles	Long-term memory	appropriate and optimal reaction to amount of vehicles	Expertise, Knowledge, Number of Cues
	define timing of traffic	Perceptual sensitivity	appropriate and optimal reaction to timing of traffic	
	categorize vehicles		appropriate and optimal reaction to	

			type of vehicles	
	define traffic pattern		appropriate and optimal reaction to traffic pattern	
Adapt/Learn	appropriate and optimal reaction to amount of vehicles	Long-term memory	efficient visual inspection of traffic patterns to complete mission	Expertise, Knowledge, Number of Cues, Ti Constraints
	appropriate and optimal reaction to timing of traffic		efficient visual inspection of traffic timing to complete mission	
	appropriate and optimal reaction to type of vehicles			
	appropriate and optimal reaction to traffic pattern			
Goal image	efficient visual inspection of traffic patterns to complete mission	Long-term memory	further inspection needed to determine significance of traffic pattern within visual data feed	Quality of Feed, Salience, Visibility, Rate o Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Exper Expectations, Knowledge
	efficient visual inspection of traffic timing to complete mission	Processing strategy	further inspection needed to determine significance of traffic timing within visual data feed	

Patterns of Life/ Local Norms
Weather Factors

Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to local norms in visual data feed	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Vis Activity Levels, Expertise
	pay attention to	Perceptual		

	actions related to weather factors	sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	search for weather related actions within visual data	Quality of Feed, Visibility, Salience, V Rate of Change, Activity Levels, Com Watch Window or Feeds, Number of Expertise, Expectations
Search	search for weather related actions within visual data	Sustained attention	recognize and label current weather conditions	Salience, Visibility, Activity Levels, Ex Number of Cues
		Perceptual sensitivity	recognize and label actions as weather related	
Identify	recognize and label current weather conditions	Perceptual discrimination	store information on current weather conditions	Expertise, Number of Cues, Rates of in Feed, Situation Awareness
	recognize and label actions as weather related	Long-term memory	store information on possible actions related to the weather	
		Working memory		
Store in Buffer	store information on current weather conditions	Working memory	figure out if activity is related to weather	Computational Aid, Time Constraints
	store information on possible actions related to the weather	Processing strategy		
Compute	figure out if activity is related to the current weather conditions	Processing strategy	determine meaning behind current weather conditions	Computational Aid, Time Constraints Expertise
		Working memory	determine relationship behind activity and the weather	
Plan	expectations of weather	Working memory	determine meaning behind current weather	Expectations, Expertise

	conditions		conditions	
	expectations of how the weather affects people's activities	Processing strategy	determine meaning behind activity	
			determine relationship behind activity and the weather	
Interpret	determine meaning behind current weather conditions	Long-term memory	define weather condition	Expertise, Knowledge, Number of Cu
	determine meaning behind activity	Sustained attention	define activity as weather related	
	determine relationship behind activity and the weather		define activity as not weather related	
Categorize	define weather condition	Long-term memory	appropriate and optimal reaction to current weather conditions	Expertise, Knowledge, Number of Cu
	define activity as weather related	Perceptual sensitivity	appropriate and optimal reaction activity seen	
	define activity as not weather related		appropriate and optimal reaction to relationship between activity seen and weather conditions	
Adapt/Learn	appropriate and optimal reaction to current weather conditions	Long-term memory	efficient knowledge of current weather conditions to complete mission	Expertise, Knowledge, Number of Cu Time Constraints
	appropriate and optimal reaction activity seen		efficient visual inspection of activity to complete mission	
	appropriate and optimal reaction to relationship between activity seen and weather		efficient correlation between weather and activity seen to complete mission	

	conditions			
Goal image	efficient visual inspection of traffic patterns to complete mission	Long-term memory	further inspection needed to determine significance of activity based on weather within visual data feed	Quality of Feed, Salience, Visibility, R Change, Activity Levels, Competing V Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	efficient visual inspection of traffic timing to complete mission	Processing strategy		
	efficient correlation between weather and activity seen to complete mission			

Patterns of Life/ Napping on Roof				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Search	weather related activity	Sustained attention	recognize and label actions weather related	Salience, Visibility, Activity Levels, Exp Number of Cues
		Perceptual sensitivity	recognize and label timing	
Identify	recognize and label weather related activity	Perceptual discrimination	keep relevant weather related actions saved	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness
	recognize and label timing	Long-term memory	keep timing of activities saved	
		Working memory		
Store in Buffer	keep relevant weather related actions saved	Working memory	deviation between normal and abnormal action based on weather	Computational Aid, Time Constraints
	keep timing of activities saved	Processing strategy	deviation between normal and abnormal timing of action based on weather conditions	

Count	track amount of people performing activity	Sustained attention	deviation between actual number of people accounted for from beginning to end	Number of Competing Feeds, Amoun Activity
		Working memory		
Decide/Selec t	normal or abnormal behavior based on weather conditions	Long-term memory	match activity to weather conditions	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
	normal or abnormal timing of behavior based on weather	Processing strategy	match activity to time of day	
	amount of people accounted for in performing activity			
Plan	match activity to weather conditions	Working memory	actual behavior performed	Expectations, Expertise
	match activity to time of day	Processing strategy	actual number of people accounted for	
Test	actual behavior performed	Perceptual sensitivity	potential need for further investigation	Knowledge, Expertise
	actual number of people accounted for	Working memory		
		Long-term memory		
Interpret	potential need for further investigation	Long-term memory	reason for behavior	Expertise, Knowledge, Number of Cue
		Sustained attention	estimate of unaccounted for people	
			reason for unaccounted for people	
Categorize	reason for behavior	Long-term memory	efficient visual inspection of weather related activity to complete mission	Expertise, Knowledge, Number of Cue
	estimate of	Perceptual		

	unaccounted for people	sensitivity		
	reason for unaccounted for people			
Goal image	efficient visual inspection of weather related activity to complete mission	Long-term memory	further inspection needed to determine significance of activity	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy	further inspection needed to determine significance of time	
			further inspection needed to determine significance of unaccountable people or person	

Patterns of Life/ Significance of Local Norm Examination				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Identify	recognize and label local norm under inspection as suspicious behavior	Perceptual discrimination	keep relevant actions saved	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness
	recognize and label abnormal timing of local events	Long-term memory	store information on current local norms for selected AOI	
	recognize and label abnormal patterns of traffic	Working memory		
Store in Buffer	keep relevant actions saved	Working memory	figure out if activity is a local norm	Computational Aid, Time Constraints
	store information on current local norms for selected AOI	Processing strategy	figure out if activity is significant	

Compute	figure out if activity is a local norm	Processing strategy	track people performing activity	Computational Aid, Time Constraints, Expertise
	figure out if activity is significant	Working memory		
Count	track people under inspection	Sustained attention	people performing normal or abnormal activity	Number of Competing Feeds, Amoun Activity
		Working memory		
Decide/Select	normal or abnormal actions	Long-term memory	continue to match to normal observed behavior	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
		Processing strategy	continue to match to abnormal observed behavior	
Plan	match to normal observed activities	Working memory	test current behavior being observed to normal	Expectations, Expertise
	match to abnormal observed activities	Processing strategy	test current behavior being observed to abnormal	
Test	test activity being performed to knowledge of a normal activity	Perceptual sensitivity	potential need for further investigation	Knowledge, Expertise
	test activity being performed to knowledge of an abnormal activity	Working memory		
		Long-term memory		
Interpret	potential need for further investigation based on interpretation	Long-term memory	reason for action	Expertise, Knowledge, Number of Cue
		Sustained attention		
Categorize	reason for action	Long-term memory	efficient visual inspection of actions to complete mission	Expertise, Knowledge, Number of Cue
		Perceptual sensitivity		

Adapt/Learn	appropriate and optimal reaction to actions performed	Long-term memory	efficient visual inspection of activity to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient visual inspection of activity to complete mission	Long-term memory	further inspection with FMV	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy	further inspection with WAMI	
			stop inspection of current activity and continue scanning for other patterns of life activities	

Patterns of Life/ Ignore Local Norms				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Identify	recognize and label normal behavior of activity	Perceptual discrimination	dispose information on inspected locally normal activity	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness
	recognize and label normal timing of local events	Long-term memory		
	recognize and label normal traffic patterns	Working memory		
	recognize and label activity as non-significant based on pattern of life			
Purge	dispose information on inspected locally normal activity	Selective attention	ignore past activity observed	Expertise
Decide/Select	ignore past	Long-term	begin new scan	Number of Competing Feeds, Amoun

	activity observed	memory		Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
		Processing strategy		
Control	begin new scan	Response Precision	need for further investigation of other activities within watch window	Expertise, Knowledge, Number of Cue Constraints
Interpret	need for further investigation of other activities within watch window	Long-term memory	thorough inspection of all locally normal activities to complete mission	Expertise, Knowledge, Number of Cue
		Sustained attention		
Goal image	thorough inspection of all locally normal activities to complete mission	Long-term memory	make judgment on local norms to complete mission	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Customer Gives AOI(s)/ Create Watch Window(s)				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to customer's message	Selective attention	recognize and label message as an AOI	Salience, Rate of Change in Feed, Visi Activity Levels, Expertise
		Perceptual sensitivity		
Identify	recognize and label message as multiple AOIs	Perceptual discrimination	written or verbal message of multiple AOI's needed for mission	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness
		Long-term memory		
		Working memory		

Message	written or verbal message of multiple AOI's needed for mission	Response precision	keep location of AOI for future use	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Roo
Store	keep location of AOI for future use	Working memory	use locations of AOIs to figure out if multiple watch windows are needed for AOIs	Computational Aid, Time Constraints
		Long-term memory		
Compute	use locations of AOIs to figure out if multiple watch windows are needed for AOIs	Processing strategy	use a separate watch window for every AOI	Computational Aid, Time Constraints, Expertise
		Working memory	use watch windows and main screen for AOIs	
Count	use a separate watch window for every AOI	Sustained attention	create watch windows	Number of Competing Feeds, Amoun Activity
	use watch windows and main screen for AOIs	Working memory		
Decide/Select	create watch windows	Long-term memory	make sure correct area	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
		Processing strategy	make sure can tell the difference between each watch window	
Test	make sure correct area	Perceptual sensitivity	define or name watch window	Knowledge, Expertise
	make sure can tell the difference between each watch window	Working memory		
		Long-term memory		
Categorize	define or name watch window	Long-term memory	appropriate and optimal reaction to multiple AOIs given by customer	Expertise, Knowledge, Number of Cue

		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to multiple AOIs given by customer	Long-term memory	ability to efficiently visualize multiple AOIs to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	ability to efficiently visualize multiple AOIs to complete mission	Long-term memory	multiple watch windows created to efficiently view all AOIs given by customer	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Customer Gives AOI(s)/ Define Starting Point(s)				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to AOI given	Selective attention	recognize AOI	Salience, Rate of Change in Feed, Visi Activity Levels, Expertise
	pay attention to new POL activity	Perceptual sensitivity	recognize POL activity	
Identify	recognize AOI	Perceptual discrimination	keep location of AOI for future use	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness
	recognize POL activity	Long-term memory	keep POL activity for future use	
		Working memory		
Store	keep location of AOI for future use	Working memory	compute starting point for scanning watch windows based on location of AOI	Computational Aid, Time Constraints
	keep POL activity for future use	Long-term memory	compute starting point for scanning watch windows based on POL activity	
Compute	compute starting point for scanning watch windows	Processing strategy	choose starting point	Computational Aid, Time Constraints, Expertise

		Working memory	if starting scan for new POL activity get rid of old POL activity details	
Purge	if starting scan for new POL activity get rid of old POL activity details	Selective attention	choose starting point	Expertise
Decide/Select	choose starting point	Long-term memory	to efficiently inspect POL activity to complete mission	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
		Processing strategy		
Goal image	ability to efficiently inspect POL activity to complete mission	Long-term memory	define starting points to inspect POL activity	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Define Starting Point(s)/ Slow Scan				
Cognitive Agent Task	**Example**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to potential POL activities	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visi Activity Levels, Expertise
	pay attention to target	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	determine if activity requires attention	Quality of Feed, Visibility, Salience, Vi Rate of Change, Activity Levels, Comp Watch Window or Feeds, Number of Expertise, Expectations
Detect	determine if activity requires attention	Perceptual sensitivity	slowly search for only POL activities	Expertise, Expectations
		Distributed attention		
Search	slowly search for only POL activities	Sustained attention	recognize and label activities	Salience, Visibility, Activity Levels, Exp Number of Cues

		Perceptual sensitivity		
Identify	recognize and label activities	Perceptual discrimination	store relevant information on activity	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store in Buffer	store relevant information on activity	Working memory	figure out if activity is POL	Computational Aid, Time Constraints
		Processing strategy		
Compute	figure out if activity is POL	Processing strategy	expectations of a POL activity	Computational Aid, Time Constraints, Expertise
		Working memory		
Count	keep track of number of individual's performing activity	Sustained attention	expectations of a POL activity	Number of Competing Feeds, Amoun Activity
		Working memory		
Plan	expectations of a POL activity	Working memory	determine meaning of activity observed	Expectations, Expertise
		Processing strategy		
Interpret	determine meaning of activity observed	Long-term memory	define and name activity as POL	Expertise, Knowledge, Number of Cue
		Sustained attention		
Categorize	define and name activity as POL	Long-term memory	inspect POL activity	Expertise, Knowledge, Number of Cue Quality of Feed, Expectations
		Perceptual sensitivity	communicate with customer	
Adapt/Learn	responses to certain activity	Long-term memory	confirming POL activity	Expertise, Knowledge, Number of Cue Constraints
			reason to communicate	

Goal image	inspect POL activity	Long-term memory	further scanning for inspection of POL activity	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	communicate with customer	Processing strategy		

Scanning/Switch to FMV				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**
Input Select	pay attention to POL activity found significant	Selective attention	filter out rest of activity	Salience, Rate of Change in Feed, Visi Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity	Selective attention	keep relevant information on POL activity for future use	Quality of Feed, Visibility, Salience, Vi Rate of Change, Activity Levels, Comp Watch Window or Feeds, Number of Expertise, Expectations
Store	keep relevant information on POL activity for future use	Working memory	find POL activity in FMV	Computational Aid, Time Constraints
		Long-term memory		
Reset	need more detailed view of activity	Selective attention	switch to FMV	Expertise
		Response precision		
Decide/Select	switch to FMV	Long-term memory	expect FMV to show POL activity	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
		Processing strategy		
Plan	expect FMV to show POL activity	Working memory	response to need for more detail on POL activity	Expectations, Expertise

		Processing strategy		
Adapt/Learn	response to need for more detail on POL activity	Long-term memory	efficient visual inspection using all resources to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient visual inspection using all resources to complete mission	Long-term memory	switch to FMV for more detailed view of POL activity	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Black/White Inversion in WAMI				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**
Input Select	pay attention to POL activity found significant	Selective attention	filter out rest of activity	Salience, Rate of Change in Feed, Visi Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity	Selective attention	keep relevant information on POL activity for future use	Quality of Feed, Visibility, Salience, Vi Rate of Change, Activity Levels, Comp Watch Window or Feeds, Number of Expertise, Expectations
Store	keep relevant information on POL activity for future use	Working memory	find POL activity in Black/White inversion of WAMI	Computational Aid, Time Constraints
		Long-term memory		
Reset	need more detailed view of activity	Selective attention	perform black/white inversion in WAMI	Expertise
		Response precision		
Decide/Select	perform black/white	Long-term memory	expect black/white inversion of WAMI to	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o

	inversion in WAMI		show more detail of POL activity	Rate of Change, Expectations
		Processing strategy		
Plan	expect black/white inversion of WAMI to show more detail of POL activity	Working memory	response to need for more detail on POL activity	Expectations, Expertise
		Processing strategy		
Adapt/Learn	response to need for more detail on POL activity	Long-term memory	efficient visual inspection using all resources to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient visual inspection using all resources to complete mission	Long-term memory	perform black/white inversion of image for more detailed view of POL activity	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Alter Brightness in WAMI				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**
Input Select	pay attention to POL activity found significant	Selective attention	filter out rest of activity	Salience, Rate of Change in Feed, Visi Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity	Selective attention	keep relevant information on POL activity for future use	Quality of Feed, Visibility, Salience, Vi Rate of Change, Activity Levels, Comp Watch Window or Feeds, Number of Expertise, Expectations
Store	keep relevant information on POL activity for future use	Working memory	find POL activity in altered brightness version of WAMI	Computational Aid, Time Constraints

		Long-term memory		
Reset	need more detailed view of activity	Selective attention	alter brightness in WAMI	Expertise
		Response precision		
Decide/Select	alter brightness in WAMI	Long-term memory	expect altered brightness of WAMI to show more detail of POL activity	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
		Processing strategy		
Plan	expect altered brightness of WAMI to show more detail of POL activity	Working memory	response to need for more detail on POL activity	Expectations, Expertise
		Processing strategy		
Adapt/Learn	response to need for more detail on POL activity	Long-term memory	efficient visual inspection using all resources to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient visual inspection using all resources to complete mission	Long-term memory	alter brightness of image in WAMI for more detailed view of POL activity	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Change View in WAMI				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**
Input Select	pay attention to POL activity found significant	Selective attention	filter out rest of activity	Salience, Rate of Change in Feed, Visi Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of	Selective	keep relevant	Quality of Feed, Visibility, Salience, Vi

	activity	attention	information on POL activity for future use	Rate of Change, Activity Levels, Comp Watch Window or Feeds, Number of Expertise, Expectations
Store	keep relevant information on POL activity for future use	Working memory	find POL activity in new view of WAMI	Computational Aid, Time Constraints
		Long-term memory		
Reset	need more detailed view of activity	Selective attention	manually change view of activity in WAMI	Expertise
		Response precision		
Decide/Select	manually change view in WAMI	Long-term memory	expect new view of WAMI to show more detail of POL activity	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
		Processing strategy		
Plan	expect new view of WAMI to show more detail of POL activity	Working memory	response to need for more detail on POL activity	Expectations, Expertise
		Processing strategy		
Adapt/Learn	response to need for more detail on POL activity	Long-term memory	efficient visual inspection using all resources to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient visual inspection using all resources to complete mission	Long-term memory	change view of activity in WAMI for more detailed view of POL activity	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Scanning/Determine Significance				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**

Identify	recognize and label POL activity under inspection in FMV	Perceptual discrimination	keep relevant actions saved	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness
	recognize and label POL activity under inspection in WAMI	Long-term memory		
		Working memory		
Store in Buffer	keep relevant actions saved	Working memory	figure out if activity is significant	Computational Aid, Time Constraints
		Processing strategy	figure out if activity is non-significant	
Compute	figure out if activity is significant	Processing strategy	track people performing activity	Computational Aid, Time Constraints, Expertise
	figure out if activity is non-significant	Working memory		
Count	track people under inspection	Sustained attention	people performing normal or abnormal activity	Number of Competing Feeds, Amoun Activity
		Working memory		
Decide/Select	normal or abnormal actions	Long-term memory	continue to match to normal observed behavior	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
		Processing strategy	continue to match to abnormal observed behavior	
Plan	match to normal observed activities	Working memory	test current behavior being observed to normal	Expectations, Expertise
	match to abnormal observed activities	Processing strategy	test current behavior being observed to abnormal	
Test	test activity being performed to knowledge of a normal activity	Perceptual sensitivity	potential need for further investigation	Knowledge, Expertise
	test activity being	Working		

	performed to knowledge of an abnormal activity	memory		
		Long-term memory		
Interpret	potential need for further investigation based on interpretation	Long-term memory	reason for action	Expertise, Knowledge, Number of Cue
		Sustained attention		
Categorize	reason for action	Long-term memory	efficient visual inspection of actions to complete mission	Expertise, Knowledge, Number of Cue
		Perceptual sensitivity		
Adapt/Learn	appropriate and optimal reaction to actions performed	Long-term memory	efficient significance of activity determined to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	efficient significance of activity determined to complete mission	Long-term memory	determined significant	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy	determined non-significant	
			document for final product report	

Scanning/Re-orient WAMI				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task & Environmental Demands**
Input Select	error in visual location of WAMI	Selective attention	keep relevant information on correct location	Salience, Rate of Change in Feed, Visi Activity Levels, Expertise
		Perceptual sensitivity		

Store	keep relevant information on correct location	Working memory	re-orientation will display correct AOI	Computational Aid, Time Constraints
		Long-term memory		
Reset	need re-orientation in WAMI	Selective attention	manually change orientation in WAMI	Expertise
		Response precision		
Decide/Select	manually change orientation in WAMI	Long-term memory	expect re-orientation of WAMI will display correct FOV	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
		Processing strategy		
Plan	expect re-orientation of WAMI will display correct FOV	Working memory	response to incorrect location of WAMI	Expectations, Expertise
		Processing strategy		
Adapt/Learn	response to error in location of WAMI	Long-term memory	correct location of WAMI to complete mission	Expertise, Knowledge, Number of Cue Constraints

Tracking/ Tracking Request Made				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to customer's request to track target	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visi Activity Levels, Expertise
	visually pay attention to target for tracking	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	recognize and label target	Quality of Feed, Visibility, Salience, Vi Rate of Change, Activity Levels, Comp Watch Window or Feeds, Number of Expertise, Expectations

Detect	customer requires tracking of target	Perceptual sensitivity	recognize and label target	Expertise, Expectations
		Distributed attention		
Identify	recognize and label target	Perceptual discrimination	requires the visual inspection process to track target	Expertise, Number of Cues, Rates of C in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Queue to channel	requires the visual inspection process to track target	Working memory	store information on target to carry out tracking request	Expertise, Knowledge, Number of Cue Constraints
		Processing strategy		
Store in Buffer	store information on target to carry out tracking request	Working memory	figuring out if WAMI is sufficient for tracking	Computational Aid, Time Constraints
		Processing strategy		
Compute	figuring out if WAMI is sufficient for tracking	Processing strategy	follow process for following out a tracking request	Computational Aid, Time Constraints, Expertise
		Working memory		
Purge	follow process for following out a tracking request	Selective attention	reset to track target	Expertise
Reset	reset to track target	Selective attention	reacting to customer's tracking request	Expertise
		Response precision		
Control	reacting to customer's tracking request	Response precision	start visual inspection process to track target	Expertise, Knowledge, Number of Cue Constraints
Decide/Select	start visual inspection process to track target	Long-term memory	plan for tracking target	Number of Competing Feeds, Amoun Activity, Expertise, Visibility, Quality o Rate of Change, Expectations
		Processing		

		strategy		
Plan	plan for tracking target	Working memory	processing tracking requests for targets	Expectations, Expertise
		Processing strategy		
Adapt/Learn	processing tracking requests for targets	Long-term memory	follow out tracking request to complete mission	Expertise, Knowledge, Number of Cue Constraints
Goal image	follow out tracking request to complete mission	Long-term memory	switch to FMV feed	Quality of Feed, Salience, Visibility, Ra Change, Activity Levels, Competing W Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy	place pin for tracking	

Tracking/ Switch to FMV

Cognitive Agent Task	Input	Human Information Processing Resources	Output	Task and Environmental Demands
Input Select	switch to FMV feed	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
	pay attention to target	Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	search for target	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Search	search for target	Sustained attention	recognize and label target	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity	recognize and label movement of target	

Identify	recognize and label target	Perceptual discrimination	message to have spotball moved due to movement of target	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize and label movement of target	Long-term memory		
		Working memory		
Message	message to have spotball moved due to movement of target	Response precision	use military jargon in message	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Code	use military jargon in message	Response precision	verbal or written message on movement of target	Expertise, Knowledge
		Working memory		
		Long-term memory		
Transmit	message is written or verbal	Response precision	verbal or written message on movement of target	Expertise, Knowledge, Quality of Oral Communication, Quality of Chat Room
Reset	FMV feed changes due to spotball repositioning	Selective attention	track target	Expertise
		Response precision		
Count	keep track of targets if more than one	Sustained attention	search and identify target	Number of Competing Feeds, Amount of Activity
		Working memory		

Decide/Select	track target	Long-term memory	track target using new spotball position	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Plan	track target using new spotball position	Working memory	test if target can be tracked with new spotball position	Expectations, Expertise
		Processing strategy		
Test	test if target can be tracked with new spotball position	Perceptual sensitivity	spotball in correct position	Knowledge, Expertise
		Working memory	spotball in incorrect position	
		Long-term memory		
Interpret	spotball in correct position	Long-term memory	start tracking target	Expertise, Knowledge, Number of Cues
	spotball in incorrect position	Sustained attention	new message to get correct positioning of spotball	
Adapt/Learn	responding to target movement	Long-term memory	efficient repositioning of spotball to complete mission	Expertise, Knowledge, Number of Cues, Time Constraints
	responding to need for new spotball position		efficient tracking of target using FMV to complete mission	
Goal	efficient	Long-term	track target for	Quality of Feed, Salience, Visibility, Rate

image	repositioning of spotball to complete mission	memory	successful mission	of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
	efficient tracking of target using FMV to complete mission	Processing strategy		

Tracking/ Track Target				
Cognitive Agent Task	**Input**	**Human Information Processing Resources**	**Output**	**Task and Environmental Demands**
Input Select	pay attention to target	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	search for target	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Search	search for target	Sustained attention	recognize and label target	Salience, Visibility, Activity Levels, Expertise, Number of Cues
		Perceptual sensitivity	recognize and label movement of target	
Identify	recognize and label target	Perceptual discrimination	keep track of targets if more than one	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
	recognize	Long-term	track target	

	and label movement of target	memory		
		Working memory		
Count	keep track of targets if more than one	Sustained attention	track target	Number of Competing Feeds, Amount of Activity
		Working memory		
Decide/Select	track target	Long-term memory	plan for tracking target	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Plan	plan for tracking target	Working memory	efficient tracking of target at starting position to complete mission	Expectations, Expertise
		Processing strategy		
Goal image	efficient tracking of target at starting position to complete mission	Long-term memory	track target for successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

Tracking/ Define Starting Point(s)				
Cognitive Agent Task	**Input**	**Human Information Processing**	**Output**	**Task and Environmental Demands**

		Resources		
Input Select	pay attention to target for tracking	Selective attention	filter out rest of activity in watch window	Salience, Rate of Change in Feed, Visibility, Activity Levels, Expertise
		Perceptual sensitivity		
Filter	filter out rest of activity in watch window	Selective attention	recognize target	Quality of Feed, Visibility, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations
Identify	recognize target	Perceptual discrimination	keep identification of target for future use	Expertise, Number of Cues, Rates of Change in Feed, Situation Awareness
		Long-term memory		
		Working memory		
Store	keep identification of target for future use	Working memory	compute starting point for scanning watch windows based on location of AOI	Computational Aid, Time Constraints
		Long-term memory	compute starting point for scanning watch windows based on target	
			compute starting point for scanning watch windows based on POL activity	
Compute	compute starting point for scanning watch windows	Processing strategy	choose starting point	Computational Aid, Time Constraints, Expertise

		Working memory		
Purge	get rid of old information	Selective attention	choose starting point	Expertise
	get rid of other watch windows		give other AOIs to other analyst	
Reset	give other AOIs to other analyst	Selective attention	choose starting point to start scanning for target	Expertise
		Response precision		
Decide/Select	choose starting point	Long-term memory	to efficiently track a target to complete mission	Number of Competing Feeds, Amount of Activity, Expertise, Visibility, Quality of Feed, Rate of Change, Expectations
		Processing strategy		
Goal image	ability to efficiently track a target to complete mission	Long-term memory	define starting points to track a target for a successful mission	Quality of Feed, Salience, Visibility, Rate of Change, Activity Levels, Competing Watch Window or Feeds, Number of Cues, Expertise, Expectations, Knowledge
		Processing strategy		

APPENDIX C: Frequency of Human Processing Resources Tables

C.1 Table for Frequency of Human Processing Resources for Communication Function

Communication Human Information Processing Resources	**# of occurrences**
Selective Attention	19
Perceptual Sensitivity	20
Distributed Attention	7
Perceptual Discrimination	7
Long-term Memory	50
Working Memory	38
Response Precision	25
Processing Strategy	35
Sustained attention	8

C.2 Table for Frequency of Human Processing Resources for Mapping Function

Mapping Human Information Processing Resources	**# of occurrences**
Selective Attention	12
Perceptual Sensitivity	15
Distributed Attention	4
Perceptual Discrimination	4
Long-term Memory	30
Working Memory	21
Response Precision	7
Processing Strategy	21
Sustained attention	5

C.3 Table for Frequency of Human Processing Resources for Pattern of Life Function

Pattern of Life Human Information Processing Resources	**# of occurrences**

Selective Attention	16
Perceptual Sensitivity	42
Distributed Attention	6
Perceptual Discrimination	15
Long-term Memory	81
Working Memory	59
Response Precision	1
Processing Strategy	57
Sustained attention	35

C.4 Table for Frequency of Human Processing Resources for Scanning Function

Scanning **Human Information Processing Resources**	**# of occurrences**
Selective Attention	19
Perceptual Sensitivity	15
Distributed Attention	1
Perceptual Discrimination	4
Long-term Memory	42
Working Memory	27
Response Precision	6
Processing Strategy	26
Sustained attention	6

C.5 Table for Frequency of Human Processing Resources for Tracking Function

Tracking **Human Information Processing Resources**	**# of occurrences**
Selective Attention	12
Perceptual Sensitivity	8
Distributed Attention	1
Perceptual Discrimination	4
Long-term Memory	18
Working Memory	15
Response Precision	6

Processing Strategy	15
Sustained attention	5

APPENDIX D: Frequency of Task and Environmental Demands Tables

D.1 Table for Frequency of Task and Environmental Demands for Communication Function

Communication Task and Environmental Demands	**# of occurrences**
Salience	12
Visibility	6
Rate of Change in Feed	21
Expertise	110
Expectations	50
Number of Cues	7
Activity Levels	35
Time Constraints	35
Knowledge	79
Computational aid	11
Situation Awareness	21
Aid	7
Quality of Communication Feed	34
Vigilance	11
Physical Action	2
Competing Transmissions	31
Display Representation	11
Competing Chat Rooms	7
Quality of Image	1

D.2 Table for Frequency of Task and Environmental Demands for Mapping Function

Mapping Task and Environmental Demands	**# of occurrences**
Salience	20
Rate of Change in Feed	28
Visibility	26
Activity Levels	27

Expertise	60
Quality of Feed	17
Competing Watch Window or Feeds	11
Number of Cues	29
Expectations	29
Situation Awareness	8
Number of Competing Feeds	5
Knowledge	24
Time Constraints	16
Computational Aid	9
Aid	2
Quality of Communication Feed	4
Physical Action	1
Display Representation	1
Competing Transmissions	2

D.3 Table for Frequency of Task and Environmental Demands for Pattern of Life Function

Pattern of Life Task and Environmental Demands	**# of occurrences**
Expertise	137
Number of Cues	78
Rates of Change in Feed	51
Situation Awareness	15
Number of Competing Feeds	20
Activity Level	58
Visibility	47
Quality of Feed	29
Expectations	48
Knowledge	60
Time Constraints	34
Salience	40
Competing Watch Window or Feeds	21
Computational Aid	22

D.4 Table for Frequency of Task and Environmental Demands for Scanning Function

Scanning Task and Environmental Demands	# of occurrences
Expertise	68
Number of Cues	31
Rates of Change in Feed	33
Situation Awareness	4
Number of Competing Feeds	11
Activity Level	33
Visibility	30
Quality of Feed	22
Expectations	30
Knowledge	24
Time Constraints	21
Salience	22
Competing Watch Window or Feeds	13
Computational Aid	13
Quality of Communication	1

D.5 Table for Frequency of Task and Environmental Demands for Tracking Function

Tracking Task and Environmental Demands	# of occurrences
Salience	13
Rate of Change in Feed	20
Visibility	18
Activity Levels	20
Expertise	41
Quality of Feed	12
Competing Watch Windows or Feeds	8
Number of Cues	19
Expectations	16
Situation Awareness	4
Knowledge	13
Time Constraints	8

Computational Aid	4
Number of Competing Feeds	6

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