Time Sensitive/Dynamic Targeting Analysis Techniques and Results

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ABSTRACT[1]

SRA provides analytic support to defense transformation through several modeling and analysis efforts. The project heavily dependent on knowledge of command and control capabilities and modernization is the Time Sensitive Targeting/Dynamic Targeting (TST/DT) model. Command and Control (C2) is recognized as the backbone for the TST/DT process. C2 functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in controlling forces and operations in the accomplishment of the mission; therefore SRA has invested heavily in accurately capturing all portions of the C2 process relevant to TST/DT that can be modeled. This paper reviews SRA's modeling and analysis procedures and describes the TST/DT modeling tool, as well as its applications for analysis and training (including a Visual CONOPS developed for 7th and 9th Air Forces). We then discuss key results of our analysis, including performance insights from JEFX 04, and our progress towards analysis of the "to be" TST/DT environment. Finally, the paper describes future plans, including the development of a TST/DT debriefing tool based on our model.

1. Introduction

In 1999, then-commander of United States Air Force Air Combat Command, General John Jumper, set the goal of striking time sensitive targets in "single digit minutes." Since then, many technologies have been brought to bear in both the Air Force Distributed Common Ground System (DCGS, where intelligence information is processed, exploited, and disseminated) and the Air and Space Operations Center (AOC, where targeting solutions are developed and the decision to strike is made) to speed the time sensitive targeting process. However, much of this technology insertion is occurring without consideration of each technology's effect on the overall process. A particular technology may reduce the time required to execute one phase of the process, while placing additional burdens on other parts of the process, thus negating the potential benefit.

Since 2002, SRA International, Inc. has been under contract with Headquarters, United States Air Force to model and analyze the current time sensitive/dynamic targeting (TST/DT) process as it is practiced in today's AOC and explore concepts for improving that process in the future considering both materiel and non-materiel solutions. SRA used Extend™, a commercial-off-the-shelf modeling environment, to develop a baseline model that reflects the latest Air Force

Operational Tactics, Techniques, and Procedures (AFOTTP 2-3.2), including improvements from experiences in Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF). SRA has used this baseline model to compare actual and exercise operations in various theaters and has used the model to analyze the performance of several initiatives in the Joint Expeditionary Force Experiment 2004 (JEFX 04). A logical out growth from this baseline TST/DT model is the development of a prototype Dynamic Targeting Debrief Tool (DT2)

SRA has had several opportunities to model emerging information technologies – an effort that will continue as we develop our TST/DT process model to reflect Combined Air Operations Center (CAOC) activities in the year 2012. This Way Ahead Model (WAM) uses Metis® Model Designer Software tailored to provide escalating levels of detail to multiple decision maker levels. To date, SRA successfully developed and implemented a Metis® enterprise model to depict the Combined Joint Task Force Exercise (CJTFEX) 04-2 intelligence, surveillance, and reconnaissance (ISR) architecture and an Extend™ business process model to reflect the exercise-unique TST process.

The plethora of system solutions available create an atmosphere in which a solution is primarily evaluated based on the presentation skills of an advocate and ultimately is tested in an exercise environment. These incremental improvements are occurring in a less than optimal fashion with slight enhancements to the TST process. SRA's modeling metrics have provided AF decision makers with empirical data regarding TST manpower and technology process efficiencies and supported operational requirement development, AOC operator training, resource planning and programming, and experimentation.

2. Definitions

Targeting is a very popular subject among military strategists, planners, and analysts. As such, different organizations throughout the Department of Defense have come to use different terminology for what this paper refers to as DT or TST. This section introduces the definitions SRA is using for its process analysis.

2.1. Dynamic Target

A target identified within the Air Tasking Order (ATO) cycle of significant importance to all components that it should be struck during the ATO period given available assets. In OIF, the United States Central Command (USCENTCOM) Guidance, Apportionment, and Targeting (CGAT) determined which target sets were DTs. [2]

2.2. Time Sensitive Target

Joint Publication 3-60, Joint Doctrine for Targeting defines time sensitive targets as "…those targets of such high priority to friendly forces that the [Joint Force Commander (JFC)] designates them as requiring immediate response because they pose (or will soon pose) a danger to friendly forces or they are highly lucrative, fleeting targets of opportunity. The JFC normally provides specific guidance and prioritization for TSTs within the operational area. TSTs such as airborne aircraft and missiles and submerged submarines may be handled by separate components while others, including those on the surface of the earth, may require detailed inter-Service and/or functional component planning and coordination."[3]

2.3 Time Critical Targeting

According to *Air Force Operational Tactics, Techniques, and Procedures (AFOTTP) 2-3.2, Air and Space Operations Center*, time critical targeting is "an Air Force term that pertains to TST targeting processes, team specifics, and system processes."[4] Formerly, Air Force terminology included the noun "time critical target." However, the Air Force is migrating to the joint terminology. Therefore, TCT is the *process* for prosecuting TSTs.

2.4 Other Relevant Terms

For the rest of the discussion, we limit ourselves to the use of the terms "DT" and "TST." However, the following other terms with the same or similar meaning are frequently used:

- Mobile and Emergent/Emerging Targets (noun)
- Immediate/Unplanned/Unanticipated Targets (noun)

Regardless of the terminology, this analysis seeks to provide insights into the prosecution of targets which (for reasons of timeliness or importance) must be considered *outside* the normal targeting procedures in place in the AOC.

It is interesting to note that these types of targets generally form a very small percentage of the totality of targets nominated or prosecuted in a given conflict. According to a recent report from the U.S. Central Command's Air Component Commander (CENTAF), just 156 Operation Iraqi Freedom (OIF) missions were treated as TSTs, while an additional 686 missions were executed as dynamic targets. Throughout OIF, some 30,000 targets were nominated.[5]

3 The Models

This section describes the modeling tools adopted by SRA to perform analysis of the TST process. We describe the Extend™ modeling package and the Metis® modeling package, as well as the specific processes and sub-processes we model focused on activities within the Air Operations Center.

SRA International has been using Extend™, a commercial model and simulation toolkit produced by Imagine That, Inc., to perform business process evaluation for more than 10 years. This software suite was selected for its many strengths. According to Imagine That literature:

> The Extend simulation environment provides the tools for all levels of modelers to efficiently create accurate and credible models. Extend's modern, advanced design and rich feature set reduce the amount of time developing, validating, verifying, and analyzing simulation models. Model builders can use Extend's pre-built modeling components to quickly build and analyze systems with little or no programming. Simulation tool developers can use Extend's built-in, compiled language, ModL, to develop new reusable modeling components. All of this is done within a single, self-contained software program that does not require external interfaces, compilers, or code generators.[6]

Extend™ was originally designed to represent manufacturing processes. SRA has found that the tools for representing manufacturing processes map well to the areas of C2 and ISR.

Metis® software was selected as the tool to build WAM, the 'To Be' architecture model. SRA chose Metis® because it provides a means for producing a visual representation of vast and complex information, not only to answer critical questions but to help solve problems. "Metis allows you to capture information about multiple areas of an enterprise, from products to processes to systems, and link this information together. It allows you to view your enterprise at a high level or focus in on the details. By analyzing information and relationships captured in a model, you can see what is affected by changes and make informed decisions about your business."[7] More specifically, "with Metis® you can:

- Search for information meeting simple criteria
- Create multiple views of a model to address different audiences or areas
- Navigate a model
- Traverse relationships
- Perform methods such as calculations
- Link to external files"[8]

Using Metis® enables SRA to synchronize operationally acquired AF TST process data with the materiel and non-materiel programmed improvements to the AF C2 Constellation initially and to the Joint Targeting Process as resources permit.

3.1 TST/DT Modeling Tool

Process modeling is a commercially proven method of evaluating business processes across the Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) spectrum. Examining a process in its entirety, rather than focusing on a single sub-process, provides comprehensive understanding of how changes at the system level will impact the overall process. When considering system improvements, it is important to understand how a change in a single process will affect associated processes and determine the expected output or change to the whole. Evaluating a process from end to end enables exploration of the effects a modification will have as well as identification of problem areas prior to fielding. Process modeling provides quantitative analytical support to what is commonly a subjective process.

Extend™, utilizes a visual programming interface and hierarchal structure facilitating quick development of accurate 'business process' models. These constructs are also scalable and reusable by virtue of 'libraries', which provide capability to store, share, and reuse basic or complex building blocks from one model to another. Extend™ users are also supported by inter-process communication with Microsoft Office products. For example, data from model runs is easily captured and delivered to Excel, greatly increasing the capability to process the resulting data into meaningful information.

In large part, the analysis is performed in four basic steps as depicted in Figure 1. The first step is to conduct research required to establish a 'baseline' model, or point of departure from which to measure. Each initiative submitted for analysis must also be thoroughly investigated. The second step is actual model development. Step three is evaluating the resultant data and identification of critical vulnerabilities – the knees in the curve. With the first three steps completed, an overall solution can be developed.

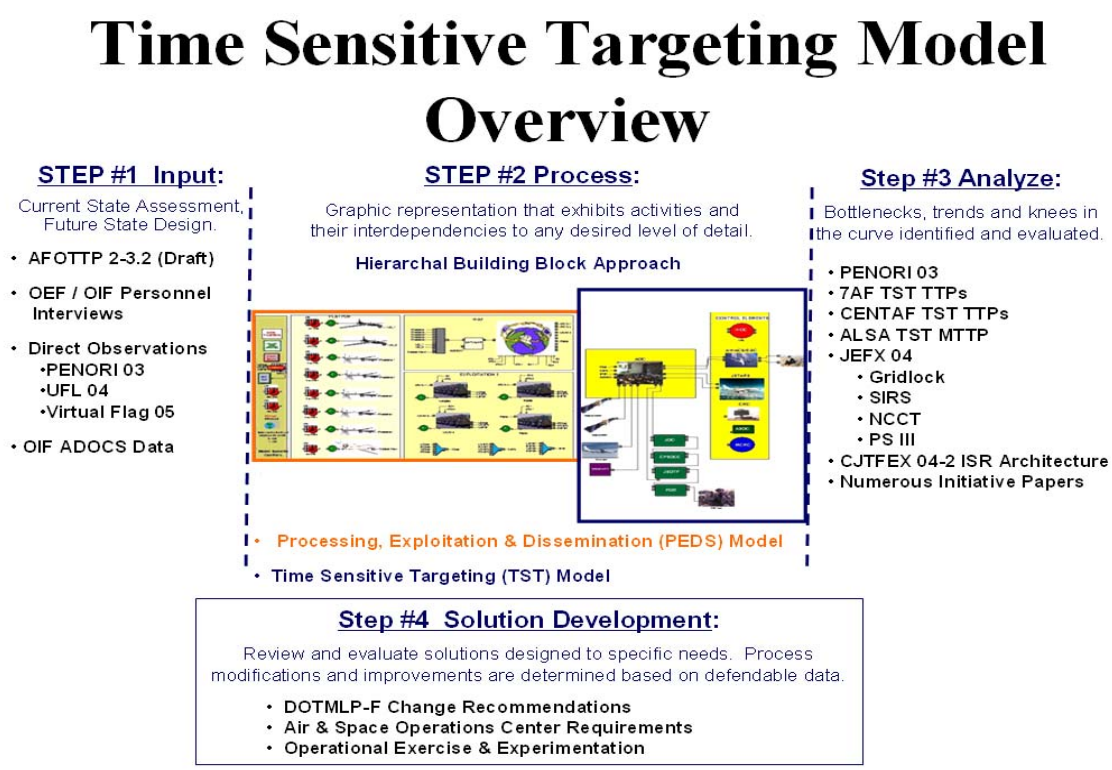

Figure 1: Basic Modeling Steps

SRA's research phase included reviewing Air Force documentation, interviewing Air Force OEF and OIF veterans who participated in the prosecution of TST/DTs, and site visits to interview participants and observe operations at the AF Hardened Theater Air Control Center (HTACC) in the Korean Theater, 9th AF at Shaw AFB, SC, and Combined Air Operations Center-Nellis (CAOC-N) at Nellis AFB, NV. The combination of interviews and observation helped us to understand the complexities and nuances of the Dynamic Targeting process as actually practiced. SRA recently received Automated Deep Operations Coordination System (ADOCS) data from OIF. To thoroughly examine this data, SRA created an ADOCS extraction tool. This extracted data will soon be used to incorporate real world data into the model. SRA has methodically documented each step of our research process.

Step two consists of model construction. Extend™ utilizes a visual programming interface, and hierarchal building block approach, facilitating quick development of accurate 'business process' models. In this case, the business is prosecuting Time Sensitive/Dynamic Targets. The USAF uses Find, Fix, Track, Target, Engage, Assess (F2T2EA) to describe this process. All of these steps are represented within the model. Find, is represented by the ISR platforms to the left side of the model. A communications network moves the raw imagery to the DCGS for processing, exploitation, and dissemination. Imagery identified as potential TST/DT is then sent to the AOC, and after review, becomes a nomination. The F2T2EA decisions/processes take place, largely within the Combat Operations floor. Additional intelligence feeds to the AOC are represented by the blocks below the AOC, and include National Technical Means Imagery, Signals Intelligence, Human Intelligence, JSTARS, and Special Forces input. Beyond the AOC, there are intermediate C2 nodes and strike platforms. (Figure 5 on page 14 depicts the Combat operations portion of the model.)

In order to evaluate the impact of an initiative on the overall process, it is necessary to compare the 'as-is' or baseline process to a new process which includes the initiative for evaluation. Two models must be built, a 'baseline', and one including the initiative. Aside from changes required to build the initiative into the baseline model, all other model components remain unchanged. Comparative model runs are then performed and the resultant data collected. Only in cases where logical, or where customer requested, were changes to model controls made. Additionally, if controls were changed, as in the case of a sensitivity study, equal changes were made to both models and comparative model runs performed. Comparative analysis was only performed on data produced from model runs with equivalent input.

Step three begins with analysis of the collected data. While it is important to understand the immediate impact of the initiative, it is more important to understand performance of the process overall. A newly added system may actually perform magnificently, but actually introduce no net gain across the board. Furthermore, it is even possible to improve one sub-process to the detriment of another. In these circumstances, the 'solution' has merely moved the 'problem'; this is often referred to as moving the bottleneck. At the sub-process or individual position level we examine queue rates, actual processing time, utilization rates, and overall holding time. At the macro level we examine timelines and throughput. Figure 2 is a sample graph of data gathered at the sub-process level. The queue data set indicates the amount of time in minutes a new task awaited processing. Actual refers to the amount of time actually spent processing, the total is self explanatory. Figure 3 represents an overall timeline graph and displays the minimum, average, and maximum time taken to process a nomination, develop a targeting solution, approve the solution, and release orders.

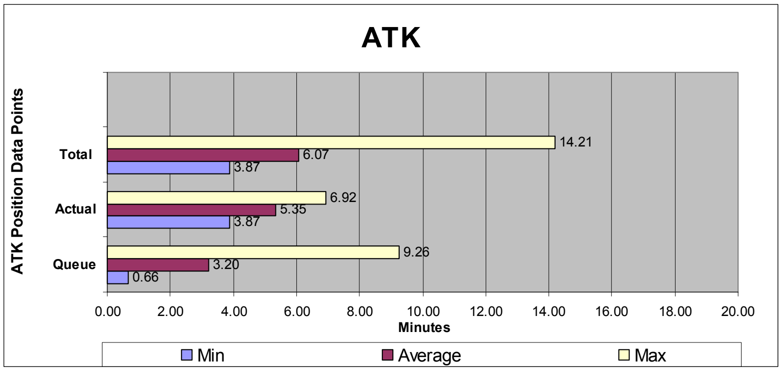

Figure 2: Attack Position Data Points

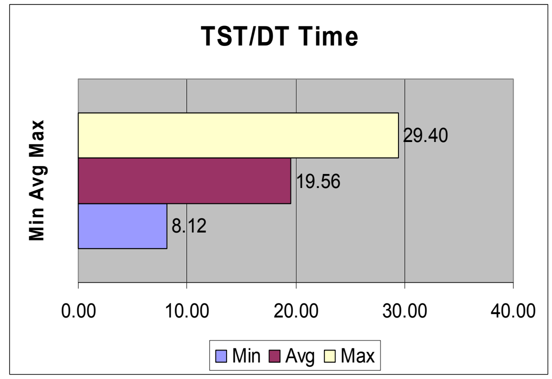

Figure 3: TST/DT Timelines

In Step four we present our analysis, draw our conclusions and present recommendations. Presentation is usually in the form of a paper that details our research, specific modeling approach, analytical results, and explains our recommendations. SRA has also presented study results in a briefing format. The advantage to this type of presentation is we are able to provide a modeling demonstration as part of the brief.

3.2 Way Ahead Modeling Tool

The real power of the Way Ahead Model (WAM) is as a problem solving and investigative tool with relationships created to represent how objects are linked to each other, affected by other objects, and the dependencies between them. The TST WAM provides the ability to easily view and understand the outcomes which constitute a very useful capability not currently being used for planning and guidance. This model can also be used as a means of orienting and focusing detailed discussions by subject matter experts at all levels of military operations. The main features of this product are: operational nodes and elements, the relationships between them, and the characteristics of the information exchanged between them. Each information exchange is represented by an arrow (indicating the direction of information flow) which is annotated to describe the characteristics of the data. Information-exchange characteristics can be shown selectively on the diagram, or more comprehensively in a matrix format. The information can then be used to make decisions about which systems are needed to satisfy the operational needs of an organization or functional area.

When developing the WAM, SRA made the following assumptions:

- The WAM only focuses on Air Force architecture at this time, but will continue to be updated with information from other services as acquired/needed.
- The WAM will be Department of Defense Architecture Framework (DoDAF) and Capability Maturity Model Integration (CMMI) Level 3 compliant.

- WAM inputs/information will be limited to TST/DT-related operations. Until information has been researched and verified, placeholders will be positioned within the WAM.
- For TST/DT operations, the TST/DT process analysis time begins with target identification and ends when engagement authority approval is given.
- TST/DT processes are based upon the current AFOTTP 2-3.2.
- Only prosecution of kinetic TST/DT attacks are considered and kinetic TST/DT engagements will be accomplished through the Dynamic Targeting Cell (DTC).

The model currently focuses on seven prime players including: Unmanned Aerial Vehicles (UAV: Global Hawk and Predator), JSTARS, AWACS, Combined Air Operations Center (CAOC), Ground Theater Air Control System (GTACS), Special Operations Forces (SOF), and strike assets. These are considered the critical nodes in the TST process and host critical connectors between the TST assets. Prime Players can be characterized by their mission, data handling capacity, speed of data/information movement across/through platform, transfer connections (airborne, space, ground, and seaborne platforms etc.), data transfer receive rates, and own consumption of data.

The model functional requirements include the depiction of TST assets to reflect the capabilities for the F2T2EA mission, the graphical display of the relationships among the prime players and their connectors, and the graphical display of the impact of future weapon systems on the F2T2EA process. Additionally, the model contains an analysis section which links to critical budgeting processes. The WAM can draw budgeting data from other sources including: the Planning, Programming, and Budget System (PPBS), Automatic Budget Interactive Data Environment System (ABIDES), AF Operational Manuals, Theater Specific plans and AF projected funding plans. With that data, the analysis section will allow planners, action officers, and budgeters to visualize the TST architecture and determine what effect budget cuts will have on the overall architecture, individual programs, and program elements. Using the Program Budget Analysis object created in Metis®, budgeters will be able to "what-if" scenarios to ensure that the budget cuts and changes will have the least amount of impact on the overall TST architecture through immediate visualization of the data. Lastly, the WAM will provide a template for future system acquisitions that will ensure a more organized and coordinated approach to preparing and analyzing outcomes.

3.3 Model Validation

Model validation occurs through close coordination with the customer and through practical application of the tools. Once the models were developed, the customers were briefed on our development process, information gathering and sources, and requested to provide feedback and recommendations. As the models were used in the applications described below, validity and accuracy of the modeling processes were verified.

4 Applications

4.1 Training Application

“We must train the way we intend to fight.”[9]
General Richard B. Myers, Chairman of the Joint Chiefs of Staff

Training is the cornerstone of flying operations. The importance of training was repeatedly emphasized by CAOC returnees of OEF and OIF. These skilled veterans stated that two events had the greatest impact on the improvement of OIF command and control (C2) operations over OEF C2 operations:

1. Participation in live-fly training exercises prior to deployment for OIF. These exercises allowed the CAOC C2 element, the airborne C2 element, and the shooters to hammer out the procedures they would use to prosecute TSTs.
2. ‘Rock Drills,’ or procedural exercises, conducted on the Combat Operations (Ops) floor at the CAOC prior to the start of hostilities in OIF. These ‘Rock Drills’ were used to ensure all participants had a clear understanding of their duties and responsibilities during TST prosecution.[10]

In an effort to support the training efforts conducted on the CAOC Combat Ops floor, SRA modified the TST Baseline Process model into two user friendly, organizationally-specific training aids:

1. 7th Air Force Visual Concept of Operations (CONOPS). This CONOPS is currently being used by the 607th Combat Operations Squadron (COS) to train incoming HTACC personnel.
2. United States Central Command Air Forces (USCENTAF) Dynamic Targeting Visual CONOPS Model. This CONOPS is currently being used by the 609 COS/DOOT (Training) section at Shaw AFB, SC.

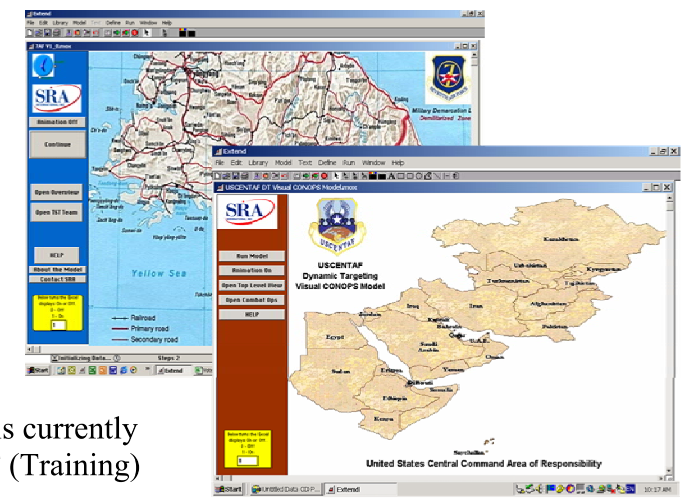

Figure 4: 7th AF and USCENTAF Visual CONOPS Overview Screens

These models capture the TST/DT thread and provide current processes and information flow used within an AOC. A simple ‘point and click’ capability allows the trainee to easily maneuver throughout the visual CONOPS. Buttons throughout the visual CONOPS link the user to descriptions of the various screen displays as well as organizationally-specific and over-arching AF documentation to include specifically AFOTTP 2-3.2 – AF definitive document on Air Operations. As a result, the visual CONOPS are ideal for familiarization of TST-related authoritative documentation.

Since the Visual CONOPS are modifications of the TST Process Model, AF planners in both organizations now have a limited capability to examine TST/DT-related manpower, system and TST/DT improvement requirements without having to actually execute a mission. An accompanying detailed, textual and pictorial user's guide provides complete operating instructions for users of the Visual CONOPS.

4.2 Analysis: JEFX 04

Air Force Command & Control and Intelligence, Surveillance, and Reconnaissance Center (AFC2ISRC) requested SRA assess and summarize the predicted value added of TST related initiatives associated with Joint Expeditionary Force Experiment (JEFX) 04. SRA reviewed the JEFX 04 architecture and identified four initiatives suitable for analysis: GRIDLOCK, Satellite Communications (SATCOM) Interference Response System (SIRS), Project Suter III (PS III) and Network Centric Collaborative Targeting (NCCT). Each has a desired end state of reducing one or more segments of the overall timeline to F2T2EA the TST collective enterprise effect. The four analyzed initiatives relevant to TST in JEFX 04 provide additional insight into future decisions regarding requirements, acquisition, fielding and employment in support of the TST process.

4.2.1 DESCRIPTION

SRA examined each initiative independently and then collectively. For each initiative, we prepared and released a Topic Paper describing the initiative and our assessment of how we perceived the initiative would perform within JEFX 04 Main Experiment. We provided the timeline improvements on the TST process that we predict will be afforded by incorporating the initiative.

Descriptions of the four selected TST-specific initiatives follow:

GRIDLOCK is a National Geospatial-Intelligence Agency (NGA) Advanced Concept Technology Demonstration (ACTD) technological enabler that automatically auto-registers tactical imagery to Digital Point Positioning Database (DPPDB) imagery thus producing a 'smart image'. The Smart Image Viewer (SIV) enables extraction of the embedded metadata ("actionable target information - latitude, longitude, elevation, and associated circular and linear error (CE/LE) estimates").[11] GRIDLOCK provides a method for simple 'point and click' generation of accurate target aimpoints. This ability is especially useful when determining multiple Desired Mean Points of Impact (DMPIs). With GRIDLOCK, multiple aim points can be determined by a few mouse clicks over a smart image in just seconds.

The purpose of SIRS is to "provide a set of automated tools that improve unprotected SATCOM link situational awareness and enable F2T2EA actions against hostile SATCOM jammers."[12] As the leading initiative for the future Rapid Attack Identification and Reporting Systems (RAIDRS), SIRS provides immediate detection, supports dedicated geolocation, and enables effective collaboration between the warfighters and decision makers. SIRS enhances current capabilities by providing a dedicated asset to the detection and location of SATCOM interference sources.

Project Suter III integrates the intelligence and operations communities in utilizing all available ISR, C2, Space and Information Operations (SIO) and communications systems to positively influence terrorist activities by gaining and maintaining information superiority over the battlefield. Desired effects may be achieved through kinetic or non-kinetic means, or non-kinetic treatments may be used to shape the information battlefield for kinetic attack. The PS III concept is based on a redefinition of relationships, responsibilities, and operating procedures among airborne, space borne, and ground based elements subordinate to or supporting the Combined Forces Air Component Commander (CFACC).

The purpose of NCCT is to "rapidly synchronize multiple Command & Control (C2) systems and Intelligence, Surveillance, and Reconnaissance (ISR) sensors on Time Sensitive Targets (TSTs) to create timely, engagement-quality information for tactical commanders."[13] NCCT will provide automatic cross-cuing between the ISR sensors and systems for fast correlation and collaboration of TSTs. NCCT uses machine-to-machine (M2M) interface in order to provide horizontal integration of all ISR sensors and C2 assets. One platform operates as the hub, collecting data from all the other platforms and retransmitting that data back out to the rest of the platforms.

4.2.2 RECOMMENDATIONS

The realization of a true net-centric approach to warfare will serve to transform most combat operations, but is of particular interest to TST prosecution as net-based answers lend themselves to greatly decreased timelines. NCCT provides a universally appealing approach to achieving decreased timelines in numerous steps of the TST process. The ability to dynamically task on the collection side of F2T2EA, supply target quality solutions in the absence of sufficient assets to perform the necessary functions, and have an extant solution integrated in the C2 and execution portions of the process provides a capability contributory to an enterprise solution for the TST problem. The combinative effects of a greatly improved approach to mensurated coordinates in those cases where necessary for weapons employment make GRIDLOCK another universally beneficial initiative to achieve a warfighter's objectives in TST. The final two initiatives occupy more refined and specialized roles in their contributions to TSTs generally. The non-kinetic aspects of PS III make it very expedient in achieving a timely solution by negating the need to perform in-depth positive identification (PID) and collateral damage estimates (CDE) in many instances. The ability to drive the adversary to a predictable action makes PS III particularly attractive to select a time, place and approach of the commander's choosing to engage. In this case, timing reaches a more controlled state by removing the dependencies associated with reacting to an adversary's moves.

SRA recognized the value of each TST-related initiative selected for JEFX 04 participation and recommended the following fielding prioritization:

1) NCCT: In the stand-alone analysis, NCCT showed the greatest ability to shrink the TST timeline. Improvements ranged from 18.2-83.3% over baseline depending on the scenario being analyzed. As it was incorporated into the combinations above, improvements continued to be realized. Furthermore, NCCT is relevant to each element of the F2T2EA process and demonstrates capabilities long sought after to more quickly correlate and collaborate TSTs and cross-cue ISR sensors.

2) GRIDLOCK: This initiative significantly improves (19-69% increase to baseline TST capability) the mensuration process which has been historically slow and laborious using current ISR Division capabilities. Though its benefits are limited to ground based point targets being engaged by precision munitions, these represent the types of targets on the Air Tasking Order each day along with targets engaged in the TST process. As it was incorporated into the combinations above, the non-GRIDLOCK initiatives may reduce the number of targets requiring GRIDLOCK-derived precision coordinates.

3) SIRS: The SIRS initiative represents a proactive attempt to protect communications essential to operational success. The stand alone analysis shows a suspected timeline reduction of 52% which jumps to 65.4-77.8% improvement with the addition of NCCT and GRIDLOCK. It is very likely that the TST process could be seriously impaired by the type of SATCOM interference SIRS is designed to address, making it very relevant to protection of all communications along with TST execution protection.

4) PS III: The PS III experiment is narrowly focused on improving the ability to engage a limited target set: terrorists and terrorist networks. This more narrowly focused initiative shows a 7-26% improvement over baseline capability; however in combination with NCCT and GRIDLOCK, the increase is 39-51% making this a formidable combination. Elements of PS III that cannot be modeled, but must not be ignored are the E-FAC concept, Playbook, and specific TTP to shape the battlespace. These are not captured in the numbers but are indicated to provide valuable contributions to the TST engagement process as well.

4.2.3 SUMMARY

SRA analysis indicated the most broad-based improvement would prove to be the NCCT capability since it serves as an enabler for multiple initiatives and offers great promise within the confines of those C2 and ISR platforms capable of working in a network-centric environment. As more assets become capable of network-centric operations, NCCT should gain even more appeal in prosecuting TSTs. GRIDLOCK will significantly improve timelines associated with deriving precise coordinates, but this only benefits a specific target type (a point on the surface) and certain weapon types (such as JSOW, JDAM, and ATACMS). However, when GRIDLOCK is appropriate and available, its contribution results in a four-fold increase in throughput.

The comparative analysis of JEFX initiatives measures the relative contribution the initiatives could make and assists decision makers concerning which initiatives to pursue. If an initiative can't meet performance design goals without a significant increase in effort on a cost plus program, one can assess the impact of current capability and compare it to the performance design goals - aiding the USAF decision to invest additional money, change the requirement, or drop the initiative. As a result of JEFX '04 experimentation, NCCT received immediate transition funding and will begin fielding in 2006; SIRS and PS III were recommended for transition funding in 2006.

4.3 CJTFEX 04-2: Connection of Extend™ and Metis®

Under the auspices of SRA's TST contract, we were able to model the Combined Joint Task Force Exercise (CJTFEX) 04-2. SRA used the Extend™ baseline AF TST process model which already existed and was reconfigured to mirror the subtleties of the CJTFEX 04-2 TST process. Metis® Software was used to model the CJTFEX 04-2 architecture, and depicted the ISR architecture linkages amongst the exercise objectives, ISR platforms and DoD DCGS tables of organization & equipment (TO&E), and DoD DCGS participant survey data regarding the operational utility/suitability of the Tactical Exploitation System (TES). The model was tailored to provide escalating levels of detail to multiple decision maker levels. Microsoft® Access and Excel applications were used to transfer data between the models. The process model computes the bottlenecks in the TST process, which could then be imported into the architecture to visually depict the effects. Changes can then be made to the architecture and those changes re-imported to the process model. The process model is then run and the new data gathered to see if the process is improved. This technical solution involving commercially available products is capable of dynamically providing decision makers with escalating levels of information relevant to their level of interest and scope of responsibility.

5 Future Plans

5.1. Dynamic Targeting Debrief Tool

Efforts to build and validate the baseline TST Model have afforded SRA's analyst the opportunity to observe operations in AOCs, attend AOC Orientation courses, review applicable Tactics, Techniques and Procedures, and interview veterans of OEF and OIF. SRA is currently using this information to develop an initial prototype of a debrief tool for CAOC-N.

At the November 2004 Red Flag/Virtual Flag, the 505 OS/CC explained to SRA analysts his needs for a viable debrief capability. A comprehensive Virtual Flag experience could be achieved if there were a measurement and debriefing system to capture and recreate critical decision making processes in the AOC. SRA's Dynamic Targeting Debrief Tool (DT-2) will help CAOC-N lead debriefers and instructors make this comprehensive experience a reality.

DT-2 will identify problem areas enabling debriefers and instructors to provide the necessary guidance to Virtual Flag participants so they learn the proper lessons and maximize their training experience. The commonly accepted Air Warfare Center philosophy is that "80% of learning happens in the debrief."

CAOC-N's number one priority requirement for a debrief tool is the ability to auto-populate their Excel formatted Debrief Sheet. Additional requirements include an event play back capability and the ability to identify problem areas so learning points may be made during the debrief. The following describes SRA's Dynamic Targeting Debrief Tool prototype which was demonstrated at Joint Red Flag 2005 in March and responds to these primary CAOC-N requirements.

5.1.1 TECHNICAL APPROACH

The prototype DT-2 in development by SRA is focused on using ADOCS output to auto-populate the CAOC-N Debrief Sheet and provide a rudimentary playback capability of CAOC-N activities. The debrief tool, using this data, would replay the TST/DT events as they occurred during the exercise period. Debrief displays will enable exercise participants to examine decision making time and process delays at individual work stations. The SRA proposed primary debrief displays are shown in Figures 5 and 6.

Figure 5 is a visual depiction of the Information Flow around the Combat Operations floor (i.e., an animated 'football drill'). It includes a clock which displays actual time events occurred during the CAOC period; a message text box which highlights the occurrence of significant events such as "Execution order out"; and the green spade represents information sent from the Dynamic Targeting Cell Chief en route to the Command & Control Duty Officer.

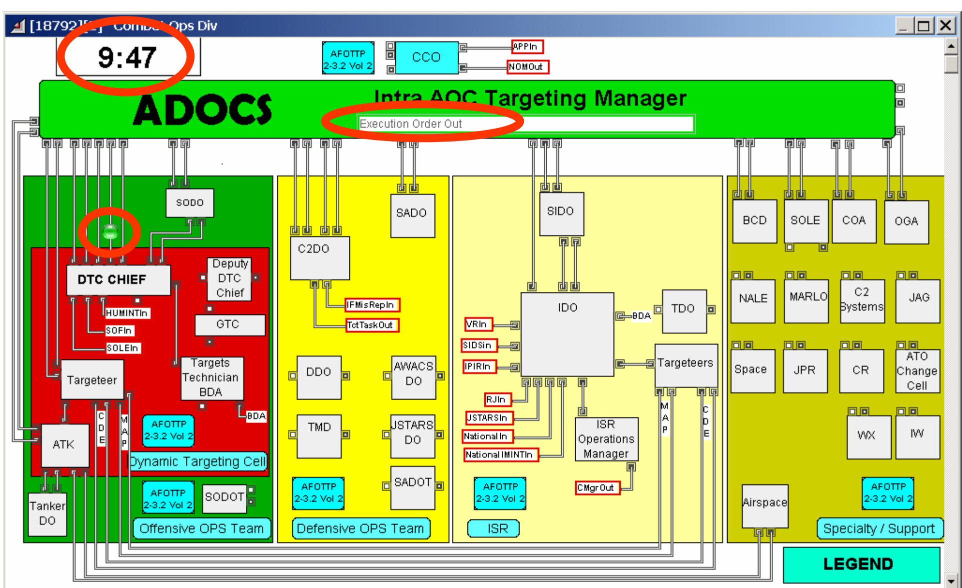

Figure 5: Combat Ops Info Flow

Figure 6 is the ADOCS Coordination Spreadsheet which displays DT/TST coordination per work station as it occurs.

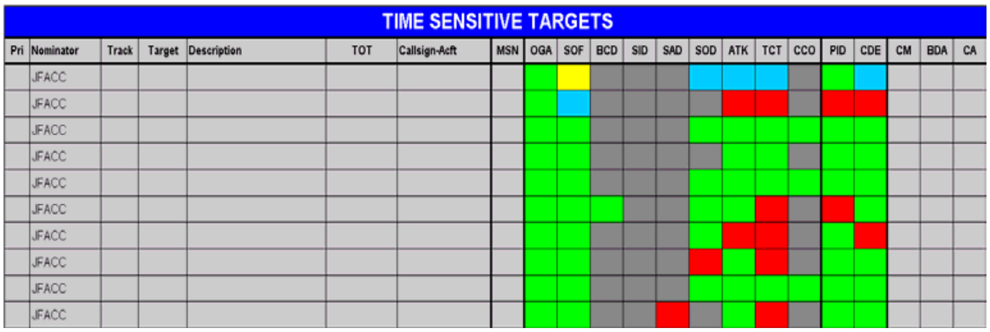

Figure 6: ADOCS Coordination Spreadsheet

A selectable variety of graphs will also be available to aid the lead debriefer or instructor in identifying problem areas allowing them to focus their teaching points. SRA will continue to work closely with the debriefing staff to develop graphs and outputs as needed by CAOC-N. Lead debriefers or instructors will define the most useful outputs to identify problem areas, allowing them to address these areas and optimize the efficiency of training.

5.2 Battle Damage Assessment Process Modeling

Based on SRA's previous ability to provide a solid analytical foundation capable of supporting analysis on C2 and ISR initiatives, applications, systems, and programs affecting the TST process, SRA was awarded an additional contract to model Battle Damage Assessment (BDA) procedures used in the AOC.

As part of this new contract, SRA will be working closely with Headquarters Air Combat Command (HQ ACC)/INX to perform analysis of BDA practices utilized in Blue Flag (BF) 05-02 which is scheduled for the mid-July 05 time frame. Unlike many past exercises, BDA will take center stage in this upcoming BF. HQ ACC desires that SRA capture the BF assessment process flow as outlined in AFOTTP 2-3.2. Additionally, data compiled and analyzed by SRA during BF is to be used in future BDA exercise comparative analysis. Ultimately, SRA plans to use the BF BDA analysis results to assist in reducing/eliminating the number of restrikes currently performed during on-going combat operations.

6 Conclusion

Since 2002, SRA has been carefully studying Air Force and Joint TST processes, baselining the current process, and looking for materiel and non-materiel solutions to make the process more effective for the future. We have developed a series of models and related tools which are being used to actively support Numbered Air Forces and exercises such as JEFX 04. We are now focused on the way ahead for time sensitive targeting, and providing the tools and thoughtful analysis to evaluate various concepts and initiatives. We are also using our toolkit to facilitate the TST mission debriefing process for CAOC-N and Joint Red Flag, and plan on addressing key BDA issues in the near future. We stand ready to assist in the continuing development of the AOC as a weapon system, and its integration into the C2ISR enterprise, including interfaces with DCGS.

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[1] This research is sponsored by the United States Air Force originally under GSA Schedule GS-35F-0764J, Delivery Order T0602BN2703 and later under SOW for Letter Contract No: GS00T04AJC0018.

[2] C2 TIG, *CENTAF "PACAF Demo", Time Sensitive Targeting Briefing* , 30 June 2003, slide 5.

[3] See Joint Chiefs of Staff, *Joint Publication 3-60: Joint Doctrine for Targeting*, 17 January 2002, p. B-1.

[4] See 505th Operations Squadron, *Air Force Operational Tactics, Techniques, and Procedures 2-3.2: Air and Space Operations Center*, 25 October 2002, p. 341.

[5] See USCENTAF Assessment and Analysis Division, *Operation IRAQI FREEDOM – By The Numbers*, 30 April 2003, pp. 4 and 9.

[6] See David Krahl, "The Extend Simulation Environment," *Proceedings of the 2002 Winter Simulation Conference*, San Diego, CA, 8-11 December 2002, p. 205.

[7] Computas, Training Manual: *Modeling wih Metis® -Basic, 2004*

[8] Ibid

[9] CJCS Guide 3501, "The Joint Training System: A Primer for Senior Leaders, 10 October 2003

[10] SRA interviewed several Operations ENDURING FREEDOM and IRAQI FREEDOM CAOC TST Cell veterans, to include the TST Cell Chief, from May to September 2003.

[11] GRIDLOCK Advanced Concept Technology Demonstration (ACTD), Post-JEFX 04 (Block 0) Transition Plan Version 1.0, 7 May 2004

[12] Satellite Communications (SATCOM) Interference Response System (SIRS) Concept of Employment (CONEMP) for Joint Expeditionary Forces Experiment (JEFX) 04, 22 March 2004

[13] Network Centric Collaborative Targeting Architectural Requirements for JEFX-04, 31 October 2003