Counter-terrorism Modeling and Simulation
A New Type of Decision Support Tool

The US government has spent billions of dollars developing models and simulations for training commanders and analyzing combat operations. The tools and techniques that have emerged from these projects can make a significant contribution to the war on terrorism. Simulations capture the dynamic relationships between a wide variety of objects and allow the humans using them to extend their faculties of analysis and extrapolation.

The enclosed paper introduces some of the ways that modeling and simulation can provide valuable support in new counter-terrorism missions. Specifically,

1. Understanding the relationships between all aspects of a terrorist organization.
2. Identifying connections between the terrorists, their targets, and our own counter-measures.
3. Teaching leaders to understand this type of threat.
4. Uncovering early indicators of future terrorist actions.

We are providing this paper in an effort to make you aware of the power of simulation and to begin the process of identifying and customizing existing tools and of creating new tools that can be applied to the terrorist threat. We would be happy to provide our professional services in undertaking this work and in identifying other companies and individuals who are best suited to tackling this problem.

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INTRODUCTION

On September 11th, the primary focus of the United States political, military, law enforcement, and intelligence organizations shifted to terrorism. Though the topic had been part of most organizations for decades, it suddenly moved to center stage. The complexity of dealing with this new threat will require the application of all types of military and intelligence assets –including computer systems for managing, sifting, and correlating data. This should include the application of systems dynamics models, combat engagement simulations, and analytical wargames. These tools exist to manage complexity and to discover relationships and meaning in data that is spread across multiple domains and distributed along a causally related timeline.

As analytical and decision support tools, models and simulations are like databases that change automatically in response to relationships between new and old information. Where a database is generally a tool for organizing, storing, and searching for data, a simulation is a dynamic tool for rearranging, combining, changing, and exploring new configurations of data from one minute to the next. This makes them invaluable tools for predicting future terrorist actions based on past and present events and conditions.

Unfortunately, the professional simulation community has never focused its resources and ingenuity on a complete analysis of the terrorist threat. As a result, there are currently no models that capture all aspects of terrorism and look for warning signs of future actions. Combat models that allow Special Forces to rehearse attacks against terrorist strongholds do exist. And intelligence models that identify the logical and physical relationships between members of a terrorist cell are available. But, there is no digital model that includes the military, economic, political, security, and legal facets of the threat. A suite of tools that describes this world is conceivable and the exploration into such a tool should become a primary focus of organizations involved in studying, understanding, and countering terrorist actions.

The White House executive order establishing the office of Homeland Security calls for that office to "prevent terrorist attacks within the United States." Dynamics models operating on the data we have gathered about terrorist groups will help prevent future attacks by identifying the conditions for their emergence and predicting the form they will take, the most likely locations and possible times.

DECISION SPACE COMPLEXITY

All of the activities and interests of a terrorist organization cannot be represented in a single homogeneous model – the problem is too big and too diverse. Such a complex organization is better represented in a suite of models that exchange information that is relevant in one dimension of the problem and that also impacts another dimension. A terrorist organization may consist of one or more command nuclei, multiple field cells around the globe, host nations that allow it to operate, operational assets such as weapons and communications equipment, financial assets, and sympathetic groups and individuals that provide support.

Figure 1. Terrorist Organizational Components

Such a diverse organization presents many unique dimensions that are intertwined. Each is a different facet of the problem that must be described and captured in a unique way within a simulation. Like the real world organization, each facet has specific relationships with the others and these connections are essential to understanding how the entire organization works. Legal actions against financial assets may have a direct impact on the ability of a field operative to purchase airplane tickets and pay for living expenses. Political and economic sanctions against a host nation may hinder its ability to establish and maintain training camps, thus reducing the number of terrorist available for missions. Humanitarian assistance may decrease the level of dissent within potential recruits and their families, which may limit the types of missions that they are willing to accept.

SIMULATIONS MANAGE COMPLEXITY

Simulations are the best tools for exploring the dynamic relationships between objects and activities. Traditionally, databases and spreadsheets have been used to capture a static snapshot of data. Add-on products allow these databases to sift, analyze, and compare data in an attempt to identify important conditions that should be brought to the attention of an operator. But this is not as powerful as creating a model specifically designed to mimic and predict terrorist actions. These models tie hundreds or thousands of these database snapshots together over time by identifying the relationships between

the objects and actions involved. Algorithms that represent movement, combat, intelligence, human behavior, logistics support, and hundreds of other activities track current events and predict what is possible in the future. The result is a moving picture of the past and present that can be used to peer into the future. The weakness of all models and simulations has been our own ability to discover or distill relationships between objects and events into specific algorithms. In theory, if these relationships were perfectly known, then the model would perfectly predict future states and events. In fact, some scientists view the world as a giant simulation in which all relationships are known and the "world simulation" then uses these to predict the future by creating it. Such an idealistic perspective encourages practitioners to discover these hidden relationships so that digital simulations can approximate the same calculations and provide a window into the future before it arrives.

Figure 2. Component Relationships and Countermeasures

Many organizations use databases, spreadsheets, and other tools to capture and manage information about their mission. The human mind then serves as the modeling engine for exploring the dynamic and future states of that data. A few organizations have discovered the advantage of off-loading much of this analysis and prediction to digital simulations. These simulations handle the drudgery of calculation and animation, freeing the mind to work at a higher level and providing people with much more information than could have been derived manually. As an example, this type of simulation leverage is currently being applied to identifying the best operational patterns for commercial

airlines and interstate trucking. The number of objects, variables, and interactions in such large systems makes it impossible for a human to analyze and optimize the entire system, therefore, all major airlines and trucking companies have turned to simulation to manage, analyze, and understand their businesses. The military has also been a huge proponent for analytical and training simulations, but have not focused on the terrorist threat yet.

SIMULATION AS A COUNTER-TERRORISM TOOL

Models are specially constructed to capture and animate a sub-set of the real world. We are a long way from being able to create a single simulation that can look at all of the dimensions involved in a terrorist organization. Therefore, the best approach is to create multiple simulations, each focusing on one aspect of the organization. These can then be linked together such that the information exchanged from one dimension to another is only that which influences the second dimension.

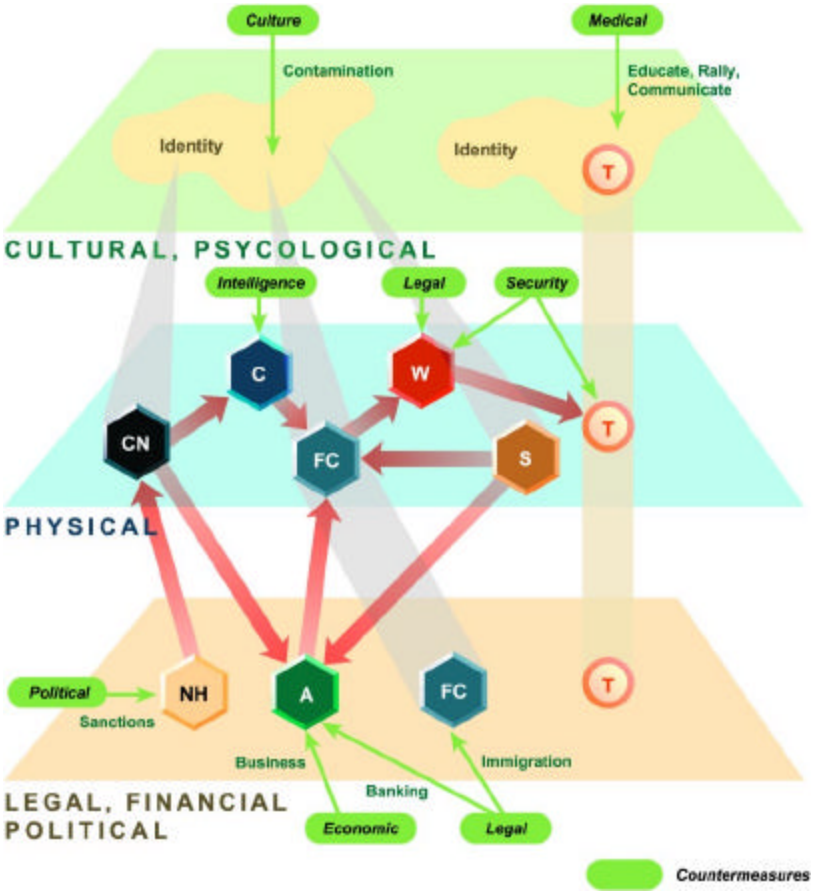

Figure 3. Multiple Facets of Terrorism and Cross Domain Relationships

Many military laboratories already contain multiple simulations that are linked to form a unified virtual world. However, the purpose for creating multiple simulations has been to spread the computational workload across multiple computers, not to explore multiple dimensions of that world as described above. A suite of counter-terrorism simulations would use existing simulation interoperability techniques, but each simulation would

represent a unique facet of the problem – military, security, economic, political, legal, and humanitarian actions and objects.

A simulation of the physical world would be used to place the command nucleus and field cells on the map. These assets would then become the targets for air strikes, Special Forces attacks, intelligence collection, and police arrests. Many combat simulations with these capabilities already exist and can be adapted to this new mission.

A simulation of the legal, financial, and political domain would capture the state and dynamic changes of host nations, group financial assets, and the legal status of field cell members. In these simulations, we would apply political and economic pressure to the host nation. Changes to this nation's status would change the ability of the command nucleus to hide and operate within the physical model. This would enable changes in other models to impact the success of operations in the physical model and vice versa. Models of legal actions against field cells would impact the cell's ability to enter and operate within the target country. This could directly impact the number and locations of physical attacks on targets.

Finally, a model of the cultural, psychological, and humanitarian environment could be used to represent the will of sympathetic individuals to support terrorist networks. By applying humanitarian aid to displaced people in the host nation, we may change the ability of that nation to continue to harbor the command nucleus. Aid may also influence global sympathizers to stop providing financial support and shelter to terrorists.

CONCLUSION

The concepts described here are just an initial outline of the role that models, simulations, and decision support tools can play in the war on terrorism. Such a diverse and complex problem has not been captured by these types of tools before and will require significant exploration before it can be captured accurately.

We have been using simulations for decades to explore the capabilities of our military forces and to train soldiers to perform their missions better. But, in the war against terrorism, this technology needs to come out of the training centers and into the operations centers of several organizations. If it becomes part of the daily fight against terrorism, such a tool will be constantly changing, improving, and becoming more accurate.

Computers, databases, models, and simulations are all an important part of the next generation of decision support tools. As our enemies have become more complex, our leaders need more powerful tools to help them manage, understand, and penetrate this complexity. They need the insight that a simulation can add to information in a database or to icons on a map display.