

# Dr. Theodore Bially

## Director

### Information Exploitation Office

## Lifting the Fog of War

Welcome to IXO—home of the fog lifters.

IXO's mission is to make the battlefield safer for ourselves and more lethal for our adversaries. Our weapon is information technology, and we exploit that technology in every way we can think of, to lift the fog of war for our side and thicken it for the enemy. But what is the fog of war?

The fog of war is the uncertainty and confusion that occurs when information provided to any level of command is incomplete, inconsistent, late in arriving, difficult to manipulate, or hard to visualize. It's caused by too much information as well as by too little. Even perfectly accurate and up-to-date information can thicken the fog of war if it's presented to someone who needs it quickly, in hard-to-understand or poorly organized formats.

The fog of war is a long-term phenomenon. It's there when we're actually fighting, but it's also there well before the conflict begins and it remains in place long after the shooting stops.

IXO's mission is to lift that fog for our side while making sure it's as thick as possible for our enemies. We seek to do that by collecting, processing, and exploiting every available item of information that could conceivably contribute to our understanding of the evolving

situation—before the conflict starts, during the fight, and after it ends.

So what does information exploitation really mean? How does it contribute to lifting the fog of war? And most importantly, what are the critical gaps in our portfolio of exploitation technologies that your ideas and innovations can help to bridge? Those are the topics for this article.

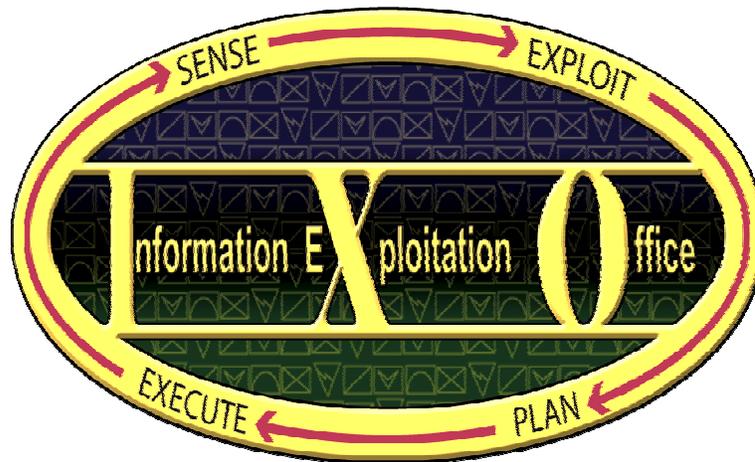
My office dictionary says that to *exploit* is to utilize to the greatest possible advantage and to

make use of for self-serving reasons.

We want to extract every last molecule of useful information from every possible source, to ensure that our troops always have the most complete and up-to-date picture of the battlespace.

And we want to provide this information to them unambiguously and in easy-to-understand ways, so they don't have to spend valuable time trying to decipher its meaning. This is certainly consistent with the dictionary's first definition, namely to utilize to the greatest possible advantage.

But for self-serving reasons? Of course! Absolutely! We selfishly want to protect our own troops and give them the greatest possible advantage over the enemy.



## Lifting the Fog of War

### Information—The Essential Ingredient

The first instruction in a famous old recipe for chicken soup is to “steal a chicken.” Information is like a chicken. It’s the essential ingredient in the recipe for lifting the fog of war. And like catching a chicken, getting your hands on information isn’t easy. Information doesn’t just lie around waiting to be exploited. It has to be coaxed out of its hiding places – databases, sensor outputs, intelligence reports, open source literature, and observant people.

Sensors, databases, and reports are sources of data, but data isn’t information. Data is a carrier of information. To get at the information lurking deep within the data, we have to process that data. After we distill the information content, we have to understand the significance of that information as it relates to our mission, geospatially, historically and militarily.

We have to draw conclusions from the information we’ve extracted, and these conclusions have to result in timely and correct military actions and command decisions. This start-to-finish process is what we call information exploitation, and that’s what IXO is all about.

IXO is exploiting information technology to develop new fog-lifting weapons across an incredibly broad set of military applications, ranging from warfighting situations in open terrain to conflicts in high density urban areas, and from force-on-force engagements to counter-insurgency operations, and against enemies having social and cultural traditions that may be counter-intuitive to us, and whose actions often appear to be irrational because we don’t understand their context.

Knowledge of the enemy is absolutely essential to military success. And the best way to learn about an adversary—what he’s done, what he’s doing, and what he’s likely to do—is through continual observation using as many observation mechanisms as possible. We call this persistent surveillance. It is the key to information exploitation.

We’ve learned that occasional or periodic snapshots don’t tell us enough of what we need to know. To really understand what’s going on, we have to observe our adversaries and their environment 24 hours a day, 7 days a week, week-in and week-out. That implies a multiplicity of platforms, sensors, and sensor types—on the ground, in the sea, in the air, and in space. We have to continually monitor enemy communications, networks, and data repositories for new clues about how he may be organized and what his next moves might be. And we have to constantly upgrade our understanding of the enemy’s inherent motives so we can effectively shape the battlespace to avoid further hostilities.

When we talk about persistent surveillance, we’re really talking about persistent exploitation—surveillance generates data and exploitation converts data into information and knowledge. Persistent surveillance enables persistent exploitation.

Persistent exploitation requires a systems approach, and IXO is a systems office. We build new sensor systems and new system-level exploitation tools that fill gaps in our ability to see and understand the enemy. We develop planning tools and control methodologies for coordinating and controlling multiple data collection and information processing systems. We develop knowledge discovery techniques that combine live sensor data with archived material drawn from multiple data repositories. This leads to in-depth understanding of our adversaries and an ability to enumerate their possible courses of action. Taken together as a system of systems, IXO’s technology portfolio will provide the persistence of surveillance and persistence of exploitation that no single system can accomplish alone.

### Area

IXO is aggressively pursuing new and innovative fog-lifting technologies and systems in a number of critically important military application domains. We will discuss exploitation and persistent

## Lifting the Fog of War

surveillance in the context of our three major thrust areas. Let's start with *Detection, Precision ID, Tracking, and Destruction of Elusive Targets*.

This has been IXO's traditional domain since its inception. We continue to make good progress in this area in our sensing, tracking, and target recognition programs. Our objective is to facilitate the engagement of elusive targets across a wide range of warfighting situations and environments. That is to say, detect enemy assets, identify them, locate them, track them, and target them precisely, and, subsequently, verify the effectiveness of strike actions taken against them.

Detecting enemy threats and identifying them unambiguously requires more than good sensor data. Context information and historical background is equally important. For example, we often need to know where a specific enemy vehicle was last seen, what other enemy assets are typically deployed in its vicinity, and what collateral damage might be incurred if we strike it.

A major challenge in exploitation is to quickly and accurately answer these kinds of questions as soon as a potential target is detected, both to confirm that it is what it appears to be, and to assess how disabling it—or not—might affect future events.

The answers depend on our having observed, recorded, and analyzed the battlefield environment in a thorough and persistent manner for days, weeks or even months in advance, and having organized the collected data and analysis results in ways that allow us to retrieve all available relevant information as quickly and effortlessly as possible. That's the idea behind persistent surveillance and persistent exploitation.

Another important fog-lifting area for IXO is in trying to *Understand the Enemy*. Short of immersing yourself in an enemy's environment for long periods, the best way to gain understanding of an unfamiliar culture and mindset is through continual observation. That means persistent surveillance and persistent exploitation of news articles, radio and TV broadcasts and reports from

street-level observers; in other words, persistent monitoring of every available source of data that might offer clues to the enemy's motivations, beliefs, and social values that, taken together, can help us fight him more effectively and defeat him with fewer losses. We've begun to address some of these very difficult but critically important issues in several of our newer program initiatives. But it's just a beginning.

IXO is also working to *Accelerate the Pace of Battle* by developing new automation capabilities for managing and controlling combat operations in real time and for speeding up the command decision-making process. Managing a rapidly evolving combat operation requires continuous monitoring of the states of all participating assets. We need persistent surveillance of our own forces, as well as those of the enemy, to provide our commanders with full and accurate situational awareness at all times. Also, since human decision-making is rapidly becoming the major component of delay in the target prosecution chain, we're observing our own military personnel in simulation and wargaming exercises to discover how they interact in executing their tasks.

### Directions

There are three exciting new directions that IXO is pursuing, where there are lots of opportunities for new contributions.

First, we have a new thrust aimed at pre—and postconflict operations. Preventing conflict and maintaining order after the shooting stops require persistent observation and thorough analysis of the adversary's actions.

Second, we're developing a family of advanced exploitation technology projects jointly with the National Geospatial Intelligence Agency (NGA). These projects will help to create a truly global-scale capability for persistent and rapid all-source exploitation for NGA's combat support operations.

## Lifting the Fog of War

Our third new initiative will turn the large inventory of disparate surveillance assets available to our warfighters into a coordinated, persistent surveillance system-of-systems.

In preconflict operations, we try to avoid the outbreak of hostilities in a region where we may eventually be called upon to fight. Postconflict operations are aimed at containing and controlling enemy combatants who continue to fight after the major battle is over. Our challenge in both of these areas is to anticipate how various actions—theirs and ours—might affect future events. We're pursuing a model-based approach that will let us evaluate causes and possible effects using complex computer models of the society, culture, economy, and prejudices of a region of interest.

This activity brings together two very broad but different professional disciplines: information technology and the social sciences. We face major challenges in combining key concepts of sociology, economics, and cultural understanding with information technology. If we succeed—and we need your help in this—we will achieve fast and accurate analysis and predictive capabilities that will enable our troops to operate efficiently and effectively in unfamiliar social and cultural surroundings.

In our new joint program with the NGA, we're developing technologies that will multiply an analyst's ability to exploit real-time data from a wide range of deployed sensors, in combination with archived historical records and earlier analysis assessments.

Critically important knowledge can be inferred from imagery, but of the millions of bits that comprise an image, how can we automatically tell which contain useful, mission-relevant information and which are simply excess baggage? The automatic extraction of information from imagery looms as a major technical challenge because it's a very difficult problem. It's also a crucial problem to solve because the number of images being produced by strategic and tactical sensor systems is enormous and it's growing by leaps and bounds as we deploy new sensors and new sensor platforms. There aren't enough imagery analysts in the population to keep up with this torrent of data.

Now consider a multiplicity of data repositories containing millions or trillions of bits and snippets ranging from images and maps to newspaper clippings and text messages. Of all these items, which are likely to shed light on a specific urgent problem and which are irrelevant? How can we quickly zoom in on the important material without wasting time on everything else? And how can we present the results to an analyst in ways that are best matched to that person's ability to assimilate and understand? Good information is the single most powerful mechanism for military dominance, and it is one of the hardest to pin down.

Our new system-of-systems effort, called POSSE, will provide persistent surveillance and persistent exploitation capabilities that are desperately needed to effectively counter the wide range of threats facing our deployed troops and allies every day. It will establish a powerful persistent surveillance architecture with application to future conflicts.