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IN REPLY REFER TO:

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FOIA ONR 14-002

July 11, 2014

Sent Electronically
john@greenewald.com

Mr. John Greenewald, Jr.
[REDACTED]
[REDACTED]

Dear Mr. Greenewald:

This is in response to a FOIA request you made to the Defense Technical Information Center, which referred it to the Chief of Naval Operations (CNO). The CNO numbered the request DON 2014F000053 and referred the responsive document to the Office of Naval Research (ONR), in a letter dated November 20, 2013. You requested release of document ADB377321, entitled, *The Black Swan Problem in National Security Affairs: Briefing to the CNO's Strategic Studies Group (16 October 2009)*.

The decision of ONR is to make this document available to the public. A copy of the document is enclosed.

The category of the request was "other." There are no assessable fees for services from ONR.

If you have any questions about this request, you may call Ms. Bonnie L. Gay at 703-696-4309 or email her at Bonnie.Gay.ctr@navy.mil.

Best regards,



Curtis Howard
Acting Director,

Corporate Logistics Department (BD04)

Enclosure:

As stated

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14. ABSTRACT As the defense analytical community faces the 21st century, the new challenges of irregular warfare and counterinsurgency- not to mention climate change and the shifting sands of global geopolitics-might demand new analytical methods, models, and tools. Attempts to refocus traditional threat-based perspectives on such new types of threats seemed unconvincing, and the idea of capabilities-based analysis seemed ill-defined, with different analysts using the term to mean different things, confusing an already confused situation. CNA's traditional focus on hard-headed empiricism just might be the key to a better way of addressing these future challenges, particularly those related to Black Swan events. This briefing, presented at the request of the CNO's Strategic Studies Group, explores these issues and addresses the integration of analysis and wargaming to build a better approach to exploring future possibilities.					
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The “Black Swan” problem in national security affairs

Briefing to the CNO's Strategic Studies Group
(16 October 2009)

Peter P. Perla

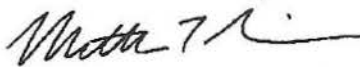
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CNA
ANALYSIS & SOLUTIONS

Att 3

Approved for distribution:

January 2012



Matthew T. Robinson, Director
Expeditionary Systems & Support Team
Advanced Technology and Systems Analysis Division

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Why am I here?

- First of all, I was invited—thanks
- The idea of “Black Swans” has been gaining traction in DoD for the past couple of years
- My *Phalanx* paper *So a Wargamer and a Black Swan Walk into a Bar . . .* won the MORS Walker Award as best paper of the year
- I have been working on a CNA-initiated effort to explore the application of Black Swan thinking to national security
- I am anxious to hear your ideas

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Where am I going? •

- Brief description of my approach to this research
- Delve into the Black Swan idea and book
- Operations research (OR), systems analysis (SA), and the logic of failure
- Wargaming and why it works
- Wargaming in an era of change
- Future directions of research

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Approach

- Methodology
 - Research into the Black Swan idea
 - Review history of OR and SA
 - Integrate ideas based on my experience
 - Draw on ideas, insights and feedback from other CNA staff
- Range of sources for original research
 - CNA *Annual Report* essays from late 1980s
 - Origins of OR in WWII, both British and U.S.
 - Planning and management literature
 - Recent scholarship on psychology and economic behavior
- Interchange with other people and organizations
 - Internal CNA discussions
 - Presentations at MORS, Connections, National Academy of Sciences, Army Center for Strategic Leadership
 - Today's discussion with the SSG
 - Always open to new opportunities

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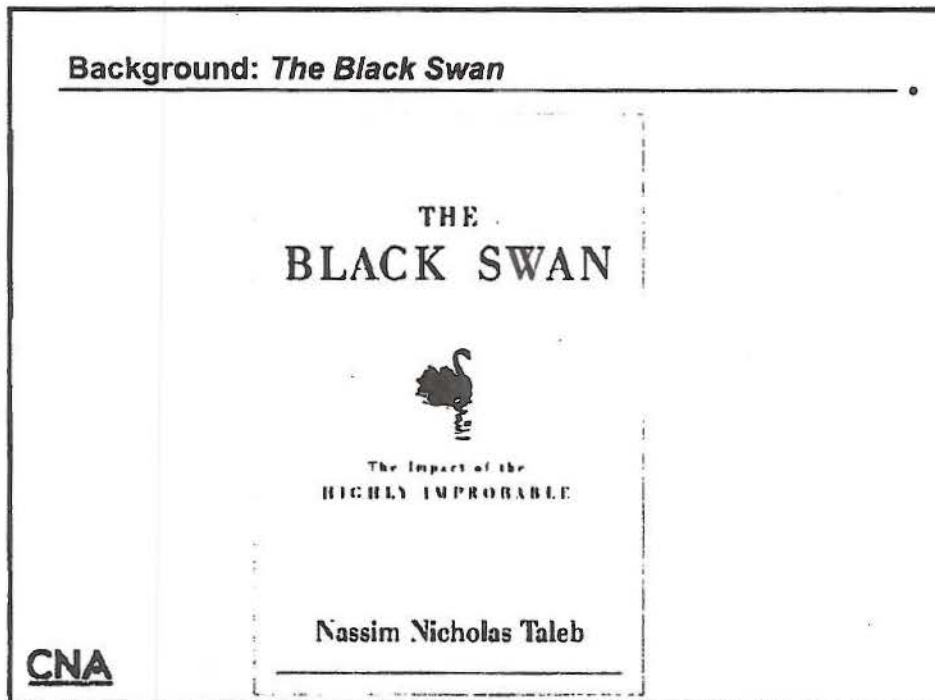
Prologue

In the summer of 1982, large American banks lost close to all their past earnings (cumulatively), about everything they ever made in the history of American banking—everything. They had been lending to South and Central American countries that all defaulted at the same time—"an event of an exceptional nature." So it took just one summer to figure out that this was a sucker's business and that all their earnings came from a very risky game. All that while the bankers led everyone, especially themselves, into believing that they were "conservative." They are not conservative; just phenomenally skilled at self-deception by burying the possibility of a large, devastating loss under the rug. In fact, the travesty repeated itself a decade later...after the real estate collapse of the early 1990s in which the now defunct savings and loan industry required a taxpayer-funded bailout of more than half a trillion dollars. The Federal Reserve bank protected them at our expense: when "conservative bankers make profits, they get the benefits; when they are hurt, we pay the costs.

—from *The Black Swan*, p. 43

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Background: *The Black Swan*



Some of you may have heard of or read the book *The Black Swan*, by Nassim Nicholas Taleb. I won't even try to give you more than a small glimpse inside it, because it is full of ideas and wit, both insightful and the infuriating. Suffice it to say that its author is an unlikely mix of philosopher and Wall Street quant, a fallen probabilist and a successful options trader. His was one of the very few voices crying in the wilderness about the explosive risk bankers were sitting on before the market collapsed last year.

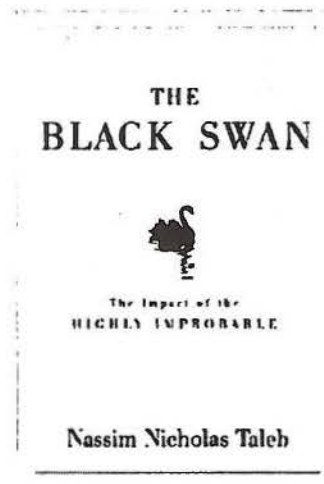
A Black Swan, as Taleb defines it, is a highly improbable event that has the three characteristics listed on the slide: it is, by definition, unpredictable; it has massive impact on the course of history; and once it occurs, we work hard to convince ourselves that we could have predicted it "if only." (By the way, Taleb says that the 2008 collapse was NOT a Black Swan because he, and many others, had been predicting it for months or even years.)

The term itself originates from the historical fact that for centuries, Europeans believed that, by definition, a swan was white—for the very simple reason that no one (that is, no European) had ever seen a black swan—until European explorers discovered them in Australia. The black swan story is an illustration of one of the human race's major cognitive flaws—we are too ready to believe that the past is always a good predictor of the future; that absence of evidence is the same as evidence of absence. Not so much.

Background: *The Black Swan*

- The book
 - Traditional economic analysis fails to represent true market volatility
 - Assumes Gaussian "error"
 - Assumes rational decision making
 - Discounted discontinuities
 - Black Swans dominate major historical shifts
 - Unpredictable
 - Massive impact
 - Post-hoc rationalization
 - Explores problems of cognition
 - "Black Swan Blindness"
 - "Confirmation Bias"
 - Platonic "Narrative Fallacy"
 - "Distortion of Silent Evidence"
 - "Cognitive Tunneling"

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Taleb argues that the traditional tools of quantitative economics are fundamentally flawed in their assessment of market volatility. They fail to account for the true nature of market volatility and discontinuities, falling into the trap of assuming Gaussian fluctuations in a situation of non-Gaussian dynamics. Instead, he argues that in the markets, as in all of history, the unexpected and dramatic swings dominate; history doesn't crawl, it jumps. His book explores the problems that human cognition confronts when trying to deal with the increasingly complex modern world. Among those problems are these five. We'll talk about each of these more in later slides.

Background: *The Black Swan* and my idea

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| <ul style="list-style-type: none"> • The book <ul style="list-style-type: none"> - Traditional economic analysis fails to represent true market volatility <ul style="list-style-type: none"> • Assumes Gaussian "error" • Assumes rational decision making • Discounted discontinuities - Black Swans dominate major historical shifts <ul style="list-style-type: none"> • Unpredictable • Massive impact • Post-hoc rationalization - Explores problems of cognition <ul style="list-style-type: none"> • "Black Swan Blindness" • "Confirmation Bias" • Platonic "Narrative Fallacy" • "Distortion of Silent Evidence" • "Cognitive Tunneling" | <ul style="list-style-type: none"> • My idea <ul style="list-style-type: none"> - Traditional national-security analysis/modeling fails to represent reality - DoD planning and acquisition faces new challenges <ul style="list-style-type: none"> • Irregular warfare and insurgency • Climate change • Post-Cold War geopolitics - Planners and analysts grasping for "new wine in old skins" <ul style="list-style-type: none"> • "We just got it right and it changed!" • Threat-based paradigms not working? • "Capabilities-based analysis" confused and confusing - CNA's traditional focus on empiricism may be the way "back to the future" |
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I sought out Taleb's book when a friend of mine from IDA heard me raving about the failures I saw in warfare modeling and the apparent self-delusion of many of the modelers. I was thus not surprised to find that I resonated with many of Taleb's ideas. I also concluded that some of his ideas had direct implications for DoD and the analysis community. Even the most entrenched warfare analysts could see that the new challenges of irregular warfare and counterinsurgency—not to mention climate change and the shifting sands of global geopolitics—might demand new analytical methods, models, and tools. They were not happy—one guy said at a MORS workshop on wargaming and analysis a couple of years ago that "we" had finally got the models for conventional war right, and things had changed on us. I and several of my colleagues just looked at each other. Models had got conventional warfare right? We must have missed the memo!

New attempts to refocus our threat-based perspective on new types of threats seemed unconvincing and the idea of capabilities-based analysis seemed ill-defined, with different analysts using the term to mean different things, confusing an already confused situation.

I began to think that maybe CNA's traditional focus on hard-headed empiricism just might be the key to a better way of addressing these future challenges.

Background: the project

- CNA-initiated began in 2008
 - Started from instinct that national-security models and simulations no better predictors than financial ones
 - Research into origins and growth of OR/SA
 - Thesis: preparing for the future (not predicting it) requires an integrated approach using analysis, exercises, history, real-world observation, and wargaming
 - Initial paper published in *MORS Phalanx*
- Extended into 2009 and now 2010
 - Incorporate additional research and broaden participation of CNA analysts and insights from other individuals and organizations
 - Subsequent papers to be targeted on other publications
 - Ultimate objective of producing a book-length monograph

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These sorts of readings and musings led me to propose that CNA conduct an internally funded project to allow me to explore the ideas in more depth. I was fortunate enough to get the idea approved and I began work in mid 2008. My going in thesis was that we might not be able to predict the future, but we could still prepare for it. And successful preparation demands that we use all our available tools—analysis, exercises, history, real-world operational observations, and, of course, wargaming. I have been able to show enough progress that CNA has continued to fund me and another analyst to do some additional work this past year and to continue into 2010. Our ultimate goal is to produce a book-length piece to encapsulate all the associated research.

Black Swans in national security affairs

- Conquests of Alexander the Great
- Protestant Reformation and resulting conflicts
- Rise and fall of Napoleon
- Fall of France, 1940
- Sudden and relatively peaceful collapse of the USSR
- 9/11 attacks
- Tsunami of December 2004 and the growth of Navy humanitarian assistance/disaster relief (HADR) operations?
- Iraq insurgency?

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So let's consider the idea of Black Swans as they might show themselves in military history and national security affairs. Here are a few examples that I think would qualify as Black Swans. What do you think? Do any others come to mind?

The problem of prediction

- "The inability to predict outliers implies the inability to predict the course of history." —Taleb, *The Black Swan*
- What does it mean to predict?
- How can something be "unpredictable" rather than merely not predicted?
- I'm a probabilist; I think of "unpredictable" as an event that is not an element of my sample space—so it has no probability, not zero probability.
- Is there a practical difference between a zero-probability event and one that isn't even in that sample space? I think so, but what is it?

CNA

We analysts are ultimately in the business of providing some sort of predictions to support decision makers. We'll talk about this more a little later. But if you accept that notion for the moment, then Taleb's prime conclusion is worrisome. We can't predict the outliers, so we can't predict the course of history.

But what does prediction mean? Indeed, how can something be unpredictable rather than simply not predicted? Can't we "predict" anything? For example, I predict that the Washington Redskins will win this year's Super Bowl. Does that mean that their winning is not a Black Swan? Maybe. Maybe not.

When in doubt, I return to my roots. I'm a probabilist. I think of events in terms of the universe of possibilities I can conceive of—or a sample space of possible observations. If something is in my sample space, I can assign it a probability, even if that probability is 0. But if something is not in my sample space, I cannot assign it a probability—it is not even a zero-probability event. Is that what it means to be unpredictable? Is there even a practical difference between a zero-probability event and such an unpredictable event? My gut instincts tell me that there is, but I can't seem to articulate it in non-mathematical terms.



Black Swan Blindness

Why don't we (humans) acknowledge Black Swans until after they occur? Taleb says:

- We're hardwired to learn specifics rather than generalities.
- We concentrate on things we already know and fail to consider what we don't.
- We prefer reasoning and thinking linearly. We have been fooled by the large number of phenomena that usually are well-behaved, and we tend to think of extremes as not only unlikely but also inconsequential.
- We're unable to truly estimate opportunities.
- We're too vulnerable to the impulse to simplify, narrate, and categorize.
- We're not open enough to rewarding those who can imagine the "impossible."

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We're Black Swan suckers

We fall too easily into error and fallacy

- "We focus on preselected segments of the seen and generalize from it to the unseen: *the error of confirmation*."
- "We fool ourselves with stories that cater to our Platonic thirst for distinct patterns: *the narrative fallacy*."
- "What we see is not necessarily all that is there. History hides Black Swans from us and gives us a mistaken idea about the odds of these events: this is *the distortion of silent evidence*."
- "We ... focus on a few well-defined sources of uncertainty, on too specific a list of Black Swans (at the expense of the others that do not easily come to mind):" this is *cognitive tunneling*.

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Confirmation bias. We generalize from the seen to the unseen: we develop theories and then look for the data that confirms those theories, seldom seeking very hard for the data that will prove them wrong.

The narrative fallacy. We have a Platonic thirst for distinct patterns: we are prone to developing and believing stories that help us fit our data, observations, and information into easily understood and remembered patterns. We seldom withhold judgment on the individual facts while simultaneously remembering them.

The distortion of silent evidence. What we see is not necessarily all that is there. History hides Black Swans from us and gives us a mistaken idea about the odds of these events. Too frequently, history reports on what happened, not what didn't happen. We are too quick to attribute specific causes to success because they seem common to repeated occurrences—without checking to ensure that the same "causes" were not also present among the failures. This is where so many statistical analyses, especially regressions, go badly off the rails, especially when they suffer from the simultaneous problem of linear thinking.

Cognitive tunneling. We focus on a few well-defined sources of uncertainty, even on too specific a list of potential Black Swans (at the expense of the others that do not easily come to mind). Most of us think of randomness and uncertainty in terms of games of chance (the *ludic* fallacy) or in terms of statistical homework or exam questions. In the real world, of course, we don't know the probabilities; we can't calculate the odds, at least not in an objective way.

We live in two "countries" at once

- "*Mediocristan*:" relatively stable, day-to-day, "primitive" world
 - Gaussian errors bound the degree of uncertainty we are willing to admit to
 - Example: sample heights of humans
- "*Extremistan*:" unpredictable, complex world
 - "Scalable" errors of power law functions: low-probability, high-impact events
 - Example: sample incomes of humans (especially if Bill Gates is involved!)

CNA

We can get a better handle on some of Taleb's ideas by looking at one of his most memorable metaphors: the contrast between the two lands of *Mediocristan* and *Extremistan*. In *Mediocristan*, no single observation is going to have a significant effect on the total value of a large sample. For example, if we averaged the heights of everyone in this room and Shaquille O'Neal walked in and we redid the calculation, the mean would not be much different. We are in *Mediocristan*. On the other hand, if we averaged the yearly income of everyone in the room and then added Bill Gates to the sample, the average would explode. That is *Extremistan*.

Things go south in a hurry, however, when we find ourselves lost in the wilds of *Extremistan*, with no better tools for confronting the dangers of the deadly Black Swan. What makes *Extremistan* so worrisome is what Taleb calls the "scalability" of so much of real life—of fat tails and of extreme events with not-infinitesimal probabilities, which defy our standard approaches to uncertainty and probability.



The unfortunate result

- "We behave as if the Black Swan does not exist: human nature is not programmed for Black Swans."
- We think (and too often behave) as if we live in "Mediocristan" when in fact we live in "Extremistan" (or both at once).
- We fool ourselves into thinking we know more than we actually do.
- We restrict our thinking to the irrelevant and inconsequential, while large events continue to surprise us and shape our world.

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We humans behave more frequently as if we live in Mediocristan than in Extremistan. In Mediocristan, basic statistical techniques and Gaussian errors tend to stand us in good stead. But because of that fact, we tend to delude ourselves into thinking that we are always in Mediocristan and so we fool ourselves into believing that we know more than we actually do. By focusing on those things that we think we understand, we actually spend too much of our time thinking about the little things (which route should I take to the bank) and ignore the truly consequential things that are shaping our world beyond the limits of our myopic vision (my bank has just gone under, taking my savings with it).

Why should we care? .

- National-security analysis (at least CNA-style) is in the business of “applying scientific methods to solve public policy problems – to bring results-oriented solutions backed by proper data and insightful analysis.”
- We believe in “the data”—do we believe too much?
- We produce and use mathematical models to analyze complex events—do we understand them enough?
- We advise government officials and military officers about potentially life and death decisions for both individuals and the nation—are we blind to the dangers of Black Swans?

CNA

Taleb argues that we need to refocus our modes of thinking if we are to deal better with this world of Black Swans. I think it's pretty clear that he's right—yet we should not respond by throwing out the familiar tools that work just fine, thank you, as long as we are in Mediocristan. We need classic military OR to deal with those problems. But—if it's important to prepare to deal with potentially world-changing Black Swans—we need to ask ourselves some serious questions.

Where am I going?

- The importance of the research and the need for a new approach
- The importance of the research and the need for a new approach

➤ Operations research (OR), systems analysis (SA), and *The Logic of Failure*

- Wargaming and why it works
- Wargaming in an era of change
- Future directions of research

CNA

So let's turn now to discuss the origins and practices of operations research and systems analysis. We'll wrap up that discussion by introducing some ideas from another interesting book with the provocative title, *The Logic of Failure*.

A brief trip in the "Way-Back Machine"

- P.M.S. Blackett, one of the first UK "operational" researchers in WWII, on the science of OR
- Morse and Kimball, OEG fathers, on operational data and hemibel thinking
- Hitch and McKean and the peacetime (or Cold War) origins of systems analysis

CNA

I want to give you just a taste of some of the basic reading I have done in the foundational literature of operations research and systems analysis. We'll start with Professor P.M.S. Blackett, one of the original practitioners of what the British called operational research during WWII. Blackett was a noted scientist (he eventually won the 1948 Nobel Prize in Physics for his investigation of cosmic rays using his invention of the counter-controlled cloud chamber) and he led one of the first of the British OR groups. Then we'll go on to the Americans Philip Morse and George Kimball, who were among the original founders of the U.S. OR effort during the war and credited as the founders of ASWORG, the direct ancestor of today's Operations Evaluations Group. Finally, we'll take a peek at Charles Hitch and Roland McKean, charter members of McNamara's "whiz kids" and definers of the art of systems analysis, which came into existence during the early days of the Cold War.

Blackett on the science of operational research

One obvious characteristic of operational research, as at present practised, is that it has, or should have, a strictly practical character. Its object is to assist the finding of means to improve the efficiency of war operations in progress or planned for the future. To do this, past operations are studied to determine the facts; theories are elaborated to explain the facts; and finally the facts and theories are used to make predictions about future operations. This procedure ensures that the maximum possible use is made of all past experience.

from Blackett, Studies of War

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Here is what Blackett had to say. His focus is on the practical nature of the work using the scientific approach to collect observations, develop theories, and then predict future outcomes based on the observations and theories.

Morse and Kimball on hemibel thinking

Compare the value of the constants obtained in actual operations with the optimum theoretical value, if this can be computed. If the actual value is within a hemibel (i.e., within a factor of 3) of the theoretical value, then it is extremely unlikely that any improvement in the details of the operation will result in significant improvement. In the usual case, however, there is a wide gap between the actual and theoretical results. In these cases, a hint as to the possible means of improvement can usually be obtained by a crude sorting of the operational data ... In many cases a theoretical study of the optimum values of the constants will indicate possibilities of improvement.

from Morse and Kimball, Methods of Operations Research

CNA

Morse and Kimball take Blackett's broad ideas into a more detailed arena of quantitative analysis. They recognize the value of numbers, but warn of the inherent and irreducible uncertainty associated with operational data. They also point out that the theoretical calculations, while not likely to be accurate predictors of real performance, can give important indications about where to seek out practical improvements.

Analysis from war to peace .

[T]he contribution of analysis was so clearly positive that military officers urged its continuation into peacetime, when, paradoxically, defense analysis is largely deprived of its empirical footing. In the absence of evidence that might falsify their hypotheses, analysts have too often felt free to propound the hypotheses as truths.

from CNA Annual Report, 1984

CNA

After the war, the successes of operations research were impressive enough that the military on both sides of the Atlantic argued for its institutionalization during peace time. But as argued by this quotation from a CNA essay some 25 years ago, there was a flaw in the plan. With no (or very little) actual operational data to work with, analysts began to convince themselves that their unverifiable theories were reality.

Hitch and McKean on systems analysis

The essence of economic choice in military planning is not quantitative analysis: calculation may or may not be necessary or useful, depending upon the problem and what is known about it. The essential thing is the comparison of all the relevant alternatives from the point of view of the objectives each can accomplish and the costs which it involves; and the selection of the best (or a "good") alternative through the use of appropriate economic criteria.

from Hitch and McKean, The Economics of Defense in the Nuclear Age.

CNA

This tendency became even more pronounced when OR gave pride of place to the new kid on the block, systems analysis. Rather than using a scientific paradigm, the systems analysts took economics as their inspiration. And though they were willing to use quantitative methods when they wished, they argued that the lack of numbers, or data, was not a real impediment; instead, they relied on the systems analysis paradigm to compare alternatives to one another in the context of the objectives desired.

Elements of "economic choice"

- An objective
- Alternatives
- Cost of resources used
- A model or models: "abstract representations of the real world which help us to perceive significant relations in the real world, to manipulate them, and thereby predict others."
- A criterion—the test by which we choose
- Judgment in designing the analysis, choosing alternatives and selecting the criterion

CNA

The paradigm has these major components. Although numbers could be helpful, the key element of the process lies in the judgment and perspicacity of those who design the analysis, choose the alternatives and select the criteria by which to compare them.

A CNA perspective

In sum, a war might unfold in many ways, but it *will* unfold in only one way. Before the fact, it is impossible to know how one or another piece of hardware will affect the outcome. For war is decided by men and luck; the machinery is almost incidental. Of course, it is better to have the machinery than not. But in war, the demands of the immediate situation and the user's ingenuity will determine how well a particular weapon is used.

from CNA Annual Report, 1986

CNA

I do not have time, nor the expertise, to catalog the successes and the more numerous and consequential failures of systems analysis. Another CNA essay captures the dangers of believing in our predictive judgment better than I can.

Operations research is about science

From Blackett:

"scientific method consists of a systematic method of learning by experience (Jeffreys). In more detail, scientific method may be defined as that combination of observation, experiment, and reasoning (both deductive and inductive) which scientists are in the habit of using in their scientific investigations (Yates). It may be noted that it is the use of appropriate and precise methods of observation and reasoning which make an investigation scientific."

CNA

So, systems analysis is about consensus. But operations research is about science. For the last word on that subject, let's return to our old friend Blackett. Here again, quantitative methods are implied, but not central to the definition, which focuses on observation and reasoning. In the end, however, as with SA, quantitative methods came to be considered a principal element of OR.

Black Swans require preparation

- Surviving—much less profiting from—Black Swans cannot be based on prediction because we are lousy at it.
- Instead, we must bank on preparation.
- Dietrich Dörner, in *The Logic of Failure*, argues that the best preparation for dealing with complex and unexpected situations lies in games



CNA

So what can operations research and systems analysis do to help us deal better with these ugly black birds? If we cannot predict them—because by definition they are unpredictable—what can we do to protect ourselves from, or profit by, their occurrence? One answer is that we can prepare for them by being intellectually and emotionally ready to respond to the unexpected. By being observant, flexible, and adaptable. And the best way to train your mind to handle unexpected and complex situations is to practice dealing with many unexpected and complex situations.

Enter *The Logic of Failure*, another thought-provoking book I recommend to your attention. In it, Dietrich Dörner, a German psychologist, explores human decisionmaking in complex situations.

Dörner's conclusion

- Humans don't handle complex, uncertain, dynamic situations very well
- Games are opportunities to think and reflect about such situations—with guidance
- Adapt "common sense" to complex situations
 - Recognize "shapes" in time
 - Think in terms of systems
 - "Systemic thinking" applies common sense to many widely differing circumstances
 - Simulation games are the best way to present lots of different circumstances to decision makers

CNA

In the book, Dörner argues persuasively, and in a manner vaguely similar to Taleb's later thesis, that the human decisionmaking apparatus is simply not well adapted genetically to dealing with the kinds of complex situations that are the breeding ground for Black Swans (although Dörner doesn't use that term). He proposes that the most valuable tools for learning how to think about such situations are interactive simulations—what I would call games—coupled with careful post-game analysis and reflection about what happened during the game and why. What we in the Navy would call a detailed hot wash-up and post-game analysis.

He argues that by confronting the sorts of problems characteristic of the complex situations we face in the future, decision makers can learn to adapt their own common sense to an environment far more complex than it was ever designed to face. We learn to recognize patterns over time and begin to think in terms of systems. In this way, we can learn to adapt our innate sense of the world to widely differing circumstances beyond our normal experience. And simulation games are the best vehicle for developing these skills.

So, to help DoD prepare to deal with potentially world-changing Black Swans, we really need to use wargaming to create and build the synthetic experience decision makers need to respond effectively to the unpredictable.

The trick is ...

- Know what you know
- Know what you don't know
- Learn what you don't know you know
- Learn what you don't know you don't know
- *This is where wargaming will help!*

CNA

In *The Black Swan*, Taleb argues that to deal with potential Black Swans in the real world you have to be able to assess your state of knowledge without delusion. To start with, you have to be sure of what you know and what you don't know. That's hard enough. Even more importantly—and more difficult—you need to learn what you don't know you know. Finally, you have to try to discover what you don't know you don't know. It was this discussion, more than any other, I think, that convinced me that Taleb was worth studying. Because nearly 20 years ago—has it really been that long—I had written that one of the most important strengths of wargaming is that it helps us to learn what we don't know we don't know.

Where am I going? .

- Wargaming and why it works
 - Wargaming in an era of change
 - Future directions of research

CNA

This past year, my colleague at CNA, Dr. Ed McGrady, worked on exploring just why wargames, or games in general, have this ability to teach us things we need to know in such an effective way. Let's spend a few minutes talking about what Ed concluded.

Wargaming is about humans .

My definition of a wargame

A warfare model or simulation in which the flow of events shapes, and is shaped by, decisions made by a human player or players during the course of those events

CNA

Our starting point, of course, has to be wargaming itself. What is it? Too often, people in this business use the term loosely, to describe everything from the activity of thousands of real troops and vehicles maneuvering across hundreds of square miles, to the largely intellectual activity of a couple of guys crouched over a paper map and pushing around tiny cardboard squares. What I am going to be talking about here are REAL wargames, not field exercises, analytical models, or computer simulations without players. Real wargames involve human beings making decisions and dealing with the consequences of those decisions, which result from the dynamic interaction of decisions made by human players and the game events that flow from those decisions..

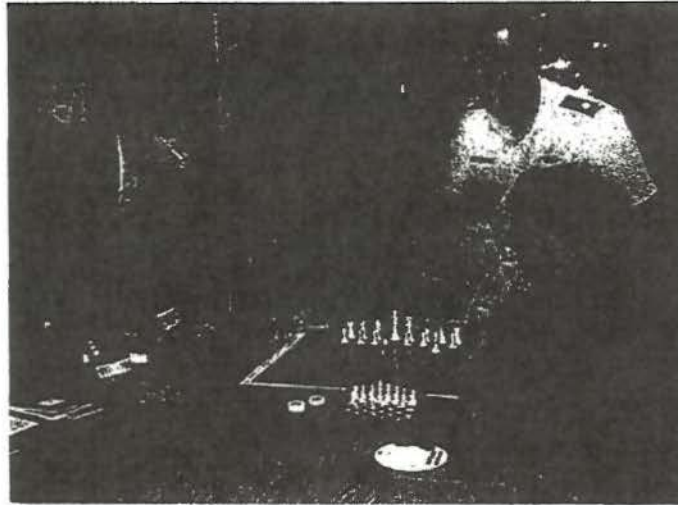
Wargaming is NOT OR/SA .

- Key words for OR
 - Scientific
 - Quantitative
- Key words for SA
 - Economics
 - Consensus
- Key words for wargaming
 - Decisions
 - Players

CNA

So, from my perspective, wargaming is not operations analysis or systems analysis, but a distinct tool. Wargaming is about players and decisions, not about science and mathematics or economics and consensus.

Players are people



CNA

And, of course, when I say players, I mean people. This picture shows a team playing InfoChess, a clever game developed by Aegis Research back in the early 1990s. Although based on chess, it added Information Chips, which you used to purchase information warfare capabilities, like reconnaissance or deception.

During the game pictured here, I was on the opposing team, led by Colonel John Warden of Desert Storm fame. We played these guys at an Air Force Connections Conference way too many years ago. We beat them in three or four moves, mainly because Colonel Warden played the players, as well as the game. He knew that at least one of these guys was a serious, rated chess player and so John expected that he would approach the situation from a chess player's perspective. Our team realized that such an approach would be vulnerable to an unconventional, asymmetric attack. We had barely sat down at the board when Colonel Warden stated his commander's intent: we would expend the bulk of our info resources immediately to go for fool's mate in three or four moves. We worked the plan. John's assessment of the enemy was right. Our plan worked.

This simple boardgame was probably a better representation of the cognitive aspects of asymmetric warfare than many of the complex simulations that today's M&S community loves to crank out. It was all about understanding the mental models of the key decisionmakers, and how to exploit them to win.

Why wargaming works

- To address Black Swans we need to change thinking of decisionmakers from "low probability/high impact" to "high impact/low probability."
- Example: planetary defense before and after comet hit Jupiter
- "This might be the most practical response to all the complicated challenges that Taleb presents in his work: by changing our emphasis, and paying better attention, bureaucrats will be in better shape to see the Black Swan coming, and do something about it before it arrives."
- "Experience" is key to making abstract risks tangible and planning possible.
- Wargaming is synthetic experience.
- Power of wargaming derives from its magnification of the power of narrative.

CNA

Here is a summary of some of Ed McGrady's thinking. He emphasized the need for decision makers to understand at a basic intellectual and emotional level just what it would mean for them to face a Black Swan event. One great example is the change in attitudes about the need to develop an approach to protecting the planet from a cosmological impact event. Despite attempts to get funding allocated during the early '90s, the assessment of the low probability of such an event made Congressional action less than urgent. Until fragments of the Shoemaker-Levy comet hit Jupiter in July 1994. Broadcast on national TV, the impact made tangible the possibility and created visualizations of what might happen if it had been Earth. Though it is hard to prove the effect of the event, the fact is that at Congressional urging NASA formed a new committee to study the issue, and the UN quickly followed with its first International Conference on Near-Earth Objects in April 1995. Perhaps even more telling of the effect on the popular imagination, in 1998 Hollywood produced not one, but two major motion pictures based on the comet scenario: *Armageddon* and *Deep Impact*.

Ed argues persuasively that by helping decision makers experience something that flips their thought patterns from "low-probability, high-impact" to "high-impact, low-probability," games can create the synthetic experience of such events necessary to get the preparation ball rolling. The power of this synthetic experience, in turn, derives from the way games can magnify the narrative power of their inherent story.

Why wargaming works: wargaming and narrative

- Narrative theory concepts of *l'entre deux* and suspension of disbelief
- Narrative meanings go beyond facts; can form an image in the reader's mind and cause the reader to react emotionally
- Wargames are "constructed narrative" involving players as actors
- Neuroscience indicates perception and understanding linked to acting; the brain is designed to move the organism through the world
- Games force players to act both physically and intellectually
- Players invest in a game more of their own identities and conception of what is real than in a prosaic narrative
- Investment has a more substantial impact on the participants than traditional narrative because players "own" the "between worlds," and for them it becomes less fictional and more "real."

CNA

I don't want to go into the literary and philosophical arguments underlying Ed's work, but this is a brief summary of the argument. It is based on the notion the *l'entre deux*, or the "between place," a concept in literary theory. It is in this in-between world, where narrative becomes, in a sense, real and reality has retreated into the background, that the reader, hearer, or viewer of the story engages in what is known as "suspension of disbelief." Wargaming takes advantage of this phenomenon in a special way by creating a constructed narrative, one in which the players are the actors in the drama. By engaging the brain in ways similar to the way it reacts to the real-world necessity to do something, players become more deeply involved in the game and tend to invest more of themselves in the resulting narrative. As a result, the game becomes more real to the players than a story or movie would be, because they must act within the story, not merely be a spectator to it.

Analysis wargaming and Black Swans

- Analysis lives and works in the relatively stable, day-to-day world of "Mediocristan"
 - "The Sun'll come up, Tomorrow!"
 - Gaussian errors bound the degree of uncertainty we are willing to admit to
- Wargaming should explore "Extremistan"
 - "Here lieth Black Swans!"
 - Help us to admit and prepare for "scalable" errors (low-probability, high-impact events)
- We need to use both for what they are best at

CNA

To tie this line of thought together with Black Swans, let's return to Taleb's two worlds. As we have seen, humans behave more frequently as if we live in Mediocristan than in Extremistan. In Mediocristan, basic statistical techniques and Gaussian errors tend to stand us in good stead. Things go south in a hurry, however, when we find ourselves lost in the wilds of Extremistan, with no better tools for confronting the dangers of the deadly Black Swan. Taleb argues that we need to refocus our modes of thinking if we are to deal better with this world of Black Swans. I think it's pretty clear that he's right—yet we should not respond by throwing out the familiar tools that work just fine, thank you, as long as we are in Mediocristan. We need classic military OR to deal with those problems. But—if it's important to prepare to deal with potentially world-changing Black Swans—we really need to use more and better wargaming.

Where am I going?

- Problem-based, iterative approach to this research
- Engage the community in the research
- Develop a series of workshops, systems analysis, and other tools to help
- Develop a research agenda

➤ Wargaming in an era of change

- Future directions of research

CNA

The MORS analysts who propounded the notion that given the changing political-military environment it might make sense to rely more on wargames until we got our traditional models recalibrated to that new environment might be overconfident in their outmoded tools, but they certainly were correct to be concerned about the effects of the change from Cold War to what appears to be close to chaos. Let's take a look at just a couple of aspects of that changing environment and what wargaming might do to help.

Fundamental change is afoot

- We are in the early stages of fundamental changes in warfare potentially as revolutionary as the *blitzkrieg*—*hybrid warfare* is the descriptor currently in vogue.
- Our ability to predict the vector of change is questionable at best.
- Wargaming is critical to preparing for that unpredictable future.

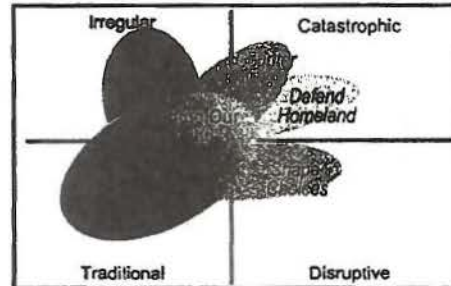
CNA

We are facing the beginnings of the real revolution in military affairs—not the one trumpeted in the 1990s but the real, no kidding versions of 21st Century warfare that we see arising around the world today. I see the coming revolution as no less an upheaval than that presented by the explosion of the *blitzkrieg* on an unprepared Europe in 1939. This revolution can take many forms and claim many names. I will use the name hybrid warfare.

Although I will describe what I mean by hybrid warfare in more detail in the next few minutes, I want to emphasize that the details are both uncertain and subject to great error. Our ability to predict the way things will go tomorrow, much less ten years from now, is questionable at best. Remember that ugly black bird. But what is not in question is the critical role that wargaming can and must play in helping us to prepare better to live in that unpredictable future world of hybrid warfare.

Hybrid warfare

- The old QDR quad chart distinguishes four types of threats.
- Most dangerous future stems from a synergy of all four.
- How do you counter an integrated threat?
- The return of attrition warfare?



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You guys have probably seen more examples of a so-called quad chart than you care to remember. I know that I have. But bear with me for a minute. The old QDR introduced the quad chart showing four classes of threats or types of warfare: traditional (the manly tank vs. tank, armored warfare reminiscent of W—W—II, the Big One); irregular (the sort of guerilla or counterinsurgency fight we are experiencing in Iraq and Afghanistan today); the catastrophic threat presented by Bad Guys armed with nukes or other weapons of mass destruction; and the disruptive threat (the kind of limited high-tech capability that Hizbollah gave the Israelis fits with a couple of summers ago). Conventional wisdom sees the United States as dominating the traditional quadrant, but needing to shift our weight more toward the irregular quadrant, while keeping our eye on the other two. But what happens if one or more of our adversaries manage to compose a synergistic threat from all four quadrants at once? What do we do then? How do we deal with a potentially dispersed threat from a handful of highly lethal weapons protected by a thin crust of high-tech conventional forces leveraging some disruptive network attack capabilities, and operating on the edges of a thick swamp of terrorists, guerillas, and other irregulars? What happens when our enemies no longer give us massed armored formations to engage with precision weapons, but rather spread out their forces into small but lethal penny packets, daring us to invade their homelands and fight a new war of attrition in urban or rough terrain?

Wargaming helps us learn

- What we *really know* (not just what we think)
- What we don't know (but think we do)
- What we don't know that we know (but can help—or harm—us)
- What we don't know that we don't know (but need to learn pretty darn fast!)
- *What we know that aint so! (and will kill us dead)*

CNA

Remember this slide? Ah, but it's not quite the same as the one you saw earlier! As I have been thinking about the litany of uncertainty recently, it led me back to an even older point, one that I have heard attributed to Abraham Lincoln in the dark days of the Civil War, but which seems to be attributable to Artemus Ward, a contemporary of the great man and his favorite author. "It aint what you don't know that will get you; it's what you know that aint so." We have seen a lot of that since spring 2003. We knew that the Iraqi people would welcome us as liberators. We knew that we could get by with a small military force while we rebuilt Iraq and turned it over to a democratically elected government. We knew . . . well, you get the picture.

Where do wargames live?

- Technology can both help and hinder effective wargaming.
- We need to harness together creative design and tailored technology.
- The instrumentality is not the game.
- The game takes place in the minds of the players.

CNA

To learn what we need to learn and avoid the dangers of getting it all screwed up as we have in Iraq and Afghanistan, we need wargaming. But not the kind of wargaming that too many DoD people think about when they hear that term—big computer models of big wars, or first-person-shooter style tactical computer games. Each of those has its place. But what we need most and are lacking most is the first-person *thinker* game. Wargaming must make use of technology; there's no question about that. But what technology and when? Because technology, especially the fancy bells and whistles we see in today's sexiest computer games, can be both a help and a hindrance. It is a help when the technical power of computers can be harnessed by the human designer to make the play of the game more engaging to the human players, both intellectually and emotionally; technology is a hindrance when game creation is dominated not by game designers, but by computer programmers who see the players as just another bunch of I/O devices to deal with. Because the game is, and always has been, in the minds of the players, not in the instrumentality of the game—whether cardboard and paper, lead and plastic, or silicon and electrons.

Critical changes in wet-ware may be under way .

- Today's "gamers" are among the DoD decision makers and players of the future.
- Their experiences and techniques of learning about and acting in the world are heavily mediated by electronics.
- Distinction between "real life" and the game are becoming blurred—as a result, the "synthetic experience" of games is becoming more real—and vice versa.

CNA

Yes, technology—both of warfare and of wargaming—continues to develop, but it is in the wet ware of warriors and gamers that the most important changes must take place. Marc Prensky, a proponent of computers and computer gaming, talks about the generations born in the last twenty to thirty years as the "digital natives." They have grown up with the computers, cell phones, and Facebooks in ways that my generation of "digital immigrants" grew up with comic books, TV, and boardgames. These digital natives are the future of DoD. Their whole way of life has been and continues to be mediated by electronic devices and different modes of interacting with others using those devices. In warfare, as in so many other aspects of reality, direct sensory experience of the environment and other people has become less frequent, less important, and less relevant. What in 1990 I called the "synthetic experience" that games could provide is becoming more literally real experience. The movie *Wargames* and its game playing computer which did not distinguish between the real world and that of its games, was ahead of its time—its time is now.

Critical changes in technology on the horizon

- Artificial-intelligence and artificial-life representations of “non-player characters”—a perennial favorite!
- Technology to represent real-world *intellectual* operating environment for key decision-makers—Twitter?
- Must also allow for real play—that is, seeing and trying out creative new ideas to see what happens.

CNA

Technologists have been talking about artificial intelligence for so long that it has become a cliché; but there has been real progress in the last decade at creating artificial life, using ideas from complex systems theory and the notions of emergent behavior. Matt Caffrey, a leading Air Force wargamer and the man who runs the Connections Conference, has argued fairly persuasively that we will enter new realms of wargaming once we cross the energy barrier into the realm of creating artificial game subordinates for human players whose actions are indistinguishable from those of other humans. Our technological prowess has so far been focused on eye candy, on creating more and more photo-realistic representations of the physical environment of the guy on the ground or in the air as he engages his enemies; to help DoD, we should be pushing even harder toward building effective and realistic representations of the intellectual operating environment of key decision makers. Is Twitter a nascent representation of a truly networked C4I system?

What's even more important, however, is that the new technology and new design concepts must never forget to include the crucial element of play—these are games, after all—not animals hunt for food or sport, as my colleague Mike Markowitz likes to say—but devices to allow the human intellect to unleash its creativity and try out new ideas to see what might happen. Electrons might die, but they don't scream. At least, not too loudly. Wargames are the place to play around without getting real people killed and real—and very expensive—stuff blown up.

Need to improve wargaming of strategic linkage

- "Strategic corporal" is a tired cliché—what about the tactical general?
- The distinction across strategic, operational, and tactical is not merely blurred, but virtually disappears.
- The problems of wargaming this environment are many and difficult.

CNA

Last year, Mike Markowitz and I, with help from Ed McGrady, worked on a project for the War Gaming Department here in Newport to explore new ideas for what they called wargaming strategic linkage. You have all heard of the so-called "strategic corporal," the guy on the ground who has to make life-and death decisions that could affect the entire strategic picture of a campaign, war, or struggle for national existence. But what about the other pressure, the pressure for the senior officers, all the way back to the White House, to tap into that corporal's sensors and integrate their input with those from all the other corporals and sergeants and captains in the area, to take control of those same decisions out of the corporal's hands? Given the direction of technological development, such a state of affairs seems just around the corner. In that case, the old distinctions among strategic, operational, and tactical levels of war may fade to meaninglessness. How in the heck are we supposed to game that sort of environment? I don't know. Do you? But I'm sure that some clever kid playing *Call to Duty VII* will eventually break the code.

Challenges*

- How to represent the flow of time and decision processes across the "spectrum of decisionmaking." (Not the "levels of war.")
- Integrating players and "control" in more effective and realistic ways.
- Devising dynamics that free the players to be creative but allow the game to be managed efficiently.

**Based on 2008-09 CNA study, Wargaming Strategic Linkage, for the Naval War College*

CNA

Here are some of the challenges we think that kid will overcome. They are taken from the reports we did for the Naval War College, based on our discussions with the Army's Center for Strategic Leadership and other experts from military and civilian organizations like the Wargaming Department at Marine Corps Combat Development Command and Mark Herman and others at Booz-Allen.

Overcoming the challenges

- No single right answer—*so stop looking for the golden bee-bee!*
- Today's effective solution *will be* tomorrow's hide-bound orthodoxy.
- Commercial gaming is a vital source for creative ideas and approaches—and excellent designers.
- Board and table (or miniature) games are a vast, virtually untapped resource for DoD wargaming, ignored by the electronic Pharisees—*stop it!*

CNA

We made some detailed recommendations to the War Gaming Department, because that was, after all, the task they asked us to do. But the real bottom line is that there is no single right answer to meeting these challenges. So we should stop looking for it. If I'm sure of anything, it is that whatever solutions we may come up with today, thinking them brilliant and revolutionary, and sweeping away the cobwebs of old ways of doing business, it won't be long before those new ideas are nothing more than tomorrow's hidebound orthodoxy in DoD wargaming. To keep the ideas alive and flowing, DoD must, absolutely must, tap into the world of the commercial and hobby wargamer to find creative new ideas, clever new approaches and—even more importantly—talented new designers who will break the barriers to developing new ways of wargaming. And not simply computer-game designers—the boardgame and miniatures gaming communities contain vast reservoirs of talent untapped by those in DoD seduced by the blandishments of the often too cocksure computer gaming community.

Tactical IW Research

Purpose: Develop a prototype capability that credibly represents ground forces conducting COIN operations while accounting for the relevant relationships with the population

Enable decisions about:

- How to change (DOTML).
- How to invest in change.
- How to conduct operations.

Aim to:

- Focus at tactical level.
- Capitalize promising research.
- Build to analytic standards.

Account for:

- Prevailing interactions between ground force tactical units and local populations in day-to-day COIN operations.
- The influences of tactical unit interactions on the civilian populations, local and higher, over time.
- Local and higher influences on local populations that impact their interactions with tactical units and their outcomes.

Analyzing the IW Environment
Decomposition

- Decomposition allows for detailed research and analysis of the IW environment within manageable elements.
 - These elements, or modules, will be researched and analyzed semi-discretely.
- Module development will focus on addressing tactical-level, analytic requirements.
- Module decomposition will start at the tactical level of operations; resolution will be at the company level with weekly planning and adjudication.
 - Operational and strategic level effects ("wrap-around") will be incorporated.
- As modules are completed, they will be incorporated into a wargame construct.
 - The full set of modules, together with the operational/strategic wrap-around, will represent the relevant IW environment.
 - Modules not fully understood will require subject matter expertise to estimate.
- Decomposition modules focus on the predominant U.S./Coalition ground force, tactical level tasks executed within an IW environment.
 - Executed tasks will result in a range of possible events, that in turn provide outcome metrics that impact tactical Lines of Effort (LOE) and local, regional, and strategic Political, Military, Economic, Social, Infrastructure, and Information (PMESII) operational variables.
- The linked Task, Event, and Outcome (TEO) modules are the core of the IW analytic decomposition.

Our task at CNA is buried in the midst of the fourth bullet: they asked us to develop a boardgaming system to serve as the operational wrap-around for their tactical computer game. From our perspective, this is a major breakthrough. We'll see if it survives.

So, what do we do?

- Use all our tools for what they are best at.
 - SA can help build a broad consensus on key issues and alternatives
 - OR can provide insight into how things work in the real world
 - Wargaming can break intellectual and bureaucratic boundaries of “the box” and teach us to think differently.
- Outside the box is where we will have to confront the Black Swans of the future.

CNA

I have always been a proponent of using all the available tools, but using them to do what they are best at. I have argued that systems analysis and operations research provide valuable perspectives and tools for dealing with part of the problems we face in the future. So, too, does wargaming, particularly its ability to help us break out of the box of Black Swan blindness and help us prepare to deal with those things we cannot predict but which we know are lurking out there. How do we do this? The first step, and one that I hope I am taking with you today, is to make more leaders in the community aware of the issues and the stakes.

Where am I going?

- Can I do some, long-term research to this research?
- Can I do some, short-term research to this research?
- Can I do some, medium-term research to this research?
- Can I do some, long-term research to this research?
- Can I do some, short-term research to this research?
- Can I do some, medium-term research to this research?

➤ Future directions of research

CNA

Now, let me close with a brief discussion of where CNA's Black Swan research seems to be heading.

Proposed campaign plan

- The goal of this research is no less than setting the agenda for national security analysis for the 21st century.
- The community has lost touch with its roots and its *raison d'être*.
- This is obviously a tremendous challenge and too much for one person or one organization.
- CNA has the talent and contacts to get the ball rolling but we need to gather some collaborators.
- Campaign plan
 - Write a series of papers documenting the core ideas and arguments.
 - Identify publishable articles and target publications.
 - Expand current work by engaging other individuals and organizations.
 - Iterate.

CNA

What we have done so far

- Findings
 - When I started this work, I had no expectation that I would end up arguing for the importance of wargaming: I was surprised.
 - OR: quantifying experience to plan action
 - SA: creating models to build consensus
 - Wargaming: synthesizing experience to hunt Black Swans
 - We need to integrate the tools and perspectives more completely
 - Need to do more research and thinking about the epistemology of analysis
 - Need help from other CNA analysts and other organizations
- Current work
 - Ed McGrady, *Why wargaming works: Games as narrative tools for exploring low-probability, high-impact events* published by CNA in September
 - Expansion of 2008 paper: *Swanning around in the analytical desert: How military operations research and systems analysis expose us to Black Swans, and why wargaming can help us prepare for them*
 - New paper for 2010: *Probability, planning, and prediction—the need for a new epistemology of national security analysis and decisionmaking*

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Current outline for the book

- Prologue: "Fundamental problem of national security analysis/decisionmaking"—How to plan for an unpredictable future?
- Chapter one: *Parable of the ships at sea* and CNA essays
- Chapter two: Operations research: quantifying experience to plan action
- Chapter three: Systems analysis: creating models to build consensus
- Chapter four: *The Black Swan* and "essential uncertainty"
- Chapter five: *The Logic of Failure* in responding to complex situations
- Chapter six: Simulation/high-engagement gaming as "language of the future" (drawing from Duke and Guerts)
- Chapter seven: The way ahead: gaming and interactive planning (drawing from Ackoff)
- Epilogue: Embracing risk: probability, planning, and prediction—the need for a new epistemology of national security analysis and decisionmaking

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Potential CNA essays and contributors

- *Epistemology of wargaming*: existing paper by NWC's Barney Rubel
- *Wargaming pathologies*: rewrite of earlier CRM by Chris Weuve
- Dr. Brian McCue on simulation?
- Dr. David Strauss on epistemology and scientific revolution?
- Dr. John Ivancovich on rationality?
- Any suggestions of sources or topics?

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Task – Event – Outcome (TEO)

- A *prevalent tactical-level task* or set of tasks is performed by a friendly unit (Company & below) in a COIN environment; executed:
 - Repetitively within an area of operations (AO) over time,
 - With an intended purpose in mind,
 - By an appropriate force size (Soldier/Marine to CO) to accomplish the purpose.
- Tactical tasks are developed by commanders using Lines of Effort (LOEs) to link multiple tasks and missions...to focus efforts toward establishing operational and strategic conditions, and *assess task effectiveness towards endstates*.
- Executing a task may prompt *one or more events to occur with associated outcomes*, good and bad, judged from the friendly force point of view.
 - Task-unique adjudication determines the events and outcomes.

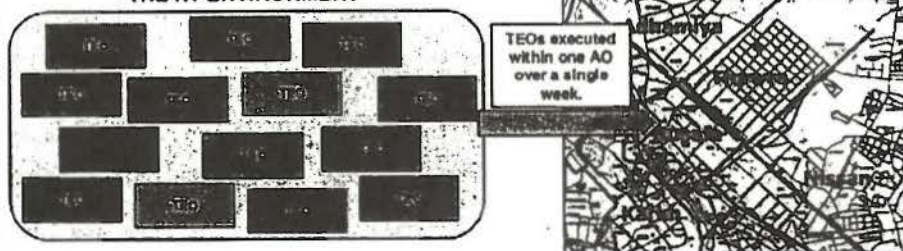
Task Examples

- Patrol.
- Cordon & Search.
- Area or Route Clearance.
- Traffic Control Point.
- Leader Engagement.
- Census Neighborhoods.

TEO Representation of the IW Environment

- TEO modules form the basis of the analytic IW decomposition and are focused on the execution of a single, typically U.S./Coalition (BLUFOR), task.
 - Task. An operationally-executed task.
 - Event(s). The range of event(s), one or more, that may take place during the execution of a task.
 - Outcomes. The results and impacts of the event(s) that occurred during the execution of a task.
- The full range of TEOs executed during a single week comprise the relevant analytic events within the IW environment.
 - A storyboard background, with decisions and events.

THE IW ENVIRONMENT



28 April 2008

AWW/ajane 1