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Executive Summary

Situation

Our most potent power projection and warfighting capabilities, developed in response to current and near future threats, are technologically advanced, hugely expensive, and have half-century service lives. The first of these characteristics gives us a temporary and possibly short lived warfighting edge. The second grants our political leaders short lived economic and political advantages. The last characteristic locks us into high expenses in maintenance and upgrades for many years in order to justify the initial sunk costs as though they were investments. This combination forces us onto a high-inertia security trajectory that is transparent to our more agile adversaries, providing them with credible information about that trajectory while giving them time to adapt with cheaper counter forces, technologies and strategies.

We must therefore wargame out to service life, the “far future”, to ensure our current and future weapons systems and concepts of operations are well designed for both the near term and the far future. However a 50 year forecasting horizon is beyond the credibility limit for wargaming. The Working Group and the Workshop explored and documented ways that wargaming can deal with this horizon.

Challenges

Working Group and Workshop participants selected the following broad challenges to wargaming the far future for examination – details are documented in this report:

Institutional
➢ Our national security institutions are short term focused.
➢ A peacetime military becomes inflexible in the face of massive surprise.
➢ Concern with the near term reduces motive to be rigorous when gaming the far future.

Process
➢ Wargaming in the far future is reactive.
➢ Command and control of advanced technology enabled forces is unclear.

Uncertainty
➢ Indeterminism and uncertainty grow as one looks out into the far future.
➢ There is a combinatorial explosion of possible interactions and futures.
➢ Credibility, Plausibility and Probability of far future scenarios are hard to determine.
➢ Discontinuous and black swan advances in technology will occur.
➢ Complexity of interacting causal factors grows as we look into the future.
Approaches

The following approaches covering these challenges were explored and are documented in this report along with their advantages, disadvantages and barriers to implementation. Since most of the approaches covered more than one challenge, there is not a one-to-one mapping between challenges and approaches.

Organizational
➢ Build an organization explicitly tasked and designed to wargame the far future.
➢ Reinvigorate best practices for wargaming and identify new ones required for gaming the far future.

Social Engineering
➢ Explore how wargaming influences military thought, not just how military thought influences wargaming.
➢ Use wargaming to increase people’s ability to handle the unknown far future.
➢ Take into account the psychology of how people think and worry about the future.

Futurism
➢ Embed futuring framework and foresight planning into the wargame process.
➢ Use systems thinking to design future scenarios.
➢ Base future scenarios on possible Revolutions in Military Affairs (RMAs) driven by changes in energy sources.

Process
➢ Wargame DoD acquisition to develop capabilities in months and years.
➢ Wargame trajectory from now to the far future using month/year acquisition wargames as inputs.
➢ Wargame our stable societal values versus our adversary societal values.
➢ Run wargames multiple times with a different game design each time.
➢ Run wargames multiple times for each game design.
➢ Wargame sensitivity analysis over many games to explore when assumed technology or capability levels become useful to the warfighting decision makers.
➢ Combine scenario planning and operational design into path gaming.

This Document

This document contains the papers written by the working group, their discussions while they wrote and refined those papers from November 2018 to June 2019, and the discussions at the workshop held during the Connections US Wargaming Conference in August 2019.
Working Group Research Papers

Using Futuring to Generate Better Wargaming Scenarios
   Stephen Aguilar-Milan

Common Pathologies and Pitfalls of Wargaming Future Technologies
   Sebastian J. Bae

Geopolitical Matrix Gaming in 15 and 50 Year Future Scenarios
   Deon Canyon, Jonathan Cham

Wargaming the Future: Developing Scenarios and Galvanizing Support
   Thomas Choinski

Break the Forecasting Horizon by Values Gaming
   Stephen Downes-Martin

Coming to Grips with Indeterminacy in the Practice of “Futures” Gaming
   for Strategy Formulation
   John Hanley

Brand New World
   William Lademan

Wargaming the Future Requires Rigorous Adherence to Best Practices
   Graham Longley-Brown, Jeremy Smith

Wargaming the Uncertain Future
   Brian McCue

From World War 3 to Starsoldier: Gaming design and gaming the future
   Ed McGrady

War and Wargames Beyond the Event Horizon
   Robert Mosher

How To Think About The Future
   Kristan Wheaton
Using Futuring to Generate Better Wargaming Scenarios

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Research Director, European Futures Observatory

Executive Summary

Wargaming can be seen as an act of anticipating future events to expose weaknesses in current thinking and to help develop strategies to overcome those weaknesses. Within this conceptual framework, the process of thinking about the future in a more systematic way can be used to help design better wargames.

From the perspective of the present, the future can be a vast space to populate. There is an extremely large, almost endless, number of possible futures that could emerge. In order to bring structure to this very large number of possibilities, futurists have developed a number of techniques to help view the future in a systematic way.

If a wargame acts as a generative vehicle for multiple futures, then playing the wargame multiple times will test the underlying assumptions of the game and provide us with a heat map of results. The heat map would help us to assess the robustness of the results. This process starts by putting the future into the wargame design. We need to start with the purpose that the wargame is to serve before we begin to think about inserting a futures approach to the design of a wargame. We need to be clear about the scale and scope of the wargame.

Whether or not such a game produces results that are convincing is neither here nor there. An unconvincing game can tell us as much about the future as a convincing game if we conduct a rigorous review of why the game is unconvincing. In many ways, that is where the injection of futures into wargame design can be useful. It forces us to identify our conscious and unconscious assumptions, and to subject them to a rigorous challenge.

In determining these issues, the wargame designer would have to confront the assumptions, which are often tacit, that are being brought into the game structure. It is by confronting these assumptions that we reduce the possibility of being blindsided by an emerging future that we hadn’t previously considered. In that sense, we would become better equipped to deal with an emerging future. And that is how futuring can be used to generate better wargame scenarios.

Introduction

At the professional level, wargaming is an act of anticipating future events to expose weaknesses in current thinking and to help develop strategies to overcome those weaknesses. Within this conceptual framework, the process of thinking about the future in a more
systematic way can be used to help design better wargames. We can think of this advantage from two perspectives – wargames that better expose the key issues facing future conflict and wargames that give better insight into how future events will unfold.

Wargames that better expose the key issues of the future are by their nature quite speculative. In their construction, much will depend upon the assumptions made by the game designers in terms of the key actors and the key relationships within the game. These assumptions are given form within the rules of the game. A more speculative approach would lead us to question the rules themselves in terms of their reasonableness in reflecting possible future events. An unfettered approach to the questioning of assumptions would provide some doubt over the validity of the game. It would be better to question the base assumptions in a more systematic way, in order to retain the structure of the game, but to vary some key elements within it. The study of the future can provide a framework in which these elements could be varied, whilst retaining the integrity of the game. It is to this framework that we shall return in the next section.

Once we have identified the key issues of future conflict, we need to consider how that could give us a better insight into future events. Using the futuring framework, we can identify a set of core uncertainties around which our studies can turn. Given the vast number of uncertainties that could arise in any future state, the study of the future has developed a number of techniques to undertake that search in a more systematic way. Obviously, much will depend upon the focus of the study, but it distils down to selecting the right tool to undertake the job in hand.

Of course, selecting the right tool is one thing, but using it properly is another. We will then move on to our final task of examining how futures can be put into game design. Professional wargaming tends to be fairly utilitarian in its approach. The game is either useful in uncovering insights or it isn’t. If design futures are adequately inserted into game design, then the chances of obtaining a set of useful insights are heightened. It increases the chances of a successful game.

Wargaming the future can be really difficult. It is likely to involve uncertain entities that have access to differing and uncertain technologies, that may be organised in uncertain ways. The aim of wargaming the future is to reduce those uncertainties. This can be achieved best by introducing an element of futuring into the wargame. Using this future framework is the best place to start our enquiry.

The Futuring Framework

From the perspective of the present, the future can be a vast space to populate. There is an extremely large, almost endless, number of possible futures that could emerge. In order to
bring structure to this very large number of possibilities, futurists have developed a number of techniques to help view the future in a systematic way. This futuring framework is used to help us tease out what we know about the future, and to help us identify the gaps in our knowledge and understanding.

The most basic form of examining the future is to assume that the future will consist of present trends extrapolated into a future space. For example, we know that the planet is warming. If we assume that the planet continues to warm, at about the same rate as experienced in recent years, then a number of consequences of that warming might be felt. To continue the example, it may cause the Arctic ice cap might melt, and that has a number of geo-strategic implications which we may wish to game.

Futurists label this type of futuring as trend analysis. The technique is very simple – identify a trend that has moved from the recent past into the present and simply assume that the trend will continue into the future. This is a pathway future, that describes how we get to from the present into the future. We may also wish to consider what the future looks like when we get there. This is an end state future. If we use trend analysis to generate end states futures, we are said to be engaged in horizon scanning. From the perspective of game design, we would use the process of trend analysis to establish the premises of the game and horizon scanning to develop the content of the game.

An example of this approach was provided at the Connections NL conference in 2018. The plenary game on Day 2 was set in 2050. The basic premise was that global warming had led to sufficient ice melt for the Arctic Ocean to be navigable. This was the result of an exercise in trend analysis. It was further built into the game that the Arctic Ocean could become a contested space between the various actors who had an interest in that contested space. That was the result of horizon scanning. A game was worked up from these basic contentions that, as it played out, yielded some interesting results. Whether it would lead to adjustments at the policy level is a matter of conjecture, but many of the participants found that it gave them food for thought about how they conceive of the future. That is the mark of a good futures project.

Whilst trend analysis and horizon scanning is one approach to the future, it is not the only one. The major problem with trend analysis, over the long term, is that trends bend and break. The trajectory of the recent past to the present is not necessarily a good guide to the trajectory from the present into the future. Circumstances have a habit of changing, and trend analysis assumes that they don’t. A different set of techniques have been developed by the futures community to address the weaknesses of trend analysis.

The key vulnerability of trend analysis is that it doesn’t cater for parametric change. It assumes that the future will develop broadly within the parameters currently observed. That could be a problem if there is a sudden and profound change to the parameters. For example,
there could be a change within the political sphere that calls into question the fundamental assumptions on which policy is based. Country X could be relying upon a security guarantee provided by Country Y, there is an election of a government in Country Y that calls into question the guarantee given to Country X. It is interesting to note that, in common discourse, we would see such a policy shift as a ‘game changer’. We would see it that way because the fundamental assumptions of the trend analysis would be called into question.

One way to address these issues would be to see the future as a combination of various systems. The political system, the economic system, the social system, and so on. All of these systems interact with each other in the present and will continue to act upon each other into the future. A systems approach allows us to identify the key actors within the system, to determine the relationships between the actors within the system, and to determine the boundaries of the system.

We can then inject change into the various systems. We could change the actors, either suddenly or gradually, to account for the appearance of some actors and the fading of others. We could change the nature of the relationships within the systems to allow for parametric change. And we could change the boundaries of the system to account for a different world emerging in the future. This would allow us to draw a richer portrait of the future. We could set the exercise to uncover a pathway into the future, or we could set the exercise to develop an end state.

The systems approach to the study of the future fits well into the wargaming environment. This can be seen if we were to change slightly the key concepts of the systems approach. The system is the wargame. Just as a systems approach to the future would have a focus on the question to be examined, so does the wargame have a purpose to be addressed. The topic under consideration would determine the key systems to be examined, just as the focus of the wargame determines the core components of the game.

A systems approach would need to identify the key actors within the system. It would have to give them a degree of agency to exercise choice as they move into the future. Within a wargame, the actors are the players. The design of the wargame would determine what the actors could or could not do, from within a range of possibilities open to them. These could be physical limitations – despite how much we want to fly unaided, the laws of physics and the human form prevents us from doing so. These could be organisational limitations – for example, the adherence to the Geneva Convention. These limitations could apply to one set of players, but not another. In the case of the Geneva Convention, one set of players has to respect it, whilst another set of players might not.

A key aspect of a wargame is that the players play against each other. Within a systems approach to the future, we would have determined not only the key actors within the system,
but also the key relationships between the actors. This is akin to the issue of wargame design in
determining how the players will play with each other. The combination of agency and choice,
with conflict and cooperation, makes the game, a game. These relationships are then bounded
into a ruleset for the game which determines how the wargame is played. This is directly
analogous to the boundaries of a system. It provides a limit to what we can do and what we
cannot do.

It is highly unlikely that a single wargame, if played more than once, will yield the same
results each time. This is the result of human agency. If we then allow for changes to the
players in the game and how they react to each other, we will be able to derive an even larger
set of possible results. If we then allow for a degree of flexibility to the boundaries of the
wargame, then we can create yet a larger set of possible results.

The question arises of how we can manage this large number of possible future outcomes.
The futures community has developed a number of methods to order the uncertainty. It is to
this that we shall now turn.

**Limiting the Possibilities**

From the perspective of the present, there are an exceptionally large number of possible
futures. Each individual decision in the present has a consequential knock on effect that helps
to determine the range of choices available in the future. These choices are made by billions of
different actors in the present, as decisions today feedforward into future possibilities. If we are
to examine future possible events, we need to bring some form of order to the range of
possible events so that we can study them in a structured way.

The futures community has a number of concepts that can be used to assist in this ordering.
Of all of the vast range of possible futures, not all of them would be plausible. For example, one
possible future could involve the consequences of a significant asteroid strike upon the Earth.
Whilst this may lay in the boundaries of possibility, this possible future event is often seen as
relatively implausible. For this reason, we tend to discount implausible futures.

We need to note two points about implausible futures. The first is that they are not entirely
uninteresting. The category of possible - but implausible – futures is where the wild cards lie.
Wild cards are a category of future which have an incredibly low probability of happening, but
an extremely large impact if they were to happen. The possibility of an asteroid strike is a case
in point. It has a very low chance of happening, but if it were to it could lead to an extinction
event.

The second point to note is that the boundary between possible futures and implausible
futures is not fixed. It can change over time. For example, in the 1990s, the security futurist
Marvin Cetron alerted his principals in Washington to the possibility of recently fuelled aircraft
being flown into tall buildings in the United States. The warnings were discounted as being too implausible to act upon. After 9-11, this boundary of implausibility shifted to account for a threat that was now very plausible. This example highlights why we ought to keep in touch with implausible futures, but it is customary for them to be the subject of a separate study that is added to a main study.

If we return to the plausible futures, there are two further types of future that need to be accounted for. The first, which is more easily recognisable, are the probable futures. These are the futures that we see as most likely to occur. They are strongly linked with trend analysis and horizon scanning but are usually modified to cater for the disruption of the existing trends. They allow for a systems approach to be grafted onto the horizon scanning to yield a richer consideration of the future.

The second type of plausible future is the preferable future. This is the range of futures that we would like to see happening. Preferable futures introduce a normative element to the study of the future. However, it becomes difficult to distinguish between a normative preferable future and just plain wishful thinking. We often see this in wargaming, where the Blue Team are given almost super-human powers, and the Red Team are portrayed as overly inept. It is useful to have an idea of how we would like the future to turn out, but we need to guard against channelling our thinking into making it appear to happen. For this reason, most futures studies concern themselves less with preferable futures than probable futures.

The range of probable futures tends to act as the core of a futures project. However, despite discounting the implausible futures, wild card futures, and normative futures, there are still a very large number of probable futures to be engaged with. If a study is likely to deal successfully with this complexity, another form of refinement needs to be introduced. It is at this point we would normally turn to our systems analysis.

The purpose of a systems approach to the future is to introduce an element of structure to our enquiry. We can do this by identifying a number of generic systems that need to be accounted for. The simplest classification given by futurists is the PEST analysis. The critical Political, Economic, Social, and Technological systems are identified and introduced as variable elements to the future. By itself, it will give us a range of actors – players in terms of a wargame – and a set of relationships that can govern the player’s interaction. This needs to be scaled and adapted according to the game in question. For example, in the context of a platoon-based wargame, the bond market may be of limited importance, whilst it may be fairly central to an economic wargame that examines conflict between two or more central banks. We tend to abstract away from, and exclude, those factors that are of minor importance.

As we undertake the process of abstraction, we need to focus more clearly on the key elements that are the subject of our examination. Futurists call these the critical uncertainties.
There may be a number of critical uncertainties to be examined. It is generally helpful to distil these into as few as possible in order to keep the study to manageable proportions. The simplest form of study here would be to distil the issue in question to two key uncertainties and to develop four probable futures using a 2x2 matrix, very similar to the ‘Prisoner’s Dilemma’. However, the process of distillation can cause important factors to be overlooked and discounted. One way of guarding against that possibility would be to conduct a number of iterations of the scenarios to test for the robustness of the results.

This is something that gaming can easily do. If a wargame acts as a generative vehicle for multiple futures, then playing the wargame multiple times will test the underlying assumptions of the game and provide us with a heat map of results. The heat map would help us to assess the robustness of the results. This process starts by putting the future into the wargame design.

**Putting Futures into Game Design**

We need to start with the purpose that the wargame is to serve before we begin to think about inserting a futures approach to the design of a wargame. We need to be clear about the scale and scope of the wargame. For example, a platoon-based wargame will require a different approach to a grand strategic wargame. Equally, a wargame whose game time represents, say, a few days, will require a very different approach to a wargame whose game time represents a few decades. Again, a wargame set in the near future, where most aspects of the game are already evident, will be a very different prospect to one set in the deep future, where very little can be taken as fixed. The determinant of these dimensions will be the question that the wargame is to address. It will also help to shape which systems are to be highlighted and which systems are of lesser importance.

The question of which systems would be better included in a wargame depends largely upon the question that the wargame is to address. If the wargame is to examine the use of financial and monetary instruments to exert state power, then the game is likely to be better delivered as a relatively high level, even abstract, game. If, on the other hand, the wargame is to examine the relative operational degradation of a two-platoon company compared to a three platoon company, then the game is likely to contain a greater degree of granularity when compared to a grand strategic game.

Part of the skill of the wargame designer is to understand the necessary degree of abstraction that a particular game requires, and to then select a game accordingly. For example, in the case cited of the economic wargame, a Committee Game or Matrix Game format might be best to yield some interesting results. Equally, the question of company effectiveness might be better resolved using a more traditional figures game or board game. The point is that the type of game designed is determined by the question to be addressed, which influences the scale and scope of the game in question.
Perhaps this can be best demonstrated by way of an example. Suppose that the question to be addressed concerns the potential for conflict in an unfrozen Arctic Ocean in the second half of the twenty-first century, say, at the year 2070. How would we begin to address that question?

One starting point would be to consider the systems that might have an impact upon that question. The key premise of the study would be that global warming had been sufficient to melt the Arctic ice cap, rendering it largely navigable for a good portion of the year. We might begin by asking what political systems govern the Arctic Ocean, who might have legitimate interests in the navigation of the Arctic Ocean, and what mechanisms of governance may be in place concerning the Arctic Ocean by 2070. We then need to ask ourselves if these would be sufficient to prevent the outbreak of open conflict. If they are, we can end the study. If they are unlikely to be, then we need to continue with our study.

Our next port of call, in the PEST analysis, would be the economic systems governing the Arctic Ocean. We have to ask why it matters from an economic perspective. We may find that the Arctic has significant economic potential for mineral deposits – especially hydrocarbon deposits, as a major trade route in international shipping trade, and as a significant fishery for Europe and North America. These three areas of potential might be mutually exclusive in some areas. For example, hydrocarbon extraction might impact upon the fishery aspect of the Arctic Ocean. This provides an overlay of potential flashpoints that we can add to the political overlay of potential adversaries.

Moving on to the social systems in the PEST analysis, we need to account for the changes in the composition of society by 2070, much of which is evident today through demographic trends, and changes to social attitudes by 2070. For example, we know from demographics that most northern hemisphere nations will be older than they are today. Could that lead to young people being given greater social value? Might that have an impact on an aversion to casualties? We cannot assume that the armed forces of the potential adversaries will have the same social context in 2070 as they do in 2020. We also cannot assume that this differential impact will occur evenly between the potential adversaries. This analysis should give us an overlay of the social system which we can add to the overlay of the political and economic systems.

The final element of our PEST analysis concerns the development of technological systems. It is important here to incorporate models of long-term technological change into this system. One such approach can be found in the work of Carlota Perez, who is very influential in futurist circles. According to the Perez model, the current technological wave – the ICT, or fifth, wave – will have burned itself out by 2050. If so, then the next technological wave, the sixth wave, will be establishing itself by 2070. There is much speculation about the content of the sixth wave, so this is the area in which the greatest degree of imagination can be exercised whilst remaining in
the boundaries of plausible futures. We can expect the technology to be autonomous, remotely controlled, possibly space borne, capital rather than labour intensive, and fairly fast reacting. It could well act at the NBIC (Nano, Bio, Info, and Cognitive) levels. Whatever we decide about the technological systems, they can then be overlaid on top of the political, economic, and social systems.

Once we have a picture of the operational world in which the base question is set, we then need to return to that base question to gain some appreciation of the scale and scope of the wargame. If our question is concerned with naval design, we may choose to produce a fairly granular wargame, possibly a figures game or board game that tries to find some traction in this decision frame. Equally, if the wargame is concerned with where to invest in naval port facilities, then we may like to have a longer time scale to represent the time it takes to build and develop port facilities and the attendant infrastructure. Normally, this would be represented in the turn structure, with the operational world being represented in the rule structure of the game.

Before we finalise the game, we might like to spend a little time thinking about wild card futures. These can yield very interesting results to the game if introduced at the right time. For example, in the case of a geo-strategic level Arctic conflict game, might there be a technology that renders the game moot? What if the development of additive manufacturing (3D and 4D printing) were such that goods were manufactured on demand at the point of consumption? Would we need a trans-Arctic trade route in such circumstances? Ought we to allow this possibility into the wargame? The point here is that at some point towards the design process, we need to determine what are permissible game moves, which, *ipso facto*, makes all other game moves inadmissible.

Whether or not such a game produces results that are convincing is neither here nor there. An unconvincing game can tell us as much about the future as a convincing game if we conduct a rigorous review of why the game is unconvincing. In many ways, that is where the injection of futures into wargame design can be useful. It forces us to identify our conscious and unconscious assumptions, and to subject them to a rigorous challenge.

**Conclusion**

The study of the future has a number of techniques that can be incorporated into game design to generate better wargaming scenarios. Trend analysis and horizon scanning are useful techniques to generate near future scenarios. The key element of near-term scenarios is that much of the operational environment is either fixed, or can be determined relatively easily. For example, when considering near term scenarios, it is relatively easy to determine who the near-term potential adversaries might be. In many ways, we are describing the world in which we currently live, only a bit further into the future.
When looking at far term scenarios, it would be more appropriate to use a form of systems analysis and modelling. By definition, far term scenarios are those in which many of the operational elements are not fixed. To continue the example, above, when considering far term scenarios, the wargame designer would have to give careful consideration to who the potential adversaries might be. We cannot assume that the current range of nations, with their current territorial limits, will not have changed in the longer term. To place a sharp point here, can we assume, in 2070, that China will not have expanded or contracted in territorial terms? Could the United States have expanded to include parts of Canada? Would Europe be a federated superstate or a collection of squabbling minor powers? When designing a wargame for 2070, the designer would have to give some consideration to how these questions could be answered.

The answers to these questions, in the far term wargame, would be written into the fabric of the game. It would help to determine the identity of the players, the scope of their operation, and the boundaries within which they have to operate. In determining these issues, the wargame designer would have to confront the assumptions, which are often tacit, that are being brought into the game structure. It is by confronting these assumptions that we reduce the possibility of being blindsided by an emerging future that we hadn't previously considered. In that sense, we would become better equipped to deal with an emerging future. And that is how futuring can be used to generate better wargame scenarios.

References


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Common Pathologies and Pitfalls of Wargaming Future Technologies

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Abstract

As the strategic focus of the United States has steadily shifted towards great power competition and near-peer adversaries, defense wargaming has increasingly emphasized wargaming the future. This shift is reflected in the significant wargaming efforts surrounding the U.S. Army’s Multi-Domain Operations (MDO) concept and the U.S. Marine Corps’ Expeditionary Advanced Base Operations (EABO) concept. Central to many future-oriented wargames, such as MDO and EABO wargames, is the role and effects of emerging and speculative technologies. Generally, future-oriented wargames can involve any number of technologies such as artificial intelligence (AI), additive manufacturing, energy-based weaponry, autonomous combat systems, and advanced forms of cyber and electronic warfare.

When wargaming the future, there exists considerable obstacles ranging from pervasive uncertainty to the difficulty of fostering creative thinking. Building upon Wargame Pathologies, a joint report by the Center for Naval Analyses (CNA) and the Naval War College (NWC), some of the identified pathologies are common to all wargames but are amplified in their severity in future-oriented wargames. Other pathologies are unique to this specific genre of wargaming, which focuses on the future and speculative technologies. This paper seeks to assist wargamers, their sponsors, and their players in avoiding or tackling some of the pathologies and pitfalls involved in wargaming future technologies.

By its nature, uncertainty is inherent in wargaming. This uncertainty is only increased as the focus of the wargame moves away from the present or reasonably known to the more unknown future – in terms of quality and degree. Two fundamental problems arise: 1) By definition, people lack experience with the future since they have not been there 2) The possible technology environment has a combinatorial explosion of outcomes and possibilities generating enormous uncertainty. In future-oriented wargames, these two fundamental problems create vulnerabilities in wargame validity, such as the technology victory machine.

These vulnerabilities can be addressed by a combination of (i) sequential gaming (sequences of games leading further into the future, sequences that incorporate different levels of technology, sequences that focus on specific technologies, portfolio games that combine technologies, and each game in the sequence informing the next game), (ii) careful selection of players and adjudicators that combine imagination and experience, and (iii) wargames designed to reward players for imagination and innovation independent of who wins.
Managing Uncertainty

Uncertainty is a critical and unavoidable element in wargames. On the surface, uncertainty seems antithetical to the notion of a rigorous, analytical wargame. Yet, in *Rules of Play*, Zimmerman and Salen emphasize that uncertainty is “a key component of meaningful play” (Zimmerman and Salen 2003 p. 181). Uncertainty is necessary to imbue the decisions of players with power – the ability to interact and affect the simulated world of the wargame. Typically, uncertainty in wargames exists on two levels: on the macro- and micro-level. The macro-level uncertainty involves the unknown outcome of the wargame itself, while the micro-level uncertainty involves the unknown of results involving specific interactions and operations within the wargame (Zimmerman and Salen 2013 pp. 181-182).

In wargames involving future technologies, the micro-level uncertainty explodes as interactions involving emerging or future technologies. For instance, how does a designer define the effects of an amorphous technology like AI into a table-top exercise (TTX)? Similarly, how does a game system adjudicate the engagement between a drone swarm and traditional air defense? Or how does a game quantify or adjudicate a kill chain involving quantum encryption and hypersonic missiles? The number of uncertain interactions is seemingly infinite – ranging from the effects of electronic warfare to quantifying the range of future weaponry. Without real world examples or experimental data, the task of examining future technologies is plagued with micro-level uncertainty. This is only further exacerbated when conceptual thinking about said technologies principally resides in vague, high-level PowerPoint presentations or hazy graphic illustrations. Ultimately, the fundamental challenge is to create a future world where players, sponsors, and designers can collectively accept.

This does not mean the task is insurmountable. Future-oriented wargames do not predict the future nor should they attempt to. Instead, they attempt to understand the underlying logic of future interactions and elements of strategic uncertainty. To that extent, designers can mitigate uncertainty in at least four ways.

1. Designers always have the fundamental choice of utilizing different types of wargames, from matrix games to more rigid rule-based games. This approach allows designers to select the type of uncertainty the wargame will emphasize and examine.

2. Another method involves assuming a capability or technology will work just as imagined or advertised. This method incorporates the core assumption into the world of the wargame, enabling players to examine a scenario where this is true.

3. Borrowing a standard method of futurism, wargame designers can draw upon historically analogous examples and computer models in an attempt to extrapolate a range of outcomes or parameters. Subsequently, these parameters can be used to guide
subject-matter experts in adjudication or be converted into a type of combat engagement table, similar to more rigid, rule-based wargames.

4. Another method is for designers to change the performance parameters of a single technology over successive wargames, allowing for the examination of various possible scenarios. For instance, one iteration can imbue next generation aircraft with 70% chance of going undetected, while the following iteration can reduce it to 50%. This method allows a wargame to examine a range of possibilities and how it affects operational choices. This type of sensitivity analysis in wargaming could be beneficial in capabilities development and concept refinement. By altering the performance of a specific technology, wargaming can reveal trends in how such variance can affect operational tactics and employment.

None of these techniques are perfect, each presents their own set of assumptions and challenges. A myriad of factors are involved in determining the best method for each respective wargame, such as expense, time, and the character of a specific technology. The danger surrounding uncertain technologies is three-fold. The first danger is creating an illusion of certainty where there is none. If a wargame is not explicit in its assumptions or conveys the impression that a technology will consistently perform at optimal levels all the time, audiences and players can arrive at dangerously faulty conclusions. This can lead to the age-old pathology of “declaring victory,” where audiences or players assume a wargame validated the importance or value of a specific technology or concept (Weuve et al. 2004 p. 39).

The second danger can occur when the $P_k$ or probability of outcome is fundamentally controversial, particularly at the micro-level. Inherently, $P_k$ values in wargames attempt to represent a range of outcomes and decisions. However, if players perceive that the $P_k$ values do not characterize the technologies as they view them, they will routinely reject the wargame and its results. As a result, future-oriented wargames benefit greatly from a deliberative adjudication process where the process is transparent. This facilitates open discussion and minimizes the perception that the ‘game is rigged.’ The last danger is overreacting to uncertainty with unwieldy game mechanics. In an effort to limit uncertainty around a technology, designers can overcompensate by creating thick technical manuals or overly complicated game mechanics. Consequently, players can struggle to absorb the mountain of new information, technologies, and related rules, which results in ineffective play. Alternatively, overwhelmed players can default to technologies that they are most familiar with and ignore other options.

**Plug and Play Fallacy**

The plug and play fallacy is not a misstep in wargame design, but a lack of imagination by both designers and players. When designing the simulated world of the wargame, designers can
fall into the plug and play trap by augmenting and introducing new technologies, while the geopolitical situation remains unaltered. Depending on the technology, the effect of a new technology can have varying levels of influence. The emergence of AI could potentially alter everything from the labor force to command and control. In the Korean Peninsula, the introduction of hypersonic missiles or a reliable, futuristic missile defense system could drastically change the political calculus in the region. Thus, designers must resist the temptation of simple substitution.

When participating in future wargames, players often merely substitute or augment an existing capability with the new technology. This reflex is completely understandable and reasonable. Military officers, which make up the vast majority of participants for defense wargames, are fundamentally trained to think and solve problems in a specific manner. This is the essence and strength of a professional military, which relies on process-based thinking and uniformity. So, it is unsurprising when military officers simply swap one capability out with an updated version, while leaving the other elements of their thinking unexamined.

Autonomous combat systems offer a perfect example. In visions of the future, autonomous combat systems come in a range of sizes and purposes. An amphibious combat system, resembling a gun turret on tracks, may augment or replace the combat power of a Marine infantry company. However, to view autonomous systems as robotic substitutes for their flesh and blood counterparts ignores a range of new tactical and operational opportunities. For example, in amphibious landings, amphibious combat systems can be delivered to shore in mass in modified torpedoes unlike their human counterparts. Comparably, in defending against a beach landing, they could hide in shallow waters to execute a pincer attack against a landing force. Unlike humans, amphibious combat systems do not need to breathe or rest, given that they are sufficiently waterproofed.

This is not to imply military officers are lacking in any way. It is a natural and fundamental human instinct to use one’s own experiences to inform one’s decisions. The wealth and breadth of experience and knowledge is the chief reason why military officers are chosen to participate in wargames in the first place (Downes-Martin 2015a). Who is better to play a 2030 brigade combat team commander than a military officer who has commanded a brigade combat team in the past? However, the key to meaningful gameplay in future-oriented wargames requires players not to be prisoners of their past. This applies to all players, not only military officers. A precarious balance is required where players are informed by their experiences and expertise, but not limited by them to the point where they cannot recognize or utilize opportunities new technologies create. Wargame designers and sponsors can help by carefully selecting participants and encouraging and rewarding informed free-play. In this regard, failure should not be demonized, but accepted as a meaningful step towards innovation (Downes-Martin 2015a).
Another method to mitigate the “Plug and Play Fallacy” is to allow participants to form a concept of operation prior to the wargame. The notion is not to create an answer before the game, but to establish a baseline to work with within the game. Participant briefings, read-aheads, and tangible assignments can encourage pre-game conceptual thinking. However, as most experienced wargame designers know, pre-game assignments rarely ever get completed by participants, who are often absorbed in their daily duties. Nevertheless, the point remains to allow participants as many opportunities to familiarize themselves with the technologies prior to the wargame.

An Overabundance of Technology

When asked to envision the future battlefield, a common reaction is to fill future with a myriad of technologies, such as hovercrafts to railguns. Whether one is science fiction writer or a military officer, the impulse to fill the unknown with fanciful technological marvels. Therefore, it is not surprising when future-oriented wargames are flooded with a plethora of technologies. Yet unlike science fiction where a future brimming with speculative technologies creates a sense of wonder and awe, in wargaming, an overabundance of technology can be detrimental.

Professional wargaming is an analytical method that seeks to examine human decision-making in simulated conflict. And like other methodologies, a surplus of variables can create confusion and muddle clarity in analysis. In The Complete Wargames Handbook, Dunnigan commented that, “It is very difficult to keep a game-design project simple. Once you get going, there are tremendous temptations to add this and that” (Dunnigan 1992 p. 114). This is particularly true for wargames utilizing future technologies. The temptation to add a whole host of technologies seems natural, almost necessary. To build a comprehensive world within the wargame, one can easily fall into the cyclical logic of: if we have lasers beams, we should also have hypersonic missiles and quantum radar. In other cases, sponsors can be overly ambitious in the number of technologies they want to wargame. In both cases, this unavoidably leads to a massive list of technologies.

When a wargame is laden with a dozen or more technologies, the analytical task of distinguishing the effect of one technology from another becomes near impossible. The surplus of variables hinders the ability to make any meaningful connections between a specific technology and the decisions of the players. At the same time, amidst an overabundance of technology, players often ignore significant portions of the assigned technologies -- frequently focusing on the technologies they are most familiar with.

Limiting the number of variable technologies in a wargame is easier in theory than in practice. Let’s say a sponsor wants a wargame that examines future urban warfare. This opens the door to a myriad of technologies from digital camouflage to swarming drones. The problem is further complicated by the fact that future warfare, as the Department of Defense envisions
it, involves a tremendous level of interconnectedness and interoperability across domains and functions. However, there are ways to avoid falling down the technological rabbit hole. First off, the gaming objectives should be focused and feasible, limiting the set of technologies examined to one to three. This can be facilitated by limiting the scope of the wargame to a specific warfighting function, such as long-ranged fires or sustainment. This will naturally help scope the technologies the wargame is concerned about including. Lastly, a disciplined lead designer can help keep a wargame stay focused and on task and manage sponsor expectations and desires, which can prove critical.

The Technology Victory Machine

With the prominence of the Third Offset (Walton 2016) and the Pentagon’s fervor to develop and acquire new technologies (Esper 2018), it is unsurprising that the US military has adopted a technology-centric approach to addressing both its present-day gaps and anticipated future challenges. This can lead to the belief that new, emerging technologies can serve as a panacea to a host of problems. And when these assumptions collide with wargaming, a technology victory machine is inserted into the very heart of a wargame. Similar to the logic victory machine, where a series of logical steps guarantee victory, the technology victory machine ensues a one-sided technological dominance and subsequent success on the battlefield (Downes-Martin et al 2004).

In a Naval War College presentation, entitled “How Not to Not Analyse Wargames,” Downes-Martin offers an example where Blue possesses “photon torpedoes, transporter beams, and replicators,” while Red is limited to “1960’s Scuds and rotary dial telephones” (Downes-Martin 2015b). Obviously, the example is purposefully extreme to illustrate a point. However, it is not uncommon for future wargames to fall into this trap to varying degrees, especially so if a game’s sponsor has a pet project. The technology victory machine can take various forms, for example:

➢ It can manifest in an unrealistic technological disparity, especially between near-peer adversaries. For instance, Blue’s soldiers are equipped with battle suits that make them near-invincible, while Red is running around in traditional body armor.

➢ Other times, a speculative technology or a suite of technologies can be tailor-made to solve a specific problem with overly optimistic estimations in terms of performance. For example, to address the fog of war and the challenges of command and control of distributed forces, Blue is given an unfailing and near omniscient AI.

➢ A subtler form of the technology victory machine is the ‘last say mechanism.’ In this context, both Blue and Red are given seemingly comparable technologies. Yet, in the micro-level action and reaction engagements of the wargame, Blue is consistently given
the last say, usually in the form of a technology that counter-acts or diminishes Red’s technologies. For instance, when Blue’s future battle tanks advance on Red’s position, Red responds with precision artillery fire via micro-satellites, but Blue perfectly counteracts with drones that intercept artillery shells.

➢ The technology victory machine is typically most acute during the last move of the wargame. Knowing that the wargame will end, players can be incentivized to make unrealistic or uncharacteristically risky actions. The absence of meaningful consequences can encourage players to press their technological advantages in controversial ways. This can manifest in various ways, such as the use of nuclear hypersonic missiles against a near-peer adversary. To avoid this, the actions of the players should be thoroughly adjudicated in the final move and players should be required to justify it, both operationally and strategically.

Unsurprisingly, the technology victory machine in all its forms can lead sponsors and audiences to conclude that a specific technology is a requirement for the military (Downes-Martin 2016). To avoid the temptation of the technology victory machine, designers can strive for balance, making reasonable assumptions about how each side could develop and utilize various technologies. For instance, given historical trends, the Chinese military could invest in technologies that complement its strategy of long-ranged fires and area denial, while the US Navy and Marine Corps could invest in technologies that enable maneuverability, precision, and combat power. Furthermore, designers can incorporate reasonable limitations on future technologies, allowing for trade-off analysis. In the case of an energy-based cannon, the designers may impose operational costs like energy consumption or cool-down periods. Thus, players are forced to decide whether the energy-based cannon is too unwieldy or only useful in specific scenarios.

Conclusion

There is no single solution to all of the pathologies and pitfalls involved in wargaming future technologies. Each challenge poses a unique dynamic, which can be solved in numerous ways. Yet, as a rule of thumb, when wargaming future technologies, designers should conduct iterative wargames as part of a series. Each wargame can be tailored to examine or explore different aspects of a complex problem set. For instance, the first wargame can be a matrix game designed to elicit creative, out-of-the box thinking (Project Cassandra 2018). The subsequent wargame can be a more rigorous wargame that incorporates realistic limitations and capabilities to a handful of future technologies. Then the outputs from the wargames can inform other analytical efforts or serve as inputs for follow-on wargames.

The wargaming efforts involving Multi-Domain Operations (TRADOC 2018), such as Unified Quest (UQ 2018), has adopted a similar series approach, where smaller wargames examine
specific warfighting functions and their related concepts and technologies. The effort culminates in a longer final wargame, which utilizes the results from the preceding wargames. The Marine Corps has also shifted to serial wargames, such as MAGTF Warrior and Expeditionary Warrior, to examine its own capstone concept. Through its Fight Club wargaming initiative, the Marine Corps University (MCU) and Marine Corps Warfighting Lab (MCWL) is also examining littoral operations in the near future. The wargames examine a range of technologies, mix varying adjudication styles, and encourage creative thinking through competition (Jensen 2019).

Ultimately, despite the pitfalls that exist, one should not shy away from examining the future and how technology can transform the contours of warfare. When done right, wargaming can empower operators, scholars, and policy-makers to ask the right questions about the future of warfare and the role technology will play.

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About the Author

Sebastian J. Bae, a defense analyst at the nonprofit, nonpartisan RAND Corporation, works in wargaming, emerging technologies, irregular warfare, and strategy and doctrine for the U.S. Army and Marine Corps. Previously, he served six years in the Marine Corps infantry, leaving as a Sergeant. He deployed to Iraq in 2009. He also previously served as a defense writer for Foreign Policy and wargaming analyst for the Marine Corps Wargaming Division. His writings have been published in Foreign Policy, War on the Rocks, Strategy Bridge, Task & Purpose, the Diplomat, and Georgetown Security Studies Review.

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Geopolitical Matrix Gaming in 15 and 50 Year Future Scenarios

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Daniel K. Inouye Asia-Pacific Center for Security Studies, Honolulu HI

Abstract

In a world where crises and disasters are increasing with frequency and intensity, few options exist to facilitate an adequate understanding of the underlying complex causal factors and driving forces. Fewer yet exist that permit us some insight into the potential and plausible future outcomes of these events. This paper describes the development of four Matrix games through a process involving threat identification, systems mapping, analysis of the driving forces of change, and foresight-based scenario planning. The games cover the topics of major power rivalry threats in Northeast Asia and climate-environmental threats in the Indo-Pacific over mid-term (15-year) and long-term (50-year) periods. Two of the most interesting insights were: (i) Technology is evolving so fast that it was difficult for participants to extrapolate or imagine what the long-term future might hold; and (ii) When people think about environmental change of an existential magnitude, they mitigate it by prioritizing the improvement of the economy, which provides more options down the track. Similar themes emerged in all groups, including the value of multi-mindedness in evaluating complexity, difficulties in committing to collective action under imperfect information, identification of core values and interests in geopolitical negotiations, and insights into possible levers of influence.
Introduction

Well-functioning security systems are vital to sustaining and expanding the management of national challenges. However, the inherent complexity of many types of crises places decision makers in the uncertain position of having to make difficult choices with limited information. Other factors, such as urgency, growing threat, and increasing pressure from stakeholder groups, the media and public all interact to expand situational complexity. Crises seldom provide managers the time they need to conduct extensive analysis to understand the problem, and so, familiarity with rapid and easy to use analytical methods is essential to ensure a higher proportion of appropriate decisions.

Preparedness is the key to facilitating rapid, evidence-based decisions during acute crises. The work environment of a national security professional constantly evolves and errors in judgement can result in significant impacts on crisis responders and communities. Maintaining the peace and keeping in front of problems requires an understanding of relationships, collaborative thinking, and awareness of system complexity. Several methods and tools exist that can help decision makers understand complex problems before they tip into chaos. Having an idea of how these problems might change in the future and what people might do in these situations is key to averting disastrous ripple effects.

This paper documents a methodology for exploring possible futures in the medium and long-term. In a four-step process, security practitioners complete a guided set of seminar discussions and simulations designed to help them understand threat systems, reveal underlying driving forces of change, create future scenarios and explore these scenarios using situational wargaming.

Facility and Participants

The Daniel K. Inouye Asia-Pacific Center for Security Studies (DKI-APCSS) is an executive education institution that offers courses for experienced security practitioners from over 35 countries in the Indo-Pacific. Fellows collaborate in a shared learning environment on issues like advanced security cooperation, comprehensive crisis management, and countering violent extremism. DKI-APCSS offers its Fellows a high-tech educational facility with an auditorium, a large lecture hall and a dozen 16-person breakout rooms with four whiteboards, a smartboard and two 50" screens. In the case assessed by this paper, participants (Table 1) were separated into eight groups of 12 to 13 people. Each group had only one person from each country or location and proportionately distributed gender. Two faculty members facilitated process and discussion for each group in dedicated breakout rooms.
Table 1: Participant details

<table>
<thead>
<tr>
<th>Total participants</th>
<th>101</th>
</tr>
</thead>
<tbody>
<tr>
<td>Countries</td>
<td>34 (Australia, Bangladesh, Bhutan, Cambodia, Colombia, Fiji, India, Indonesia, Iraq, Republic of Korea, Laos, Lebanon, Malaysia, Maldives, Marshall Islands, Mexico, Micronesia, Mongolia, Myanmar, Nepal, New Zealand, Nigeria, Papua New Guinea, Peru, Philippines, Solomon Islands, Sri Lanka, Thailand, Timor-Leste, Tonga, Turkmenistan, United States, Vanuatu, and Vietnam)</td>
</tr>
<tr>
<td>Locations</td>
<td>2 (Taiwan, and Hong Kong)</td>
</tr>
<tr>
<td>Organizations</td>
<td>4 (Japan Platform, Myanmar Red Cross, Pacific Islands Forum, UNOCHA)</td>
</tr>
<tr>
<td>Gender: Male</td>
<td>71%</td>
</tr>
<tr>
<td>Gender: Female</td>
<td>29%</td>
</tr>
<tr>
<td>Profession: Military</td>
<td>33% Major to Colonel</td>
</tr>
<tr>
<td>Profession: Law enforcement</td>
<td>10% Police equivalent</td>
</tr>
<tr>
<td>Profession: Civilian</td>
<td>57% Civilian equivalent to O3-O6 with several directors of national disaster management organizations</td>
</tr>
<tr>
<td>Origin - International</td>
<td>89%</td>
</tr>
<tr>
<td>Origin - United States</td>
<td>11%</td>
</tr>
<tr>
<td>Game staff</td>
<td>Game preparation was assisted by staff from the DKI-APCSS Visual Information unit. Game training was facilitated by the course management team. Each instance of the Matrix game was run by an experienced facilitator with the assistance of a scribe</td>
</tr>
</tbody>
</table>

Method and Results

The learning methodology documented in this paper is broken down into four steps: threat identification, domain mapping, system mapping using causal loops, exploration of driving forces of change, generation of future scenarios and Matrix gaming.

Step 1: Threat identification, Domain mapping, and System mapping

The eight groups independently went through a process to identify common threats in the Indo-Pacific region and prioritized these threats based on their experience and national priorities. Each group dealt with this step in their own way with most splitting into two or even three subgroups. The top four threats are shown below in order of (frequency).

1. Geopolitical instability and major power rivalry (5)
2. Natural disasters and climate change (5)
3. Transnational organized crime (3)
4. Terrorism and violent extremism (2)

**Variables and factors associated with geopolitical rivalry were:**

Sovereignty, diplomacy, stability, population growth and aging, migration, development, investment, military spending, aggressive policies, international aid, resource competition, risk of conflict, political dominance, diplomatic dominance, natural resources, economic growth, trade-war, culture, domestic politics, expansion, military strength, technology development, military buildup, conflict, negotiations, investment, island building, international actors, public opinion, enemies, dispute, allies, ideology, markets, airspace control, shipping, resources, hegemony, Super power influences, geopolitical instability, international laws and norms, political will, national interests, regime change, domestic disturbances.

**Variables and factors associated with natural disasters and climate change were:**

**Coordination:** NDMO, MOUs (engineers, doctors, builders, technicians, etc.), bilats, multilats training, logistics, plans, policies, budget, human resources, sharing tech and info, capacity building, disaster planning, responder training, impact assessment, resource allocation, civ-mil cooperation, timely response, info security, communication, humanitarian assistance

**Infrastructure:** roads, hospitals, power, ports, airfields, shelter, infrastructure breakdown, building codes, reconstruction of infrastructure

**Technology:** communication, equipment, networks, early warning, weather forecast, training

**Political:** impact, political will, legislation, regulation, national strategies, budget, capacity, lack of resources, resilience, mitigation, donor mandates, trust, cost, infighting

**Economic:** wealth, livelihood, corruption, aid, domestic, foreign, NGO, IO, taxes

**Social:** culture, demographics, education, resilience, health, security, food, shelter, WASH, community engagement/awareness, poverty, crime

**Environmental:** climate change, conservation of natural resources, education, population displacement, food security, mitigation of climate impacts, dev of adaptation policies, quick response, awareness, robust infrastructure, warning systems, warming, storms, flooding, access, displacement, migration, water, food production, shelter, safety and security, industrialization, deforestation, epidemics, pollution, hazards, resource scarcity, wildlife, agriculture
Domain mapping gets participants to look for general overarching relationships between categories of threats (Figure 1). This intermediate step greatly assists participants before they begin the arduous task of constructing a causal loop.

![Domain map example from a group working on geopolitical rivalry.](image)

Causal loop mapping facilitates systems thinking and the development and testing of theories of change by (i) making explicit the inter-relationships between factors; (ii) identifying and tracing anticipated effects of interventions; and iii) anticipating and monitoring unintended intervention impacts (Figure 2) (Campbell 2018).

The basic building blocks of systems mapping are:

**Key causal factors**: Conflict and disaster analyses generate many interconnected, dynamic factors that are necessary for a crisis to exist, but causal loop maps only use the most important.

**Relationships**: Links that join factors represent directional influence and show how an increase in one factor can cause an increase or decrease in another factor.

**Feedback loops**: All relationship links must eventually connect to form loops and these may be balancing (each iteration flips from negative to positive) or reinforcing (each iteration repeatedly makes things better in a virtuous cycle or worse in a vicious cycle).
Figure 2: Causal loop example from a group working on sovereignty. S indicates a relationship in the same direction and O indicates an opposite relationship.

Step 2: Exploring the driving forces of change behind the key threat

The systems mapping exercise in Step 1 helped participants to visualize and understand problem complexity. In Step 2, participants identified and categorized the basic trends and information that are currently or expected to drive future change. Using their threat prioritization, groups identified the most disruptive driving forces of change for one priority threat and rated these drivers according to their potential future impact and level of uncertainty. The results for geopolitical rivalry and disasters/climate are presented below.

Geopolitical rivalry

- High impact and uncertainty
  - Clash of cultures, financial and monetary policy, foreign affairs, capitalist investment potential, national policies, security concerns, domestic/regional instability
- High impact and low uncertainty
  - Nationalism, safeguards of constitution, education, trade, resources, stability, national defense capability, international agreements, ideology, belief, value, increase of people moving to cities/urban area, invention & innovation, energy use in industry and manufacturing, consumerism, ethnic, religion, culture, gov change, natural resource possession, information, computation
- Low impact and high uncertainty
  - Innovation, technological advancement, international agreements, pressure groups, international law, research, funding, industry
Wargaming the Far Future

● Low impact and uncertainty
  ○ Policy to promote technology advancement, new-found awareness, energy storage and generation, R&D, international politics, international trade, innovation and capability

Disasters/Climate

● High impact and uncertainty
  ○ Diversity in energy production, bi/multilat agreements, strong legislation, clean energy, academic influence on policy making, innovation, social media, lifestyle/attitudes, preparedness, migration/displacement, cyber and network security, access to technology, foreign aid, private sector, civil society, food security, inflation

○ Government funding, globalization, political will, economic goals, implementation of international laws, public awareness, education, preparedness, resilience, awareness, community participation, consensus, law and order, innovation, early warning, data collection, forecasting, budgeting, recovery planning, cooperation between private civil and military sectors, national crisis frameworks, good governance, interagency cooperation, international initiatives, local commitment, policy planning, budget for vulnerable communities

● High impact and low uncertainty
  ○ Low impact and high uncertainty
    ○ Increase national reserves, international laws and standards, religion, culture and values

● Low impact and uncertainty
  ○ Change in leadership

The Political, Economic, Social and Technological (PEST) analysis is a commonly used tool for identifying and categorizing basic trends and information about a range of different contextual issues that influence the future (Shoemaker 1995, Henry 2008). In business, PEST is used to analyze the macro environment around organizations to gain insights into market movement. In the context of security strategies, a PEST analysis can help us understand the external drivers that potentially affect outcomes. The process produces a list of drivers that require consideration when formulating a new strategy or intervention. More in-depth analyses may include consideration of Environmental, Legal and Ethical drivers (STEEP and STEEPLE). Participants contemplated each of these categories in preparation for Step 3.
Step 3: Planning and generating future scenarios based on key drivers

Strategic foresight helps crisis managers to understand complex problems, which guides decisions and planning (Vecchiato 2012). Foresight does not predict the future, but rather provides insight into plausible future situations. It empowers planners by providing them with new ways of thinking about and implementing strategies that engineer a preferred future (UNDP 2018).

Scenario planning is a foresight tool that overcomes biases, simplifies complexity, and reduces uncertainty to foster rapid and effective decision-making (Bootz 2010). Corporate decision makers have used this tool since the late 1970’s to guide decisions in times of uncertainty, to overcome cognitive limitations and to improve mental agility (UNDP 2018). In practice, it brings together managers with stakeholders to generate insights as they explore the implications of alternative futures (Horton 1999). Likewise, crisis managers find scenario planning a useful tool for managing uncertainty, risk, and opportunity because it provides a framework for understanding future needs and prioritizing near-term actions.

Scenario development requires consideration of how each of the change drivers and relevant system factors might behave under each scenario. The simplest and most commonly used approach to scenario creation is to use a two-way matrix that derives from contrasting the two most powerful or disruptive drivers. This ensures that participants explore a range of plausible, but distinct alternative futures.

In Step 3, participants created two-way matrices comprised of medium and long-term time periods vs. threat growth or decline. The two-way matrices produced four distinct scenarios for analysis (Figure 3). Each group then divided into two subgroups to develop each of the four scenarios.

![Figure 3: Future scenarios derived based on future time period and threat level.](image-url)
Participants were asked to pretend that they were living in their assigned future scenario and brainstorm what it looked like. They considered the success or failure of social, technological, economic, environmental and political (STEEP) drivers and reflected on the possible changes that each driver might cause. Taking all factors into consideration, they selected four of the most relevant and highest ranked driving forces and listed associated actors for each driver.

**Threat Growth 15 and 50 (normal 15; italics both; underlined 50)**

**Political:** instability, rivalry, sophisticated corruption, leader change, noncompliance with international agreements, *talks go wrong*, poor leadership

**Economic:** foreign investment, unsustainable urbanization and industrialization, unbound consumerism, trade with China sours, lack of R&D, recession, online commerce, increased sanctions

**Environmental:** resource exploitation, contamination, climate change, energy use, scarcity

**Social:** clash of cultures/religions/ethnicity, social media, migration, less community participation, labor issues, social inequity, lower living standards, deteriorating services, lack of law enforcement

**Technical:** invention, innovation, AI weapons, AI abuse, unregulated, cyber warfare, cyber crime

**Threat Decline 15 and 50 (normal 15; italics both; underlined 50)**

**Political:** stability, better national policies, enhanced defense capabilities, stronger foreign affairs, enforcement of laws, interagency cooperation, planning and resourcing, anti-corruption, establish and regulate international law, institutional safeguards, zero tolerance, growth in multilateral agreements, UN leads strong international law

**Economic:** better financial policies, free and open trade, consumerism, no/lower sanctions, resilience, smaller economic divide, rising costs, international currency, online commerce, infrastructure investment, social security

**Environmental:** sound management of natural resources, improve regulation and protection, unsustainable urbanization

**Social:** education for all, more aligned beliefs and values, generation change, resilience, greater public awareness

**Technical:** tech and cyber regulation and laws, R&D and alternative energy, denuclearization, replace old hazardous tech, common information sharing platform, innovation and invention, smarter energy use, AI growth, cyber warfare, mega connectivity
Step 4: Matrix games set in four different future scenarios

Among the best ways to do futures research is through the experience and analysis of serious games (Dator 2017). Repetition of a serious game with diverse participants can be very effective in revealing alternative futures. While this technique does not provide a prediction of the future, it permits a glimpse of what may occur, which aids decision makers in identifying the potential effects of policies in advance.

Matrix games are a type of global, strategic, serious game (Perla & Curry 2011). Matrix games are different from normal wargames in that there are few limitations on player behavior, the decision-making is crowd-sourced, the adjudication process is transparent, and the gameplay rarely produces clear winners or losers. These games employ a broad range of political, social, military and economic dimensions. Matrix games are particularly useful in analyzing complex geopolitical issues involving multiple stakeholders with different goals, strategies, motivations and values. Such issues include potential hostilities, diplomatic standoffs, transnational threats and geopolitical negotiations. Their purpose is to expose participants to broad perspectives, test strategies, identify key issues, and promote the exchange of ideas. Their output tends to be a qualitative narrative and interpretation rather than a quantitative prediction. They are thus useful when the game space is not well understood (Curry & Price 2017).

Based on the outcomes of Steps 1-3, the facilitators selected the two most often mentioned threats that were identified by most groups at some stage in the process: “Major Power Rivalry in Northeast Asia” (Actors: China, Japan, Russia, US, Unified Korea, Taiwan) and “Climate and Environmental Change in Asia and the Pacific” (Actors: US Global Corp, Papua New Guinea, Philippines, Unified Oceania, Indonesia). Two scenarios were developed for each threat – medium term (15 years) and long term (50 years). Each scenario included a blend of outcomes based on threat increase and threat decline. Two groups were assigned to each of the four resulting scenarios. In each Matrix game, five 45-minute turns were scheduled, separated by breaks during which negotiation was encouraged. The games concluded with a 45-minute reflection session. Actions within an actor’s power were largely successful and outcomes were determined via the Pros and Cons method followed by percentage cards and dice. When an action was proposed that was beyond an actor’s power, both the occurrence and outcomes were determined using the pros and cons method with percentage cards and dice.
Matrix Game Briefs

Matrix Game 1: Major Power Rivalry in Northeast Asia in 15 years

A rebellion broke out in North Korea and the people overthrew President Kim Jong Un’s government. North Korea and South Korea united in a search for co-prosperity and founded the Federated States of Korea (FSK). The FSK halted denuclearization, became a world nuclear power, and rapidly developed into an economic giant due to cheap labor in northern Korea.

Working behind the scenes, China manipulated the eviction of the US from the FSK and Philippines. However, this backfired when FSK turned to Russia for assistance, aid and close diplomatic ties. To maintain influence in the region Japan disregarded Title IX and began a massive military buildup with the help of the US. The US and Japan strengthened diplomatic ties and the US spearheaded international support for Japan.

China pushed forward to complete their One Belt One Road Initiative. Asia and Europe are now connected creating a flow of economic prosperity with China at the center of the network. As China rapidly became the wealthiest nation in the world, a huge gap developed between the minority rich and majority poor. Riding the momentum of progress, and in a Blitzkrieg-like move that took the world by surprise, China took a bold step and annexed Taiwan to advance their sovereign rights and secured the South China Sea once and for all.

Matrix Game 2: Major Power Rivalry in Northeast Asia in 50 years

In addition to the text in the 15-year scenario, the following text was included.

The population in China exploded because of economic growth. Cities stretched to the limits and can no longer support their populations. In search of more space and riding on the wave of imperialism, China annexed Mongolia and began a major infrastructure upgrade to their new state. The international community condemned the action, but only harsh verbal condemnation occurred in world media.

China’s move into Mongolia put Russia on high alert. Despite its weak economy, Russia implemented a large military response to signal China not to encroach further. Tensions are high as Russia seeks to keep an aggressive and wealthy China at bay.

Japan converted its Self Defense Force into an offensive three prong military force with Army, Navy and Air. With technological advancements, assistance from the US, and their new platform, Japan nuclearized and reclaimed the Kuril Islands. Already stretched to the limit on their border with China, Russia did not mount a military response, but resorted to extensive and debilitating cyber-attacks. Russia’s weakening hold in the region is clear to all. Japan and the US prepare for a Chinese border conflict. FSK warns China to respect their border and threatens fire and fury should they invade.
A large and well-resourced separatist movement emerged in China a decade later. At their core were those from Taiwan and Mongolia who initiated a civil war that has made China very unstable. All other nations view this as a significant opportunity...

Matrix Game 3: Climate and Environmental Change in Southeast Asia and the Pacific in 15 years

Over the past 15 years, the sea level has risen by a meter (3 ft). Weather events and flooding in most coastal cities are becoming increasingly destructive. Worsening climate conditions have driven mass migration and the cost of housing, food, and transportation are rising as resources become scarce.

**China:** While China maintains the largest economy in Asia, its economic growth slowed to 4.8% this year, which was blamed on rising energy prices and an aging workforce. The median age of Chinese nationals is now 44. Chinese companies and universities are globally recognized as innovators in new technologies. Their climate research has produced promising breakthroughs for cleaning the atmosphere, cutting down on greenhouse gas emissions, and restoring the ozone layer. However, China’s use of new technologies like automation and artificial intelligence have increased unemployment in all sectors of its economy.

**US Global Corp:** Corporations now wield unprecedented influence in international politics, with many holding assets equal to mid-sized countries. Five of the top 10 largest companies are in China. Business leaders use their vast wealth to influence policymakers through lobbying and coercion. The US Global Corp in the Indo-Pacific (USGCIP) is an industry representative for US corporate interests in the region. The organization sponsors development in Indonesia, the Philippines, and Papua New Guinea. US Global Corp competes with China for access and influence in the Indo-Pacific.

**Papua New Guinea:** Rising oil and gas prices have resulted in robust economic growth. While Australia remains a major player, China invests heavily in PNG and is the country’s largest purchaser of Liquid Natural Gas. China has many infrastructure projects in PNG, and it equips and trains local security to protect these interests. Many have expressed concern on PNG over reliance on oil and gas sales to China, which constitute 40% of the country’s GDP. PNG was recently accepted as a member of ASEAN. However, its relationship with the ASEAN Chair, Indonesia, remains rocky due to disagreements over West Papua.

**Philippines:** The Philippines is experiencing severe food shortages due to increased tropical storms, flooding, and the loss of agrarian land. Ocean acidification has reduced the Pacific Ocean’s fish supply, thereby raising the price of food. Manila often suffers from flooding and businesses have begun to leave. The Philippines benefits from having a young, capable, and multilingual workforce, and many US Corporations invest in the country. However, this
workforce often finds work abroad and sends remittances back home. In the face of climate change, the Philippines urgently needs outside economic support.

**Oceania**: With rising sea levels, many Pacific islands have become uninhabitable due to inundation and saltwater intrusion. New Zealand and Australia have stepped up to receive several waves of migrants, some legal and some illegal. Both countries would like Papua New Guinea to absorb a portion of those migrants. However, Papua New Guinea has been reluctant thus far. Based on their new collective identity as the final refuge of the Pacific, New Zealand and Australia have agreed to form together under a federate state called “Oceania.” Oceania is concerned about the rising influence of China in the region. However, it also blames transnational corporations for their role in driving climate change.

**Indonesia**: Indonesia has seen massive growth in both its economy and population. Jakarta in particular has grown rapidly, and with 38 million people, it is now the largest city in the World. Indonesia has positioned itself at the center of ASEAN and is this year’s ASEAN Chair. The country also regularly attends Pacific Island Forum meetings as an observer. However, increasing urbanization and pollution, along with a growing population, have reduced the available agrarian land in Indonesia. Lower yields in rice lead to frequent food shortages. In response, Indonesia has increased its economic presence in West Papua.

**Matrix Game 4: Climate and Environmental Change in Southeast Asia and the Pacific in 50 years**

In the past 50 years, the sea level has risen by 4 meters (12 ft). Shanghai, Jakarta, Manila, and Melbourne are now partially underwater. With rising temperatures, all coastal cities, including Port Moresby and Auckland have seen more frequent hurricanes and tropical storms.

**China**: Heavily affected by climate change, Yangtze and Yellow River flooding partly submerged many cities along their paths and Shanghai is underwater. Coastal city inundation has driven mass migration to inland cities like Chongqing and Chengdu. China faces severe economic and social problems due to low birth rate and an aging population. From 2049, China accepted regional climate refugees to bolster its dwindling workforce. Now, China’s cities suffer severe overcrowding from migrants and the internally displaced. Chinese elite continue to purchase land and resources in Australia and now own 50% of all Australian mines. Over 30 mil Chinese migrated to Australia, easily outnumbering the local population of 27 mil.

**US Global Corp**: Global corporations have grown greatly in size and influence in the past 50 years. The largest corporations are based in the United States and China. American corporations are predominantly privately held while China’s largest corporations are state-run. The US Global Corp in the Indo-Pacific (USGCIP) is an industry representative for US corporate interests in the region. The organization manages financial assets comparable to a highly developed nation. While their primary interest is in improving business conditions, they also
invest in the development and security of nation-states. USCGIP has invested heavily in the security and development of Indonesia and the Philippines.

**Papua New Guinea:** Benefiting from the rising price of oil, gas, and precious metals, and with substantial investment from China, PNG has gained the infrastructure to exploit many of its previously untapped natural resources. For example, China funded several seabed mines to extract minerals from the surrounding shallow seas. Large portions of PNG have been deforested to make room for Chinese-funded mines and towns. China has trained and equipped PNG’s military and police in anticipation of a conflict with Indonesia.

**Philippines:** Devastated by climate change, all coastal cities in the Philippines are partially or entirely submerged, while the rest have been ravaged by hurricanes. Frequent tropical storms, acid rain, and saltwater intrusion have ruined rice cultivation throughout the country. The Philippines now faces dire food shortages and its population has begun a mass migration to the United States, Australia, and China.

**Oceania:** Oceania hosts the world’s largest population of illegal migrants. Most Pacific Island nations are now uninhabitable, and their people have moved to Australia and New Zealand. Rising sea levels partly submerged New Zealand’s northern island and the large Australian coastal cities of Melbourne and Sydney. More extreme weather conditions cause severe drought and storms across Oceania. Overfishing and ocean acidification wiped out the Pacific fisheries. The entire Indo-Pacific region faces severe food shortages. At the same time, the majority Chinese population in Australia fundamentally reshaped the platforms of Australia’s political parties heavily in favor of pro-China policies.

**Indonesia:** Indonesia’s major coastal cities are inundated with water and the majority of Jakarta is now submerged. Rice production has declined dramatically due to rising sea levels, salt-water intrusion, and acid rain, leading to malnourishment across the country. Due to flooding in major cities, Indonesia moved a large portion of its population to new settlements in West Papua. These settlements are continually under attack from West Papua armed insurgency groups that appear to have external support. Indonesia’s military presence in West Papua has escalated tensions with Papua New Guinea that threaten to spiral into a border war.
### Matrix Game Outcomes

The outcomes reported here are only the events that happened and not those that were attempted and failed due to stronger opposition arguments or dice rolls (Tables 6-13).

**Table 2: Matrix Game 1: Group 1 – Major power rivalry in Northeast Asia in 15 years.**

<table>
<thead>
<tr>
<th>Turn</th>
<th>Successful actions</th>
</tr>
</thead>
</table>
| 1    | ● Trade agreements: PRC and Russia; Japan and Taiwan; Taiwan and Korea  
      | ● Russia builds agricultural capability in Korea |
| 2    | ● PRC purchases military technology and equipment from Russia  
      | ● Russia makes agreement with Korea to not use nukes on each other  
      | ● Japan and Korea host joint exercise in the Pacific  
      | ● Taiwan executes maritime exercise with US and Japan |
| 3    | ● Russia returns disputed territories to Japan  
      | ● Korea gives up nuclear weapons in exchange for US security umbrella  
      | ● Trade agreement between Japan and Korea  
      | ● Taiwan rebels against China and moves towards independence |
| 4    | ● US coalition will go to war to ensure Taiwan’s independence  
      | ● Trade agreement between Korea and PRC in return for HADR support  
      | ● Japan military coalition exercise with Korea, Japan and US near Chinese border  
      | ● Taiwan starts influence campaign in China to support independence |
| 5    | ● Trade agreement between US, Japan and Korea who all stop trade with Russia and China  
      | ● PRC deploys forces to Taiwan to reestablish Chinese sovereignty  
      | ● Russia deploys troops on Korea border  
      | ● Korea makes treaty with US and invites return of US troops to Korean peninsula  
      | ● Taiwan independence granted by UN, Japan, Korea and US |
### Table 3: Matrix Game 1: Group 6 – Major power rivalry in Northeast Asia in 15 years.

<table>
<thead>
<tr>
<th>Turn</th>
<th>Successful actions</th>
</tr>
</thead>
</table>
| 1    |  ● China provides more aid and loans to Korea to make it more dependent on China  
     |   ● Japan succeeds in breaking apart China and Taiwan again  
     |   ● US deploys more troops to Japan |
| 2    |  ● Japan builds alliance with Korea and Russia  
     |   ● Russia succeeds in getting all nations to sign a Kumbaya / World Peace agreement  
     |   ● US works with Japan to de-annex Taiwan from China  
     |   ● Taiwan implements economic reforms with help of US and Japan  
     |   ● Korea builds up military and nuclear power with Russian help |
| 3    | **Facilitator inject: Japan militarily takes over Dokdo Islands**  
     |   ● China establishes defense treaty with Korea  
     |   ● Japan calls on Taiwan and US to help defend the Dokdo Islands  
     |   ● Russia arbitrates peace between Korea and Japan  
     |   ● US takes control of South China Sea away from China  
     |   ● Taiwan – build up military strength with help from US  
     |   ● Korea regains full control of the islands through use of military force |
| 4    | **Facilitator inject: Russia attacks USN carrier in SCS and conducts cyber-attack against Japan’s power grid**  
     |   ● Japan restores electric power grid but Russian hackers remain in Japanese networks  
     |   ● Russia makes defense treaty with Taiwan  
     |   ● US conducts cyber surveillance against Russia  
     |   ● Taiwan and Korea sign a bilateral economic treaty |
| 5    |  ● Japan establishes bilateral trade with Russia  
     |   ● A Russian citizen becomes UN Secretary General  
     |   ● US succeeds in a Motion to remove China from the UNSC  
     |   ● Korea reduces diplomatic ties with PRC |
**Table 4: Matrix Game 2: Group 4 – Major power rivalry in Northeast Asia in 50 years.**

<table>
<thead>
<tr>
<th>Turn</th>
<th>Successful actions</th>
</tr>
</thead>
</table>
| 1    | ● China develops infrastructure in Mongolia and Taiwan to stabilize population growth  
      ● Korea does joint-military exercise with Russia  
      ● Taiwan signs alliance with Japan |
| 2    | ● Japan signs trilateral trade and fishing agreement with Russia and Korea  
      ● Round 1 secret move 10% chance: Chinese economic bubble bursts. Mongolia freed from Chinese control. Taiwan remains part of China however economic downturn causes instability in China as people continued to struggle to survive  
      ● Russia joined Korea to support and legitimize the new China gov which was effective in stabilizing the country  
      ● Taiwan supported the interim PRC gov in return for a free and independent Taiwan, but facilitator did not allow Taiwan to become free  
      <i>Facilitator injects elections in China</i>  
      ● China holds elections and becomes the Democratic Federation of China (DFC) |
| 3    | ● Japan’s trilat boosts resource management and removes tensions over disputed areas  
      ● Northern province of China Xinjiang separates from the DFC and becomes independent  
      ● Taiwan takes independence with military aid of US and Japan and succeed with a high casualty rate on all sides |
| 4    | <i>Facilitator inject: Asteroid lands in North East Sea resulting in damage to the coastal China, Korea, Japan and Taiwan</i>  
      ● Terror cells identified in Japan are confirmed as Chinese not Russian which improved Russian and worsened Chinese international relations  
      ● US offers aid to China and relations grow stronger  
      ● Korea managing the crisis internally officially refusing international aid but offers aid to China and Taiwan. China accepts aid and Korea resources become stretched |
| 5    | ● China creates free trade zone known with Japan, Russia and Korea and regional economic growth accelerates  
      ● Regional 6 party HADR security pact signed and all conduct regular non kinetic military exercises which helps to promote free trade  
      ● Russia opens up to international development and regional GDP improves  
      ● US increases investments in China and Taiwan which improves trade  
      ● Korea discovers cheap renewable energy source and sells technology to China which develops nuclear fusion  
      ● Secretariat of the 6 party talks moves to Taiwan with no significant impact |
Table 5: Matrix Game 2: Group 8 – Major power rivalry in Northeast Asia in 50 years.

<table>
<thead>
<tr>
<th>Turn</th>
<th>Successful actions</th>
</tr>
</thead>
</table>
| 1    | ● Japan improves border security  
      | ● Russia creates deterrents to military occupation  
      | ● US Navy Strike Group moved to North Pacific  
      | ● Taiwan overthrows Chinese puppet government |
| 2    | ● Air force base opened in Taiwan  
      | ● Russia, Korea, US Japan conduct joint exercise in Sea of Japan  
      | ● 5 Allies (excl. China) free trade agreement - military and economic ties are formalized |
| 3    | ● 5 Allies share intelligence information  
      | ● Strike carrier group relocates off China coast  
      | ● Russia signs security agreement with China |
| 4    | ● US trade embargo against Russia  
      | ● Korea cuts economic ties with Russia  
      | ● 4 remaining Allies support trade embargo with Russia |
| 5    | ● 4 Allies setup air defense systems in SCS and ECS  
      | ● US and Taiwan remove trade embargo against Russia |

Table 6: Matrix Game 3: Group 3 – Climate and Environmental Change in Indo-Pacific in 15 years.

<table>
<thead>
<tr>
<th>Turn</th>
<th>Successful actions</th>
</tr>
</thead>
</table>
| 1    | ● China exports new solar technology  
      | ● US Gov gets US companies to reduce CO2 emissions  
      | ● ADB and WB give loans to Philippines  
      | ● US Corp agrees to invest in Oceania companies  
      | ● Indonesia increases resource development in West Papua |
| 2    | ● PNG invites US Corp to invest in agriculture to diversify the economy  
      | ● Philippines gets US Corp to invest in education and industry  
      | ● Indonesia gets US Corp to invest in green energy and agriculture |
| 3    | Facilitator inject: Economic crisis in China and US. Typhoon in Philippines and Indonesia  
      | ● China cancels solar deal and focuses on home business  
      | ● PNG provides aid to Indonesia  
      | ● Philippines requests aid from US and ASEAN for recovery/rescue operations  
      | ● US to increase investment in Oceania’s fishery industry |
| 4    | Facilitator inject: Unrest in US mining companies in PNG  
      | ● PNG accepts Pacific refugees |
| 5    | Facilitator inject: US and Pacific environmental extremists hijack a Chinese fishing boat with casualties on all sides – demand the US-China deal on capping CO2 emission  
      | ● Indonesia negotiates as Chair of ASEAN with China and US and gets them to collaborate to seek release of hostages China works with US and Oceania on counter-terrorism and provides military assistance to Oceania nations  
      | ● US Corp get US and China to lower CO2 emissions |
### Table 7: Matrix Game 3: Group 7 – Climate and Environmental Change in Indo-Pacific in 15 years.

<table>
<thead>
<tr>
<th>Turn</th>
<th>Successful actions</th>
</tr>
</thead>
</table>
| 1    | ● PNG signs free labor movement agreement with ASEAN  
      | ● Philippines-US oil/gas venture in disputed territory wildly successful  
      | ● Oceania convinces transnational corporations to build floating islands in the Pacific  
      | ● Indonesia reduces pollution with support from ASEAN and China and successfully influences the world to address climate change |
| 2    | ● Indonesia and USGC work on agricultural tech and modernize urban environments  
      | ● Indonesia and China cooperate on mining and eco-friendly technology R&D  
      | ● US Corp agrees to provide 65% of support and utility services to artificial islands  
      | ● China starts very successful mining operation in Chinese Spratly Islands  
      | ● China and Indonesia joint infrastructure project in West Papua and China receives favorable mining rights  
      | ● PNG hosts land/naval military exercise with US, Japan, S. Korea, Philippines, Thailand  
      | ● PIF raises the cost of fishing licenses |
| 3    | ● Joint China-US State and private exploration and exploitation of minerals in space  
      | ● Indonesia agrees to a Chinese naval base in West Papua  
      | ● China and Philippines agree to a tech cooperation agreement on pollution mitigation and sustainable farming technology in Manila  
      | ● US Corp develops international airport in PNG  
      | ● China develops international airport in PNG  
      | ● Taiwan embraces One Country Two Systems, but insurgency remains active in mountains  
      | ● PNG becomes a tourist hotspot and regional flight hub  
      | ● Indonesia conducts separate joint naval exercises with both US and China |
| 4    | ● China takes over operation of US Corp aquaculture in China’s EEZ, using Chinese labor, ports and industry  
      | ● Philippines takes over operation of US Corp aquaculture in Philippine’s EEZ, using Filipino labor, ports and industry  
      | ● China assists Oceania with reinvigoration and protection of the Great Barrier Reef  
      | ● China launches space station with global environment monitoring capabilities  
      | ● China secretly monitors military movement, migration patterns, and fish stocks  
      | ● US Corp sells 10 sixth generation fighters and training to Indonesia  
      | ● Philippines votes to reopen US Military bases on Luzon  
      | ● Oceania partners with US Corp to build fisheries, but US Corp takes 65% |
| 5    | ● China adopts US Corp technology capable of capturing carbon emissions  
      | ● PNG purchases two squadrons (32) of sixth generation fighters from US Corp  
      | ● Philippines shifts energy sector to renewables  
      | ● PIF declares Oceania a nuclear weapon free zone  
      | ● Indonesia pushes automation and AI in West Papua with US support |
**Table 8: Matrix Game 4: Group 2 – Climate and Environmental Change in Indo-Pacific in 50 years.**

<table>
<thead>
<tr>
<th>Turn</th>
<th>Successful actions</th>
</tr>
</thead>
</table>
| 1    | ● 10,000 Chinese troops stationed in PNG  
      | ● PNG conducts very effective military training with Chinese operatives  
      | ● Oceania policy facilitates migration of refugees to central Australia and China |
| 2    | ● China establishes open migration policy with Australia  
      | ● Philippines invests in agriculture to assist Indonesia with food security  
      | ● Oceania receives 10 b in agriculture investment from China  
      | ● Indonesia signs rice import deal with Thailand with US Corp support |
| 3    | ● China removes its One-Child Policy to mitigate aging population  
      | ● China invests in PNG reforestation, but funds are diverted due to corruption  
      | ● Australian Navy successfully guards against illegal fishing and protects marine resources  
      | ● Indonesia enhances economic cooperation with US Corp – results in great increase in US investment in mining West Papua  
      | ● China improves domestic mood with more aged home facilities |
| 4    | ● US Corp buys PNG minerals to decrease tensions with Indonesia with marginal success  
      | ● Philippines enacts a free trade agreement with Indonesia and Oceania – lucky win  
      | ● Oceania makes Mandarin 2nd official language to improve integration |
| 5    | ● PNG clamps down on cross-border armaments to improve relationship with Indonesia and improve trade relations  
      | ● Attempts to promote peace and harmony largely unsuccessful  
      | ● Indonesia establishes new organization of friendly nations (FNO), headquartered in Indonesia for peace and harmony in the region (China, PNG, Oceania, US Corp, Philippines) – different from the UN because it is smaller, different from ASEAN because it is larger – successful and initiates a new era of cooperation in the region |
Table 9: Matrix Game 3: Group 5 – Climate and Environmental Change in Indo-Pacific in 50 years.

<table>
<thead>
<tr>
<th>Turn</th>
<th>Successful actions</th>
</tr>
</thead>
</table>
| 1    | ● China provides military support to PNG  
      | ● US Corp invests in Indonesia  
      | ● China overextension in the region causes tensions with Australia  
      | ● Philippines establishes educational and employment ties with Oceania and US Corp |
| 2    | ● Heightened internal tensions in Australia due to Chinese migrants  
      | ● China achieves internal stability  
      | ● Indonesia invests in and improves internal infrastructure  
      | ● Oceania is open for business while Philippines continues to sink economically |
| 3    | ● US Corp successfully invests in Australia/New Zealand factories  
      | ● China agrees to invest in Oceania and “New Tonga” |
| 4    | ● PNG successfully seeks int’l assistance to break Chinese influence  
      | ● Philippines received US Corp investment  
      | ● Controlled immigration increases to “Club Oceania”  
      | ● Indonesia signs political agreement to stabilize relations with PNG |
| 5    | ● On PNG Independence Day, the Chinese military are pushed out of the country  
      | ● Philippines invests in internal infrastructure  
      | ● Oceania invests in internal economic development |

Participant Takeaways

Following five rounds of gameplay, participants were given 45 minutes to reflect on lessons and takeaways from the game. The ensuing discussion brought out similar themes across all groups, including the value in multi-mindedness in evaluating complexity, difficulties in committing to collective action under imperfect information, identification of core values and interests in geopolitical negotiations and insights into possible levers of influence. Participants also provided facilitators with candid feedback for improving future iterations of the game.

Some participants lamented about their limited knowledge of some of the countries in the game. In this format, with eight games running simultaneously, it was not possible to provide additional subject matter experts to supplement knowledge deficits. However, this was not necessarily a problem because prior experience is not essential when people are asked to solve new problems (Salomon & Perkins 1989).

Faced with new situations, such as novel player moves, experts may fail to recognize when their expertise becomes irrelevant (Klein 1998).

Ultimately, participants observed that national interest takes priority and that military power is still a dominant factor on the international stage, regardless of economic status. The
game mechanics ensured that “every dog had its day” and that everyone experienced Murphy’s Law as their strategic planning continuously failed when exposed to the transparent decision-making environment.

**Perspective**

Most reflections on the games addressed issues with understanding other stakeholder perspectives. Participants noticed the presence of many different opinions that they related to different job positions or country positions and the influence of media. Some noted the value in hearing different perspectives on familiar issues and the utility of wearing different hats to examine a problem from different perspectives. Participants noted that the availability of multiple perspectives was effective in countering inaccurate assumptions that can result in ineffective decisions.

**Information and Relationships**

All decision makers have to sort through imperfect information that limits their capacity to make fully rational decisions. To mitigate this, the participants used various methods, such as disclosing confidential information, soliciting group feedback, and investigating the unknown. However, they found it very difficult to build trust and noted how hard it was to predict the actions of other actors. While they sought more clarity and completeness of information on the strengths and vulnerabilities of other actors, they realized that these only come with improved mutual understanding and stronger relationships. International negotiations are complex, and leaders have strong influence on meeting dynamics. Thus, having clear strategies and identifying shared and common interests were essential in improving national-level negotiations.

**Technology**

There was a clear relationship between highly ranked drivers and game moves (Tables 10-11). One notable exception, however, was technology, which was virtually absent in 50 year games. This category includes the myriad applications of technology within areas such as cyber, military and agriculture, while possible arguments might include investments in research and development (R&D), human capital, or technological interventions through the Internet of Things (IoT). The failure of technology to emerge as a powerful force in most games points to the difficulties in projecting long-term technological trends. Participants were significantly more active in leveraging technology within 15 year scenarios compared to their 50 year counterparts. Other limitations may have included a lack of participant familiarity with cyberwarfare options, suggesting that “the success of a global crisis wargame depends in no small measure on assembling in one place people with different talents and backgrounds to confront dynamic and complex issues” (Herman, Frost & Kurz 2009).
The pace of technological advancement presents crisis managers with one possible hurdle in foreseeing what the long-term future might hold.

**Table 10: Top four categories of drivers in each foresight scenario.**

<table>
<thead>
<tr>
<th>Threat Growth 15</th>
<th>Threat Growth 50</th>
<th>Threat Decline 15</th>
<th>Threat Decline 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Instability</td>
<td>2. Instability</td>
<td>2. Technology</td>
<td>2. Energy</td>
</tr>
</tbody>
</table>

**Table 11: Total numbers of Matrix game moves in each driver category by game scenario.**

<table>
<thead>
<tr>
<th></th>
<th>Geopolitics 15y</th>
<th>Geopolitics 50y</th>
<th>Environment 15y</th>
<th>Environment 50y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>5</td>
<td>1</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Stability</td>
<td>11</td>
<td>12</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Economics</td>
<td>9</td>
<td>12</td>
<td>22</td>
<td>16</td>
</tr>
<tr>
<td>Int’l Relations</td>
<td>15</td>
<td>13</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Society</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

**Economics**

Economics offered participants with a commonly leveraged tool in building relationships and opening new opportunities. Participants saw mutually beneficial trade as a driver of stability and prosperity, as well as a vehicle to access other domains.

Trade and investment deals were the most common moves within this category, followed by those aimed at promoting internal and external stability, such as the provision and expansion of government services. However, any agreement required adequate commitment and enforcement, otherwise it would fail due to subversion or corruption. Small states recognized their need to bandwagon to become significant economic players but required assistance to do this effectively. While more meetings and dialogues (negotiation time) helped to improve stability and decrease hostilities, they were also viewed as a source of future problems because improved relationships sometimes resulted in groupthink.

Within the environmental games, economic trade deals often lacked resilience or preparedness components. This suggests that decision makers, when confronting the existential topic of climate change, may choose to mitigate it by prioritizing improvements in their economy, which opens more options down the track.
**Systems Thinking**

A systems approach is a “management strategy that recognizes that disparate components must be viewed as interrelated components of a single system” (GWU-ICDRM 2009). Experts have long recommended systems thinking as a means for understanding slow and fast burning complex crises. For instance, the World Health Organization and the Institute of Medicine recommend a systems approach to strengthen health systems as a means to respond to incidents that exceed the normal capacity of existing health and medical services (de Savigny & Adam 2009, Hanfling et al 2012), and accrediting bodies for public health masters programs in the US list systems thinking as a core competency (ASPPH 2007).

Our training often encourages us to solve problems in a reductionist manner by breaking them up into convenient pieces. Other approaches to coping with complexity include: a) improving awareness of known and unknown information; b) broadening analysis and expanding options; c) preparing for categories of threats rather than individual threats; d) narrowing the focus by discarding irrelevant information; e) identification of driving forces; and f) framing by entity and interest and through messaging (Canyon 2018). However, if an initial attempt to understand a whole system is absent, reductionist approaches are dangerous because complex challenges involve many branches of knowledge and interrelationships that require a systems approach. Awareness of the components of a system does not equate to understanding the whole system. Far more important are the relationships between these components and how they react to each other.

Knowledge of five different types of inquiry models can assist in the appropriate implementation of systems thinking (Canyon 2013):

1. **Consensual (Glass 1965):** Inputs are processed by a group of experts who all agree on a single answer – suitable for simple, well-bounded and well-structured problems (Mitroff & Linstone 1993)

2. **Analysis (Hume 1975):** Inputs are processed using an agreed upon formula and a single numerical answer results – suitable for simple, well-bounded and well-structured problems or pieces of problems for which single numbers can serve as answers

3. **Multiple Realities (Churchman 1971):** The analysis of many models and observations will shed the best light on an issue because more angles will be covered – suitable for analyzing complex problems but assumes that each reality is unbiased (Churchman 1968).

4. **Conflict (Mason & Mitroff 1981):** Contrasts opposing expert views assuming that stronger arguments and truth will emerge from the resulting conflict – suitable for
complex problems since it challenges faulty assumptions, however, simplistic since each presenter does not have equal arguing capacity

5. Multiple Perspectives (Mitroff & Linstone 1993): Inputs are complex ‘messes’ and everyone is biased so problems must be viewed from a variety of perspectives, such as expert, epistemic, ethical, aesthetic and even spiritual – suitable for highly unstructured, unbounded, complex problems.

Upscaling from simple Consensus or Analysis models, that are based on a single truth, to a more complex model, that incorporates many truths cannot be done because belief in a single truth cannot be upscaled. A sound systems approach begins with Multiple Perspectives and downsizes when warranted. Using the right inquiry model is essential for systems thinking and can provide good insights. Whereas the use of simplistic inquiry models can result in incorrect problem formulation and bad decisions.

Modern versions of Matrix games are discovery games in the sense that they create, rather than share, knowledge, and they work on ill-defined complex problems (Bartels 2018). As Curry and Price noted, they employ Hegel’s thesis vs. antithesis approach as represented by the Conflict inquiry model in that players provide arguments and counter arguments and the strongest arguments result in decisions and actions (Curry & Price 2014). However, if the players represent a group of similar experts, the Consensual inquiry model is also in play and the outcomes will be less reliable. Ideally, the players are representative of the Multiple Realities or even the Multiple Perspectives inquiry models. When players have the background and capacity to take into account multiple disciplines and intangibles such as culture, beliefs and perceptions, the outcomes become more reliable and valid.

Conclusions

The case laid out in this paper demonstrates the utility and limitations of a comprehensive foresight exercise. Participants used systems thinking, strategic foresight and wargaming to simulate and explore the politics of dealing with plausible future events in a complex environment. Through this participatory process, participants developed transdisciplinary visions and scenarios that showed them how to achieve the future they preferred or avoid the future that they did not (Inayatullah 2008). The limited guidelines and ruleset offered participants the freedom to innovate and generate a broad variety of initiatives and responses.

This methodology also revealed several limitations and obstacles in the foresight process. While participants gained practical insights into technological drivers at the 15 year mark, they showed difficulty in extrapolating those trends to a 50 year future. Within seminar discussions, participants readily expressed the importance of technology in managing long-term crises and speculated on what that technology might look like. However, when faced with a 50 year scenario, participants were unable to apply technological levers in advancing their interests.
Additional elements in this methodology could aid participants in developing possible use cases for new technologies, either before or after the Matrix game.

The same could arguably be said for economic moves, which relied heavily on models of economic engagement used by national-level actors today. Participants understood the importance of economic levers in advancing their interests and expanding their capacity to confront future challenges. Additionally, participants gained an appreciation for how asymmetric power dynamics affected, and often undermined, stable and mutually beneficial economic relations. However, few meaningful insights were gained into new applications of economic principles.

By contrast, participants gained several useful insights into relationship building and power dynamics. This was particularly true in the 50 year scenarios where the scenario explicitly altered the geographical characteristics of many nation states. While cognizant of the cultural and historical contexts of each actor, participants became unconstrained by the biases of geography. Within the environmental game in particular, participants were forced to deal with the real consequences of rising sea levels that radically redefined national identities through the physical displacement of peoples. In response, participants imagined new forms of cross-national organization to compete or cooperate in resolving transnational problems.

The benefits of foresight gaming extend far beyond engaging course and workshop participants or delivering custom learning outcomes. They are a proven method for amplifying “plurality, diversity and multiple perspectives, which are essential for understanding and steering through post normal conditions” (Sardar 2015). Futurists find utility in games and simulations because they “embody some of the core tenets and long-standing practices of futures: systemic, yet playful, inquiry; engaged and collaborative curiosity; and anticipatory action learning through experiential approaches” (Sweeney 2015).

While they have their limitations and are not an exact replica of reality, situational, role-playing games foster the application of creative and innovative thinking on challenges that cannot be analyzed using conventional statistical methods and provide the opportunity to investigate possible reactions. Before embarking on a potentially precarious course of action, it is useful to have insight into potential command and control issues, as well as actions that may escalate or de-escalate tensions and hostilities. Leaders need methods that not only provide systems-level knowledge, but which actively challenge assumptions, positions, expectations, perceptions, facts and procedures to improve decision making in multidisciplinary, interagency and complex settings.
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Wargaming the Future: Developing Scenarios and Galvanizing Support

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Abstract

Two principal actions need to occur to wargame the future. First and foremost, some semblance of plausible futures needs to be identified. Secondly, the wargame has to be designed around those plausible futures; more importantly, people need to interact under the context of those plausible scenarios within the context and stage that wargaming creates. Wargames serve as a stage for human interaction at four levels: before the conduct of the wargame as it is being designed; just prior to the wargame as people become acclimated to the game; during the game as moves and decisions are made; and finally after the game as people carry forward the experience and knowledge they gained during the game. When wargames are used for futuring the last level of human interaction may very well be the most important simply because the results from the game will only be seen many years in the future. People carry this knowledge forward; therefore, the people interacting must be carefully selected to reap the full benefit of the game. In addition, futuring cannot be accomplished simply with one single game or scenario, rather a series of games must be designed and conducted to sort through the ambiguity and complexity that the future presents. Conducting a series of games also enable interdisciplinary groups of people to engage, increasing the chances that some of the knowledge generated from the wargame will actually stick.

This paper discusses wargaming the future by describing futuring and an approach to generate future scenarios, as well as providing insights to factoring human interaction into the design and conduct of the wargame.

Generating Future Scenarios for Wargaming

Any discussion on “Wargaming the Future” needs to start with the concept of futuring, in general. Recognize that forecasting and futuring are two different approaches for dealing with the future. Forecasting focuses on prediction in terms of a probabilistic space and using an assortment of analytical tools, e.g., simulation, modeling, Monte Carlo analysis, Bayesian conditional probability theory, Kalman filtering, etc. These forecasting tools work best for predictions with relatively short time horizons because variance grows with time. On the other hand, futuring techniques do not attempt to predict the future; futuring techniques work to distill plausible outcomes rather than probabilistic ones. These techniques work to a longer time horizon characterized by ambiguity and complexity. The lack of structure rules out the use of simulation and modeling tools. Similarly, futuring techniques cannot determine structure. However, futuring can reveal trends, opportunities, challenges and desirable outcomes worthy
of investment of resources. Some people maintain that these investments contribute to the realization of future outcomes, making futuring a self-fulfilling prophesy. In fact, our motto at the Chief of Naval Operations Strategic Studies Group (CNO SSG) was *Generare Futurum*.¹

Ironically, although futuring techniques address unstructured problems and cannot determine structure, people have structured techniques that lead toward the generation of plausible outcomes. Dr. Richard Lum (Lum 2016) discussed his approach at the *Alternate Futures Study Workshop* held at the Naval War College.² He consulted numerous organizations on futuring and holds a Ph.D. in political science from the futures studies program at the University of Hawai‘i. Dr. Lum advocates *4 Steps to the Future*:

1. Past
2. Present
3. Futures
4. Aspirations

The first step concerning the past, confronts the three essential approaches to history that include relative positivism, narratives and anti-narratives. Relative positivism seeks to establish cause and effect relationships, i.e., causality, by attempting to outline structure. However, we can never know all the facts or relate to them from the context of the time. The narrative approach to history seeks to weave reason, literary skill, politics, real life and moral awareness to build a bridge to the past and to the underlying story. The narrative approach seeks to translate knowing into telling without simply recounting events.

Far from being a problem, then, narrative might well be considered a solution to the problem of fashioning human experience into a form assumable to structures of meaning that are generally human rather than culture-specific (White 1987, 1).

The anti-narrative approach views societies as a complex living organism without addressing causality or the narrative (Hoffer 2008, 181). The anti-narrative just presents the facts without any presumptions of causality or extraction of meaning from narratives. Unfortunately, the anti-narrative approach leaves little to carry forward for future generations.

Nevertheless, the past is important for a number of reasons. For one thing, the past gives us a sense of the plausible and what could happen simply because it did in fact happen, albeit within a different context. We may not be able to prove causality from deductive reasoning, but inductive reasoning, i.e., preponderance of evidence, bolsters plausibility.

¹ The author served as the ONR Science Advisor to the CNO SSG from August 2001 to August 2003 under ADM (ret) James Hogg.

² At the request of NAVSEA 08 NR, Dr. Will Bundy, Director of the Gravely Group at the Naval War College, conducted an Alternate Futures Study in collaboration with the Naval Undersea Warfare Center from 29-31 August 2017.
Developing a better understanding of the past doesn’t tell us what will happen in the future, but it does give us an appreciation for the patterns that recur, the cycles that might be at work, and the roles that chance and randomness have played in creating our present (Lum 2016, 9).

In addition, a look at the past helps us determine what meaningful parts of the past we wish to carry forward, i.e., traditions, culture and ethics. A look back at the past helps us shape the platform we can build upon.

The second step concerns the present. In this step, we build a foundation with the relevant drivers from the past and the platform that we built. We add the signals for change we think we are detecting, along with any challenges that might slow down or prevent change, to the foundation (Lum 2016, 17). Quantifiable data from the past and/or present validate strong signals as trends. Emerging issues present themselves as weak signals often from fringe thinkers. Whether these issues ever develop the critical mass to reach a tipping point often becomes a question of faith. Other factors in the present that can potentially shape the future entail new technologies, concepts and policies. Moreover, the combinatorial effects that can arise from all these factors make the assessment of the present more challenging.

Lum states that the third step takes the building blocks from the first two to construct plausible alternative futures. The emphasis here is on the word plausible. We can build the first two steps from data by reading history and talking to subject matter experts working in different fields today; however, constructing plausible alternative futures requires more thought. Lum recommends developing scenarios in terms of continuity, perceived incremental change and potential abrupt change. We can evaluate these scenarios in terms of critical uncertainties.

Peter Schwartz proposes an alternative approach to developing scenarios, i.e., the Lum’s step 3 for the future, by starting with the identification of a focal issue for a decision. Schwartz’ provides a more pragmatic approach that help to reduce the myriad of possible scenarios that people can easily generate, many of which will not be plausible or relevant. His approach to scenario development incorporates 8 activities (Schwartz 1991, 241):

1. Identify a focal issue for a decision
2. List key forces in the local environment
3. Determine the driving forces in the macro environment
4. Rank the key and driving forces to determine which are most important and uncertain
5. Select scenario logic whose difference is relevant to decision makers
6. Flesh out the scenarios by weaving the key and driving forces into a narrative
7. Assess the scenarios in terms of the focal issue to down select and shape robust ones
8. Identify a few leading indicators to monitor in an ongoing way
The advantage of Schwartz’ approach derives from the ability to identify several key dimensions that can exercise the plausible scenarios for the future. In this manner, the futuring process emphasizes an analysis of the principal forces, rather than the actual scenarios themselves.

For example, the nature of the design of a future naval platform may be the focal issue to address in a futuring event. After going through the 8 activities prescribed by Schwartz the three key driving forces were determined to be whether the industrial base is primarily commercial or national; operations will be conducted by humans or autonomous systems; and if the competition will be primarily military or across the national spectrum of DIMEFIL (diplomatic, information, military, economic, financial, intelligence or legal). Figure 1 provides the type of information that might fall out from the activities prescribed by Schwartz.

The cube in figure 1 portray the dimensions of the problem, not necessarily a particular scenario; however, plausible futures for a naval platform, or fleet of naval platforms, can be derived from the illustration. For example, one country could select the path of building platforms based on national infrastructure, for purely military purposes and with humans operating the systems. This approach might be termed an “Armada.” That future would exist in the top-left-font part of the cube. Similarly, another country may decide to build naval platforms to with commercial systems, for operations across the broad range of the DIMEFIL using fully autonomous unmanned systems. This approach might be termed an “Insurgency.” This future would exist bottom-right-back part of the cube. The competition that emerges from these selections may never occur, but does enable people to exercise the thought process behind the dimensions of the industrial base, geopolitics and human interaction relatively quickly and easily.
Whether Lum’s approach or Schwartz’s approach is used for step 3 dealing with the future, we can return to Lum’s step 4 for aspirations. After choosing alternative scenarios, e.g., from the cube, they can be prioritized in terms of plausibility and relevance. The scenarios that bubble to the top serve as aspirational ones for further analysis in terms of strategic planning and developing a vision to pursue. Lum notes that the greater and more positive the effect on the broader community the better the chance of inspiring people to pursue it and galvanizing support.

**Gaming the Scenarios**

A single wargame alone cannot distill plausible futures. A campaign or series of wargames can accomplish this goal. Moreover, wargames provide a venue to support all four of Lum’s steps to futuring. The initial wargame design process can incorporate lessons learned or scenarios from history, as well as from previous wargames. Similarly, the wargame design phase integrates trends and drivers. Wargames can evaluate weak signals from the present to assess potential impact or relevance from a qualitative perspective. Irrelevant weak signals can be eliminated from future discussions. The first two steps can be accommodated by focusing on the design of a single wargame; however, step 3 requires a significant level of interaction to plausible futures. A campaign or series of wargames can accomplish the futuring step in Lum’s approach. Moreover, wargames can serve a powerful role in the 4th aspirational step described by Lum.

The reason why wargames can support Lum’s 4 steps is because human interaction takes place at four levels in wargames: before the conduct of the wargame as it information is gathered and people are consulted to prepare for the design of the wargame; just prior to the wargame as people become acclimated to the game; during the game as moves and decisions are made, plausible futures are uncovered and inconceivable futures are discarded; and finally after the game as people carry forward the experience and knowledge they gained during the game(Choinski 2017, 319).

Engagement with subject matter experts and history serve as a primary mechanism for the first step in futuring, i.e., engage the past. For example, after the Washington Treaty of 1922 the Naval War College began to conduct a series of wargames with different colors depicting different nation states, e.g., blue for the U.S., red for the U.K., orange for Japan, etc. These and other historical wargames can assist in game design, as well. The world’s geography changes over very long periods. Many of the geographical locations are revisited in wargames under a different context. Sometimes the historical contexts can be very similar, as well. In fact, the Naval War College replayed similar games repeatedly after WWI and leading up to WWII. During the 1990’s the Office of Naval Research collaborated with the Naval War College to conduct a series of wargames referred to as the Technology Initiatives Games (TIG). The
scenarios and results from many of these games are readily available through the archives at the Naval War College and are relevant today.³

Wargaming serves Lum’s 2nd step for futuring by providing a reason and venue to collect information about the present. An example from the past entails CAPT Hinds lecture on the knowledge he gained about the geo-political situation in the Pacific, specifically Japan, based on the knowledge he gained while serving as acting governor of Guam from September 23, 1913 to March 28, 1914. In addition, Prof. Reginald Fessenden, Submarine Signal Company, gave a lecture to student officers at the Naval War College on submarine signal receiving (the reference to today’s sonar systems) practice (Choinski 2017, 329, 383). CAPT Tompkins also visited the Naval War College to provide students and faculty with a lecture on Submarine Signaling in Peace and War (Tompkins 1924). Subject matter experts and reference material on present drivers and trends serve to inform wargame design.

Lum’s 3rd step for developing plausible futures starts by conducting a dimensional analysis using techniques such as those articulated be Peter Schwartz. Given the identification of prioritized trends, drivers and weak signals, the actual wargames can be conducted. Peter Schwartz’s approach, resulting in the dimensional analysis depicted by the cube in figure 1, can be used to select the context and scenarios for a campaign or series of games to distill plausible futures.

Dramaturgical theory argues that people are motivated to take action based on meaningful situational interaction. Wargames can be characterized through dramaturgical theories of action. Given dramaturgical theory, games are predominantly conducted based on what is taking place (act); in a given environment or situation in which the act is taking place (scene); using people acting in defined roles (agent); with tools, technologies, technologies, instruments and/or means at their disposal (agency); and for a specified reason (purpose) (Choinski 2017, 209). The chart in Table 1 serves as a framework to generate wargame context for the campaign of wargames by taking the dimensional analysis represented in the cube in figure 1 and correlating it with the five areas of dramaturgical action.

An example of the context for one wargame in a campaign series of wargames to distill the plausible futures might look like the information in Table 2. The context is extrapolated from the convoy escort scenario from the 1924 wargame with red using current commercial technology (Choinski 2017, 301-305).

The paper does not address the process of actual detailed wargame design. Other highly experienced authors in this working group are much better suited to engage in that conversation. However, it is worth emphasizing the need for incorporating an approach for extensive data collection and analysis, preferably integrated into a final narrative form. Here

³ The author accessed the list of these wargames through Record Group 5 on November 9, 2016.
again lessons learned from history provide insight. The author of this white paper conducted research from wargames conducted from 1919-1924. Tactical Problem IX (TAC. 49 Mod 1) contained participant commentary in the final report (Naval War College 1920). This information proved to be quite valuable for any post wargame analysis. Two other wargames provide less post wargame information for review: Tactical Problem IV (Tac. 85) and Tactical Problem III (Tac. 93 Mod 1) (Naval War College 1922 & 1923). The sparse information in the report made any post wargame analysis more problematic. On the other hand, CAPT Harris Lanning provided an extensive narrative based report with observations and commentary in Tactical Problem III (Tac. 96) (Naval War College 1924). This type of data collection, analysis and narrative generation was a high mark for wargame reporting during that period. CAPT Harris’ would go on to become President of the Naval War College during his career. For this reason, wargames for futuring should include a well-developed plan for data collection, analysis and narrative generation. This plan includes subject matter experts capable of distilling the important and relevant information.

When wargames are used for futuring, the last level of human interaction may very well be the most important, especially in terms of Lum’s aspirational step 4, simply because the results from the game will only come to fruition many years in the future. People carry this knowledge and decisions forward; therefore, the people interacting must be carefully selected to reap the full benefit of the game depending on the time horizon of interest. In addition, futuring cannot be accomplished simply with one single game or scenario, rather a series of games must be designed and conducted to sort through the ambiguity and complexity that the future presents. Conducting a series of games also enable interdisciplinary groups of people to engage, increasing the chances that some of the knowledge generated from the wargame will actually stick. Conducting a campaign or series of games is not only important to distill plausible futures, but also to develop a cadre of people to carry these ideas forward in the future. Again, the Naval War College graduating class of 1924 serves as a high mark because it included notable figures such as ADM Stark, who was the Chief of Naval Operations at the beginning of WWII, and ADM Nimitz, who became a Fleet Admiral in the Pacific during WWII. All in the graduating classes of 1919, 1922, 1923 and 1924 produced 37 officers who were still on active duty during WWII; nineteen of these held flag rank by 1941 (Choiński 2017, 391-392).
<table>
<thead>
<tr>
<th>Category</th>
<th>Blue</th>
<th>Act</th>
<th>Scene</th>
<th>Agent</th>
<th>Agency</th>
<th>Purpose</th>
<th>Red</th>
<th>Act</th>
<th>Scene</th>
<th>Agent</th>
<th>Agency</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Human-Fully Autonomous</td>
<td>Human-Fully Autonomous</td>
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Table 1. Wargame Contextual Development

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<th>Category</th>
<th>Blue</th>
<th>Act</th>
<th>Scene</th>
<th>Agent</th>
<th>Agency</th>
<th>Purpose (Mission)</th>
<th>Red</th>
<th>Act</th>
<th>Scene</th>
<th>Agent</th>
<th>Agency</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Base</td>
<td>National Infrastructure</td>
<td>Defense</td>
<td>Siargao Sea</td>
<td>Military Organization</td>
<td>Battle Fleet</td>
<td>Convoy Escort</td>
<td>Commercial Acquisition</td>
<td>Disrupt</td>
<td>Siargao Sea</td>
<td>Military/Civilian Mix</td>
<td>Fleet/Squadron of UxVs</td>
<td>Mission Kill</td>
</tr>
</tbody>
</table>

Table 2. Context for Wargame #1 in the Campaign Series
Summary

Two principal actions comprise wargaming the future. First plausible futures must be identified within a framework of a campaign series of wargames. Second, people need to interact in wargames within the context of those plausible scenarios. Dr. Richard Lum identified four steps for futuring that include the past, present, futures and aspirations. Wargames can serve each of these steps through the levels of human interaction that occur during the games.

A combination of approaches from Dr. Lum’s 4 step approach and Peter Schwartz’s “Art of the Long View” was presented in this paper to conduct a dimensional analysis to identify and prioritize key drivers, trends and signals. The dimensional analysis was combined with a dramaturgical description the encompasses the act, scene, agent, agency and purpose to develop a way to generate scenarios for a campaign series of wargames. Plausible scenarios can only be generated through a campaign series of wargames; single wargames do not lead to the development of plausible futures. The data collection, analysis, and narrative generation prove to be essential parts of wargame design and execution.

Wargames serve as a stage for human interaction at four levels: before the conduct of the wargame as it is being designed; just prior to the wargame as people become acclimated to the game; during the game as moves and decisions are made; and finally after the game as people carry forward the experience and knowledge they gained during the game. When wargames are used for futuring the last level of human interaction may very well be the most important simply because the results from the game will only be seen many years in the future in terms of Lum’s aspirational step 4. People carry this knowledge forward; therefore, the people interacting must be carefully selected to reap the full benefit of the game. In addition, futuring cannot be accomplished simply with one single game or scenario, rather a series of games must be designed and conducted to sort through the ambiguity and complexity that the future presents. Conducting a series of games also enable interdisciplinary groups of people to engage, increasing the chances that some of the knowledge generated from the wargame will actually stick.

This paper discusses wargaming the future by describing futuring and an approach to generate future scenarios, as well as providing insights to factoring human interaction into the design and conduct of the wargame.

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Break the Forecasting Horizon by Values Gaming

© Stephen Downes-Martin, PhD
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Abstract

Many of our most expensive platforms and weapon systems acquisitions have service lives of about half a century, forcing us onto a high-inertia security trajectory that is transparent to our more agile adversaries who can then plan around that trajectory with cheaper systems based on our research and development expenditures. We must wargame out to service life to ensure our major systems and concepts of operations are well designed for both the near term and the far future. A 50 year forecasting horizon is beyond the credibility limit for wargaming. So Instead of attempting to create 50 year scenarios based on what technology or geopolitical changes might occur and then reactively wargaming in those future scenarios, I propose that we define the future we want to be a favorable world order consistent with our values. We then annually game from the current year out 50 years to explore what capabilities we need to ensure we maintain that world order. These desired capabilities can then be used to inform the upgrades and enhancements to our power projection and warfighting military platforms and their concepts of operation. This paper describes the process for values gaming as an approach for breaking the forecasting horizon barrier for national security objectives.

Why Wargame 50 plus years?

Some of our national security related acquisitions in response to current and near future threats are technologically advanced and hugely expensive. The first gives us a temporary and possibly short lived warfighting edge, the latter locks us into high expenses in maintenance and upgrades for many years in order to justify the initial sunk costs. They commit us to a high inertia security trajectory from which it is extraordinarily difficult to diverge for both political (jobs for building large platforms) and economic (sunk costs mistaken as investments) reasons (Seligman 2019). Our high inertia security trajectory provides our adversaries with credible information about that trajectory while giving them time to adapt with cheaper counter forces, technologies and strategies.4

4 “There appears to be a cultural disposition to double down on previous expenditures of blood and treasure rather than cut losses and walk away.” Comment by Robert Mosher on April 1, 2019. “Is this disposition cultural or a cognitive bias valid for all cultures? Is it more prevalent in democracies than dictatorships? And by culture do we mean true of our nation and political system or embedded in the various military communities to different degrees? Including the sunk cost error on one side in a wargame versus an opponent who is willing to cut losses might be an interesting game.” Response by Stephen Downes-Martin April 4, 2019.
Three good examples of this dilemma are the Navy Ford Class Aircraft Carrier Program each at $13B with a near 50 year commissioned life (CRS 2019)\(^5\), the $1.5T F-35 program with its 55 year lifespan (GAO 2017, Zazulia 2018) and the $122B Columbia SSBN program with a service life for each in excess of 40 years (CRS 2018). The three step “Big A” process of requirements, budgeting and developing and buying adds one or more decades to the lifespan (CRS 2014, page 3). Replacing major systems with modern versions adds around an additional 20 years for the “Big A” acquisition process, leading to a need to plan and wargame out 70 years.\(^6\)

Once we have paid the sunk cost of acquisition we are politically and economically committed to a half-century of costs along with power projection and warfighting methods that are now publicly available to our adversaries. We must assume our adversaries will counter our initial technology advantages by closing the gap via investment (Dyer 2016) and exploiting the commercial and academic proliferation of rapidly advancing and cheap dual use technologies (Kaspersen 2015, 2016). They will continue to counter our military power superiority by fighting against our weaknesses in the non-military domain such as information, social disruption and cyber, and possibly by reverting to a modern post cold war version of proxy wars (Byman 2018) such as in Syria (Shapiro 2014) and Russia’s use of Hybrid warfare (GAO 2010) in Ukraine.

We can and will use technology advances to upgrade the onboard capabilities of our platforms. However each platform is massively expensive and in the case of an aircraft carrier the question we face is how many can we lose in a major war before continuing the war becomes politically if not militarily impossible? Our adversaries understand this question and will be working on cheaper technologically advanced ways to kill our platforms and on ever more sophisticated methods to disrupt critical elements of our social center(s) of gravity (such as the legitimacy of our democratic elections and popular support for our democratic freedoms) in the decades ahead to exploit these kills. They have what in business and game theory is called a “second mover advantage” (Dixit 2015, pages 62 & 188-190) in which they can exploit the technologies we have paid to research and develop and plan how to respond to our high-inertia security trajectory.

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\(^5\) The most recently decommissioned US Aircraft Carrier, the USS Enterprise (CVN-65), had a service life of over 55 years. CVN-78 (USS Gerald R. Ford) has an estimated acquisition cost of approximately $13B not including the support ships, aircraft, sailors and capital costs for shipyards and construction. The daily operating cost is approximately $2.5M. Follow on acquisitions will be cheaper thus introducing a pressure to buy more.

\(^6\) “Recognizing that the large platforms will be around decades, the challenge is in changing the payloads at a rate consistent with security challenges and technological opportunities; hopefully in years. Sometimes this means changing the principal mission of the platform. I question the efficacy of gaming to drive designs for the distant future.” Comment by John Hanley May 29, 2019.

“We should be thinking out 70 years as far as mission and capabilities of the platforms, where capability of platform is instantiated by what the platform carries on-board (weapons, drones, sensors, software, etc.). Trouble is the initial investment in the platform and its initial capabilities is huge, and the platform is around for 50 years plus.” Response by Stephen Downes-Martin June 16, 2019.
Wargaming the Far Future

The rate of technology advance means the time period that our forces remain technologically dominant has shrunk to less than the lifetime of our warfighting platforms, and the same technologies place our adversaries on a level playing field with us on the both military and non-military domains. It would be foolish to believe our adversaries are not thinking decades ahead about how to exploit our high-inertia security trajectory. Having committed ourselves to a 50 year trajectory we must therefore also think ahead, plan and wargame over the entire far future trajectory of 50 years and more.

The Forecasting Horizon

Attempts to forecast or wargame the far future face three major obstacles;

1. the sheer proliferation of possible futures along with the proliferation of relevant variables with the consequence that any single future has an ever dropping likelihood the farther out one looks,\(^7\)
2. the difficulty of taking discontinuous or black swan changes and their effect on society into account (Taleb 2016), and
3. the human inability to analyse the interacting effects of even small numbers of variables and their feedback loops (Dorner 1989).

These difficulties lead to the forecasting horizon (Tetlock 2015 page 244), which for the purposes of this document I define not as “how far does the forecast claim to look” or “the time period of the forecast project”, but rather “how far the forecast can credibly look”. Futurists have developed a range of excellent tools for dealing with these problems and generating categories of future scenarios within credible forecast horizons, across which plans are made with the intention being that these plans are robust across the categories (Schwartz 1991, Tetlock 2005, Chermack 2011, Tetlock 2015, Aguilar-Millan 2019). Once this has been achieved one can then plan for these futures and wargame within them.

Unfortunately many of the organizations involved with national security have built in forecast horizons driven by bureaucratic requirements (primarily the budgetary cycle) rather than the context and objectives of the forecast and the credibility of the techniques used:

- US Government Accountability Office: “five or more years” (GAO 2018)
- US Joint Chiefs of Staff: 20 years (JCS 2016).
- US Marine Corps: 15 to 30 years (USMC 2016).
- UK MoD: 20 years (UKMOD 2015) and 32 years (UKMOD 2018)

\(^7\) John Hanley has written extensively about the challenges of dealing with the proliferation of future states, and had categorized the classes of indeterminacy in very useful ways (Hanley 1991 pp 8-19, 2017, 2019).
Commercial organizations seem to have more nuanced approaches that are project or objectives based. See for example Shell Scenarios projects ranging from 5 year to 70 year forecast horizons (Shell).

The problem of wargaming 50 years into the future is one of credibility. A 50 year forecast horizon is reasonably considered not to be a credible horizon when compared to the number of variables of interest and rate at which they change. What important social, political and technological aspects of the worlds of 1920, 1970 or 2020 would a forecaster in 1870, 1920 or 1970 miss?\(^8\) Christopher Cerf and Victor Navasky provide a compendium of appallingly predictions by experts (Cerf 1984). No doubt one could find a forecast from 1970 that predicted something that could be interpreted as referring to one or more interesting novelties in the current world, however two questions must be asked. First, was that forecast considered credible and attention paid to it at the time, and second how many other accurate long range forecasts did that forecaster make? The first question addresses whether the forecaster was in fact successful, which means being both correct and listened to, and the second question addresses whether the forecast was correct by random luck. A good review of how fast the national security environment changes by decade from 1900 to 2000 is the memo written by Linton Wells in 2001 “Thoughts for the 2001 Quadrennial Defense Review” (Wells 2001).

**Values Gaming Objectives**

The traditional view of wargaming the future is to create a future scenario and then wargame within it. This is reactive, in that the future scenario is a given. Such a game provides insights into questions around how one might act in that world and insights into the usefulness or otherwise of proposed plans, conops and acquisitions. This is ideal for exploring the near term future, but is inadequate for the far term of fifty to seventy years. In addition to credibility problem of a fifty plus year forecasting horizon such a time period introduces the certainty that our adversaries are planning to mold the world to their advantage and will have a major effect on the future world. Although we should not assume a zero sum geopolitical competition, we have to consider that such a world would not be to our advantage.

We break the forecast horizon barrier by defining the game objectives to be future we want as a world order favorable to our society’s values. We then game our way from now to that future, instead of a game set in the future the game takes us from the present to that 50 year future.

\[^8\] “There are also recognized change points – for example 9/11, the Soviet coup and collapse, 1970 hostage taking, Cuban missile crisis – transformative events that don’t fit a chronological cycle.” Comment by Robert Mosher April 1, 2019.
Values Gaming Variables

Instead of gaming with specific technologies or platforms, we take a lesson from military operational level planning and instead look at capabilities. The game and post-game analysis examines the capabilities we need, to carry out actions, which strengthen our values or disrupt our adversary values or defend against adversary actions, in support of a world order favorable to us.

<table>
<thead>
<tr>
<th>Bin</th>
<th>Some Possible Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political</td>
<td>Democratic, Legitimacy, Rule of law, ...</td>
</tr>
<tr>
<td>Military</td>
<td>Under civilian control, Volunteer, Freedom of Navigation, Homeland security, ...</td>
</tr>
<tr>
<td>Economic</td>
<td>Prosperity, Capitalist, Fiscally conservative, Free movement of capital and labor, Global trade, ...</td>
</tr>
<tr>
<td>Social</td>
<td>Liberal, Freedom of speech and movement, Privacy, Social welfare, Educated populace, Healthcare, ...</td>
</tr>
<tr>
<td>Information</td>
<td>Educated populace, Free press, Evidence based government policy making, ...</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Available for all to use, Funded maintenance, ...</td>
</tr>
</tbody>
</table>

The values are at the highest level of abstraction and are the foundation of our society. A good summary of them is given by the Preamble of the American Constitution, but similar values are held by many other societies. A rigorous analytic framework is desired that supports generation of actions and capabilities from values and incorporates allies and friends, and so I propose binning the values using the PMESII structure (Political, Military, Economic, Social, Infrastructure and Information) as a useful framework. Although often used for operational level military planning the PMESII framework is a good way of organizing (not identifying) our values and identifying their specific characteristics we need for gaming. Binning acts as a checklist to reduce the chance of missing a value. The interpretation of values allows one to place them in more than one bin, and values will overlap bins. This ambiguity provides the flexibility necessary to adapt the framework to the detailed objectives of a specific game.

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9 Robert Mosher (Mosher 2019) also makes the point that wargaming the future will have to focus on capabilities rather than platforms

10 John Hanley commented that the writings of Francis Fukuyama (https://fukuyama.stanford.edu/), specifically on the origins of political order (Fukuyama 2012, Fukuyama 2015), provide a strong foundation for this approach. As John pointed out “National cultures require long times to change, if they ever do”, which seems to imply that these cultural characteristics are ones we can wargame with into the deep future.

11 Other reasonable frameworks can be used. See Canyon 2019 for descriptions of, and references to, PEST (Political & Legal, Economic, Social & Cultural, and Technological & Scientific), STEEP and STEEPLE (including Environmental, Legal and Ethical drivers), and their use in the context of security strategies.
This table raises the question of what capabilities are needed to defend, maintain and extend our values. From a military point of view DOTMLPF provides a starting point so long as one is careful to restrict to capabilities, not specific platforms or technologies. For example, instead of trying to game a specific collection of technologies (e.g. F-35) on a specific platform (e.g. a Gerald R Ford Class Carrier) the capability might be the ability to project a specific kinetic power over a given range from a mobile base.

**Suggested Game Execution**

The first move of the game is set in the present and each subsequent move progresses further into the future ending with the last move at fifty years. The game is played each year with the previous year’s geostrategic situation used to update and refine the first move. “Red” in this game are the obvious strategic competitors with the objective of molding the world to their values and disrupting our values. Our game objectives are to extend and defend a world order favorable to us in every move, and if we fail during a move to recover that favorable world order by the last move. What the length of each move should be for a long-run game is an interesting problem. One approach is descriptive where players role-play real decision makers. In this case (McGrady 2019) suggests the length of each move should match the decision cycles of those decision makers. Another is normative, players are not role playing and the move length matches geostrategic cycles, speed of research and development cycles, or some other length of time which could be varied move to move according to how the game is playing out. Five-year moves would result in a ten move game.

**Adjudication by Values Based Systems Thinking Model**

Since the game is dealing with novel future situations at the strategic values level, the game design is clearly inductive, rather than deductive, and therefore inductive adjudication will be used (Downes-Martin 2013).

Game adjudication has to be able to handle conflicting capabilities being used to support our values. Systems thinking, the qualitative precursor of quantitative systems dynamics, in the form of a set of interacting feedback causal loops is a possible approach (Sterman 2000). A formal disciplined process for generating systems thinking models was developed by the Center for Quality of Management called “Accelerated Rational Method for Effective Decision-making (ARMED)” (Mallis 2002) for commercial projects and was adapted for use during research projects at the Center for Naval War Studies at the Naval War College.13

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12 The one-year Government budget cycle, the four year US Presidential election cycle, the five year DoD FYDP, and other possible cycles spring to mind.

13 See (Mallis 2002) for details on how to build the systems thinking models and see (Perla 2009) for details on how to use them for wargaming.
The key point is that the models are used for each move of the game to guide adjudication. The models do not necessarily change as the moves project further into the future since the values do not change and the capabilities are at the abstract level.

**Assumptions**

The argument relies on the assumption that our societal values will not rapidly change permanently or drastically. Note that we accept temporary suspensions of our values when under threat (certain political and military actions during World War 2 spring to mind) and we do not always agree on the interpretation or the implementation of our values (the Supreme Court handles some of these cases). The possibility of suspending values adds to the range of decisions available to the game players. A permanent change our values, while possible, is handled by realising that avoiding such a change is explicitly part of the game objective -- a world order favorable to our values that are in place today.

**Conclusions**

It is necessary to think fifty years into the future when investing in our power projection and fighting platforms and systems given their service life. If we define the return on this investment to be the maintenance of a world order, based on our values, favorable to our way of life, then wargaming can credibly inform strategic decision making concerning the interaction between available power projection and warfighting systems, the geo-strategic situation, and required development of further capabilities:

- The game and post-game analysis examines the capabilities we need to carry out actions which strengthen our values or disrupt our adversary values or defend against adversary actions in support of a world order favorable to us.
- Required capabilities implemented as added or changed systems carried by our long-term power projection platforms are then proposed and gamed.
- We need serious research into identifying those values and operationalizing them into a game system.
- We should annually game out fifty years with first move length set at five years and the length of subsequent moves dynamically determined by the game’s trajectory.
- This requires an organization with institutionalized processes to support such gaming.
References


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About the Author

**Dr Stephen Downes-Martin** is a Research Fellow at the US Naval War College and is an independent scholar researching decision support methods (such as wargaming) applied to problems at the strategic, operational and tactical levels of warfare and business. A research focus is on how to manipulate decision support methods in general to deceive decision makers, how decision makers misuse such methods to deceive themselves, how to detect such attempts and protect decision makers from them. He works with and for a wide variety of government, military, aerospace, academic and commercial organizations in the US and internationally. His full bio is at: https://sites.google.com/site/stephendownesmartin/.

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Coming to Grips with Indeterminacy in the Practice of “Futures”
Gaming for Strategy Formulation

© John T. Hanley, Jr. Ph.D.
Research Fellow, US Naval War College

Abstract

Gaming, as the literature demonstrates, conjures a wide spectrum of activities encompassing a wider range of purposes and uses. Here we focus on operational gaming to support strategy formulation. This form of gaming is a simulation of selected aspects of an impending or anticipated real-world contingency whose outcome is affected by multiple actors. The simulation is conducted within the context of a scenario, supporting data, a set of rules, and moves with consequences to provide information for choosing a course of action to prepare and implement initial plans, and to provide experience for adjusting actions when faced with the details of the actual contingency. The essential challenge in gaming in attempting to anticipate the future is the number of states of the world that could happen. Appreciating the kinds of indeterminacy in the underlying phenomena helps provide perspective on both the value of gaming and appropriate lessons that could and should be derived from a sound game. An exploration of various classes of indeterminacy establishes a foundation explaining why efforts at mathematical prediction quickly become intractable, and even mathematical precision provides many possible solutions for future states of the world. The future in essence is a “wicked problem.” Scenario planning, operational design, and path gaming are considered as techniques for addressing such wicked problems with time-horizons of decades. An example of an effort to explore the future security environment at the end of the Cold War is provided and evaluated for its insights and effects. A less successful example of using more traditional war gaming to explore and evaluate concepts for revolutionary naval warfare innovation decades into the future is also presented. Finally, reviewing the Department of Defense’s planning and procurement paradigms regarding the need to predict the future as opposed to adapt rapidly, and the possibility of using games to address that wicked problem, is proposed.

“It took me many moons to finally understand that long range planning takes place now and that there is a constant updating as information comes in. Furthermore, as new information comes in there is a considerable feedback between the information and the updating of the plans. Even more important, as the contingencies proliferate so fast as we go out in time there have to be methods for pruning the branches to be followed. Few long-range plans can afford the luxury of working out more than a few alternative paths. Once even the most staid of firms goes out more than a few years into the future, the planning becomes more of an exercise providing a broad definition of intentions and moral imperatives, than an exercise in operations research.” (Shubik 2001)
Introduction

Gaming conjures a wide spectrum of activities encompassing a wider range of purposes and uses. Games involve play, and may be designed for entertainment, training, teaching/professional development, research, and preparation for contingencies. Gaming applies equally well to contingencies in society, business, and war. Here we focus on gaming to support strategy formulation. This form of gaming involves a simulation of selected aspects of an impending or anticipated real-world contingency whose outcome is affected by multiple actors. The simulation is conducted within the context of a scenario, supporting data, a set of rules, and moves with consequences to provide information for choosing a course of action to prepare and implement initial plans, and to provide experience for adjusting actions when faced with the details of the actual contingency.

Using Sayre’s taxonomy, the games addressed here involve imaginary contingencies, are without troops (or the civilian equivalents), on a map or similar conceptual depiction, and involve strategic and/or tactical courses of action (Sayre 1910). The data used in them should come from field maneuvers and actual operations, of all the sides represented in the game, to the extent possible.

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14 All of these elements appear in sound gaming. Efforts to partition the uses contributes to missing opportunities to create new concepts and conduct research and analysis in training and teaching games used for professional development. If not entertaining, games for professionals should be intellectually exhilarating enough to capture the players mentally in their roles.

15 Shubik refers to games for strategy formulation as operational (Shubik 1975). The term strategy formulation is used here to reduce confusion between the strategy, operations, and tactics hierarchy and strategy as ways to accomplish ends with available means. Strategy here is used in the later sense as courses of action at strategic, operational, and tactical levels.

16 A previous version of this paper employed the term serious games. Reading and reviewing the literature, such as (Huizinga 1949, Lewin 2012, Sabin 2012, van Creveld 2013, von Hilgers 2012, etc.) provides an appreciation that just as animal cubs playing to develop skills for future survival, games for entertainment, professional development, and research can be serious; not only games employed to formulate strategy.

17 Operational games expose needs for additional information on one’s own capabilities, and for intelligence on others’ tendencies and capabilities.
Some Theory

Games solely for entertainment may be about the present, but otherwise games are about the future. One issue is how far into the future. The challenge is in the number of possible future states that could obtain. The number of possible states becomes intractable to address with any precision as one proceeds further into the future, and with even near-term complex issues for which well-founded theories and laws have yet to be established. Formalizing terminology will help clarify the following discussion.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>a world</td>
<td>the object [system, contingency, etc.] about which a person is concerned</td>
</tr>
<tr>
<td>a state of the world</td>
<td>a description of the world, leaving no relevant aspect undefined</td>
</tr>
<tr>
<td>the true state</td>
<td>the state that does in fact obtain; i.e. the true description of the world</td>
</tr>
</tbody>
</table>

The world of interest depends upon the matter under consideration; the objective of the inquiry. Describing the state of the world requires an appreciation of the aspects that are
relevant to deciding upon a course of action.\textsuperscript{18} The level of precision in describing future states affects their number; e.g. when forecasting weather (temperature, probability of precipitation, and wind speed) rather than the climate being colder, warmer, or the same. Deciding some courses of action may depend upon forecasting the weather, where others may depend only upon climate change. Scenarios and supporting documents provide the relevant information setting the initial state for a game, and adjudication updates the state of the world based upon the actions of the players, the rules for adjudication, and the judgment of the umpires or control team.

Describing a state of the world involves mapping a substantive problem into a conceptual model that includes selected relevant aspects and the relationships between them.\textsuperscript{19} Conceptual models may be explicit representations of the system under study, such as descriptions and figures found in military doctrine or textbooks, but also incorporate implicit assumptions, understandings, and analytical paradigms of those creating the models.

Classes of Indeterminacy for Mathematical Techniques

Mathematic and related logical representations of phenomena are often used for prediction and optimization. The ability to predict the future, and the time over which that prediction remains accurate, depends upon the classes of indeterminacy inherent in the phenomena under study.

Decision makers select courses of action to accomplish some set of objectives within an available response time during which the objectives can be accomplished with the means at hand.\textsuperscript{20} The character of the indeterminacies inherent in the phenomena under study affects the ability to anticipate or predict the true state of the future world. If we know enough to represent the state of the world as an exact point in some state space\textsuperscript{21}, and can map the trajectory of the changing state of the world over time exactly for each decision alternative, the decision situation is deterministic.\textsuperscript{22} Using Newtonian physics, one can predict with great accuracy the motions of masses—i.e. the state transitions. Even though three or more masses

\textsuperscript{18} In military doctrine Commander’s Critical Information Requirements and Priority Intelligence Requirements are intended to capture relevant aspects of the world of interest.

\textsuperscript{19} Creating this ontology requires judgement of experts in the subject under study.

\textsuperscript{20} Even in formal terminology, e.g. (Chairman of the U.S. Joint Chiefs of Staff 2013), uses strategy both in the context of a hierarchy of strategy, operations, and tactics, and as ways for accomplishing desired ends with available means. The phrase course of action substitutes for the term strategy in the later sense.

\textsuperscript{21} Each relevant aspect represents a dimension of the state space, which results in high-dimensional state spaces for situations where many aspects are relevant to the decision maker. Deep understanding of the essence of the phenomena under study contributes to parsimony in identifying relevant aspects, making analysis more tractable.

\textsuperscript{22} Such state spaces underly the mathematical programming technique of Dynamic Programming (Denardo 1982).
with strong enough gravitational attraction behave chaotically, their motions can be predicted accurately over time frames needed for space flight using current capabilities. However, most phenomena of interest for the future rarely involve such deterministic behavior.

Now consider statistical indeterminacy. Here the initial state is set of a random variables, with one variable for each relevant aspect of the world. We do not know the world’s true initial state exactly, but we do know the probability distributions of the relevant variables, which may be described by their sufficient statistics. Monte Carlo simulations draw from this probability distribution to predict a distribution of future states. For any action taken, if the process is not chaotic, a small change in the initial state will result in a small change in the state at some future time. Either way, sufficient statistics for the initial distributions of states allows calculation of future the states conditioned upon the initial state. Regression analysis is a common technique used for forecasting, and is useful if the structure of the system is well understood and does not change.

Alternatively, we could know the initial state of the world exactly, but encounter stochastic indeterminacy in the system. In this case, many similar systems starting in the same state have the same proportion transition to a given later state at a given time. The system of states and their transition probabilities at each time constitute a stochastic process. Markov simulations were created to address stochastic processes. Obtaining data for the probabilities and times of transitions to future possible states, and requirements that the systems be stable in the sense that these values do not change, present challenges in using such techniques. However, if these conditions can be met, the system is stochastically determined. Since transition probabilities and times are prespecified, Markov simulations do not adapt from learning.

Strategic indeterminacy is created when more than one decision maker affects the outcome of the phenomena under study. In addition to the evolution of chess leading to militaries adopting war games involving more sophisticated representations of terrain and troops, chess and other two-player games also inspired efforts to determine mathematically the existence of a strategies that could not be defeated (Leonard 2010, Chapter 1). The mathematician John von Neumann initially published his minimax theorem in 1928 (von Neumann 1928) proving that an optimal strategy, or saddle point, existed in two-person, zero-sum games. Motivated by political turmoil in Europe in the 1930s, along with economist Oskar

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23 Sufficient statistics, such as a class of probability distributions (e.g. normal) with its sufficient parameters (e.g. mean and standard deviation), provide shorthand for describing a distribution with no loss of information. Note that power laws (associated with fractal characteristics) have a mean, but no standard deviation. By definition, a relatively simple equation specifies the distribution. Events that have low probability but high consequence are sometimes referred to as Black Swans, particularly when associated with power laws.

24 In zero-sum games the payoffs to all players add up to zero. However, in games with more than two players opportunities for collaboration exist.
Morgenstern, he went on to explore cooperative games with more than two players involving coalitions, publishing The Theory of Games and Economic Behavior in 1944 (von Neumann & Morgenstern 1944). Though the solution to strategic indeterminacy in two-person, zero-sum games is a point, solutions for more than two people and non-zero-sum games involve sets of solutions. The concept of a saddle point in zero-sum games was then extended to concepts of equilibrium in non-zero-sum games, which most often are sets. Just as solutions involving statistical and stochastic indeterminacy involve sets of points, solutions to all but a special form of game also involve sets of potential solutions.

When using mathematical techniques, the character of indeterminacies inherent in the phenomena under study suggest what techniques are most appropriate to use when conducting an inquiry. Table 1 highlights characteristics of phenomena under study for selecting an appropriate technique depending on the indeterminacy involved, and highlights techniques developed for that class of indeterminacy. Though employing a technique requiring more knowledge than is available can be very helpful in thinking through an issue and clarifying what is not known, any results from such an effort require caveats on how to interpret them.

**Table 1: Classes of Indeterminacy involving Mathematics**

<table>
<thead>
<tr>
<th>Character of the Subject</th>
<th>Deterministic</th>
<th>Statistical Indeterminacy</th>
<th>Stochastic Indeterminacy</th>
<th>Strategic Indeterminacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. State space clearly defined</td>
<td>1. State space clearly defined</td>
<td>1. State space clearly defined</td>
<td>1. Conflicting interests</td>
<td></td>
</tr>
<tr>
<td>2. Persistent data</td>
<td>2. Persistent data</td>
<td>2. Persistent data</td>
<td>2. Players specified</td>
<td></td>
</tr>
<tr>
<td>4. Relationships determined</td>
<td>4. Probability distributions or statistics are known</td>
<td>4. Relationships determined</td>
<td>4. Information conditions well specified</td>
<td></td>
</tr>
<tr>
<td>5. Initial state known</td>
<td></td>
<td></td>
<td>5. Probability distributions for “moves of nature” specified</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6. Players consistent and logical (rational)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Techniques</th>
<th>Deterministic</th>
<th>Statistical Indeterminacy</th>
<th>Stochastic Indeterminacy</th>
<th>Strategic Indeterminacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematic Analysis and Programming</td>
<td>Regression, Analysis of Variance</td>
<td>Stochastic Processes: Markov, Monte Carlo</td>
<td>Game Theory</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution Characteristics</th>
<th>Deterministic</th>
<th>Statistical Indeterminacy</th>
<th>Stochastic Indeterminacy</th>
<th>Strategic Indeterminacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique solution</td>
<td>Unique distribution</td>
<td>Unique distribution</td>
<td>Saddle point for two-player, zero-sum; otherwise sets of solutions</td>
<td></td>
</tr>
</tbody>
</table>
Quantitative analyses bear close scrutiny. Standards for computational reproducibility and replicability of analyses are rarely met, computer models may not adequately consider indeterminacies, and decision makers frequently are not aware of the assumptions and uncertainties inherent in a study’s results. Efforts to make analyses tractable tend to disguise uncertainties in all but simple mathematical models.

Only deterministic phenomena and two-person, zero-sum games have point solutions. Otherwise analytical results provide sets of solutions. During World War II, Operations Research Groups and the Manhattan Project came to recognize that an estimate of the range of outcomes of a process involving multiple random variables is the error (e.g. standard deviation) of a typical variable times the square-root of the number of variables (Koopman 1970). As figure 2 demonstrates, attempts to be more realistic by adding more variables to a simulation results in adding to the volume of uncertainty. Increasing the number of variables offsets the law of large numbers. Simple models that capture essential aspects of the phenomenon under study are much preferable to models that attempt to replicate reality by linking large

![Figure 2: Total Uncertainty as a function of number of variables.](image)

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26 Even when the phenomenon admits a point solution, unless the analyst is the decision maker, the analyst should present the analysis to the decision maker, but not attempt to provide “the answer.” (Kent 1967 p. 50)

27 The figure uses an order of magnitude of ten percent error in each variable, which is exceedingly generous considering errors typical in combat models for own much less enemy performance, and 1/n as the increase in accuracy by adding more detail by adding variables to the model.

28 Volume of uncertainty refers to the n-dimensional space represented by each variable creating another dimension.

**Complex Adaptive Systems**

Game Theory was an early attempt to develop well-founded techniques for addressing sequences of decisions that alter social and economic behavior. With the advent of computers, social network and influence models attempted to provide insight into systems involving multiple nodes affecting each other. Combat simulation similarly contain network-like models of nodes and edges representing engagements (Koopman 1970).

Understanding network structure has been very useful in understanding a variety of phenomena from immunology to social behavior (Barabasi 2002). Social network models using mathematical programming techniques for networks have proven very useful in understanding relationships between individuals, as demonstrated by their use in countering terrorism and current Chinese efforts to establish social reliability indices for individuals. Since most individuals have routines, such models have been exploited successfully by advertisers and political analysts to predict individual preferences. Though the ‘big’ data used in the models is updated as individuals’ conduct new transactions, more than new data is required to model the interactions as a complex adaptive system to anticipate emerging behavior.

Social influence models have been developed to address how different actors in a system influence each other. Checking solutions of such models cannot be checked in a polynomial-bounded number of computational steps [nondeterministic, polynomial-time (NP) complete], meaning that the time to compute the problem increases with the number of nodes and states of each node to the point that computing the states of the world is impractical or impossible if feedback loops are allowed. Whenever problems become too complex to guarantee the best possible solution using exact methods, heuristics (rules of thumb) and analogies serve to provide practical methods for finding a solution that satisfies immediate goals.

Using the philosophy that “all is computation,” another approach when computing the states of a system using mathematics is computationally infeasible is to use cellular automata using more general types of rules embodied in relatively simple computer programs (Wolfram 2002). Wolfram suggests approaches for addressing NP-complete problems (Wolfram 2002 pp. 1142-1147). Even simple rules can lead to orderly, chaotic, or complex systems behavior, including self-organization.

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29 (Barabási 2010) refers to individuals who follow routines as having low information entropy. People with high information entropy come under suspicion for erratic behavior.

30 The Situational Influence Assessment Model is an example.

31 (Simon 1997) introduced the notion that decision makers satisfice rather than optimize in his 1947 dissertation.
Beginning with Edward Lorenz’s systems dynamics model for weather, physicists began to appreciate deterministic chaos from sensitivity to initial conditions, originally identified by Henri Poincaré in his work on the three-body problem in 1887 (Stewart 2002). Lanchester and Salvo equations represent such nonlinear systems dynamics models. The work of Benoit Mandelbrot on identifying phenomena best modeled by power laws and fractals rather than Gaussian probability distributions and continuous functions similarly presents challenges for models used in finance on the behavior of the stock market (Taleb 2007). Given the relatively recent appreciation of chaos, whether combat phenomena are Gaussian in nature and can be represented by an expected value and standard deviation or are better represented by power laws whose standard deviation is infinite is a topic worth studying.

Agent-based models of combat, where agents act on local information according to a specified set of rules, have demonstrated some interesting emergent behavior not produced by systems dynamics models (Ilachinski 1996). Cellular automata can also be used to explore basic behavioral properties of simple local rule-based combat models. The major challenge for these models is the degree to which the rules in the model replicate the rules that actual agents use. Models with simple rules have mimicked the behavior of flocks of birds and traffic flows and jams. When one programs the rules into the system, like a swarm, one can be assured that the simulated behavior of the system will be its actual behavior.

Genetic algorithms also suggest evolution of designs better fit to the environment in which the object exists (Mitchell 1996, Holland 1965, Kauffman 1993). Here a major challenge is in specifying the values that constitute greater fitness for the environment. One feature of evolution is the tendency to converge in a stable environment. Systems that evolved to be highly optimized for one environment, such as the Cold War, may be totally unsuited for environmental change that exceeds the rate of evolution, as we are witnessing with the extinction of species resulting from rapid climate change.

Like previous models not allowing for adaptation or chaos, these newer techniques are useful for providing insights and are of greater use the more closely they represent the phenomena under study. Table 2 summarizes techniques and their characteristics. The table includes second-order modeling that would allow rules and fitness values to evolve to study what types of behavior emerge. The practice of employing complex adaptive system models of emergent behavior to make policy-relevant predictions is not yet wide-spread, but has produced some important results.32

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32 See https://necsi.edu/research for some examples.
Table 2: Chaos and Complexity techniques and characteristics.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deterministic Chaos</td>
<td>Non-linear dynamic systems, fractals, power-laws.</td>
</tr>
<tr>
<td>Cellular Automata</td>
<td>Experimental computation to observe the effects of simple rules.</td>
</tr>
<tr>
<td>Agent Based Models (ABM)</td>
<td>Emergent behavior by agents acting on rule sets.</td>
</tr>
<tr>
<td>Genetic Algorithms (GA)</td>
<td>Emergent behavior (evolution) based upon enhancing fitness for the environment. Requires specification of fitness value.</td>
</tr>
<tr>
<td>Second-order ABM/GA</td>
<td>Emergent behavior resulting from evolving rules and fitness values.</td>
</tr>
</tbody>
</table>

Adding neural networks – using an analogy to the brain – that learn by changing the strength of relationships between each node based upon a correspondence of the network to the true state was one of the early techniques used to create artificial intelligence (AI). The field of AI now uses variations of many of the mathematical techniques mentioned above. Since humans typically have low personal information entropy (Barabási 2010) – i.e. they behave in predictable patterns – AI has been successful in anticipating people’s interests, tastes, and beliefs. Though AI programs have defeated humans in games like chess and go, it has had much less success in dealing with less structured competition. Current approaches to AI depend heavily upon matching patterns. Whether AI can out-perform human decision as rules and values evolve leading to the emergence of new behaviors is highly questionable, though it will extend human cognitive capacities. Gaming will continue to both stimulate the development of new rules that provide advantages to a player, and to be useful for understanding the rules and implicit assumptions that bound choice inherent in the game.

Structural Indeterminacy

Thus far the discussion points to the difficulty of using mathematical techniques when conducting inquiry into the future. These techniques are powerful for studying stable phenomena whose structure is well understood, but much less so for phenomena influenced by human interests, tastes, and beliefs; or systems whose structure or statistics change over time.

Structural indeterminacy encompasses the unknown. It includes issues lacking an established ontology of how to bound the problem, what elements to include, and unknown relationships and data needed to perform mathematical calculations – in any discipline. It applies particularly to wicked problems. Characteristics of wicked problems include:

➢ A tangle of conditions with no definitive way to formulate: different perspectives with no objective truth
Cannot understand without proposing a solution

Rarely can be solved conclusively [decisively]

Have better or worse solutions, not right or wrong ones

Any solution will generate repercussions, possibly creating new problems

Every solution is a one-shot operation, changing the problem

Solutions have to be created, not chosen, and may not be apparent

Every wicked problem is a symptom of another problem

Are interactively complex, highly sensitive to inputs, concatenations of causes and effects: a single cause may have multiple effects, while a single effect can be the result of multiple causes (Rittel & Webber 1973)

In conducting a review of 40 years of wicked problem literature, Brian Head notes how “the policy studies literature … is providing important frameworks and insights concerning the theory and practice of policy design, policy deliberation, policy reform, effective implementation, policy evaluation, policy legitimation and the determinants of policy success and failure” (Head 2018). He suggests strengthening the analysis of wicked problems by drawing upon relevant public policy literature on problem framing, design, capacity, and implementation. This formulation provides a framework for addressing wicked problems.

**Problem Framing and Policy Design**

Framing involves “unpacking” the way in which problems are understood, including identifying key decision makers and stakeholders. Head provides a summary of literature on framing, including scenario planning. Operational design is also a useful technique for framing a wicked problem for further exploration.

“Scenarios are not concerned with getting the future “right”, rather they aim at challenging current paradigms of thinking and broadcast a series of stories in which attention is directed to aspects that would otherwise have been overlooked” (Chermak, Lynham & Ruona 2001). Hermann Kahn pioneered a technique that he called “future – now” thinking and coined the term scenarios while working at RAND in Santa Monica, California. His approach was to combine detailed analysis with imagination, producing reports as if written by people in the future to allow people to think about the “unthinkable,” such as the consequences of nuclear war. Kahn advocated his approach with industry and Royal Dutch/Shell adopted the technique. Shell credits its scenario planning with helping in anticipate dramatic changes in energy markets, beginning with the Yom Kippur war in 1973. Pierre Wack, who developed scenario
planning for Shell, found reliance on forecasts\textsuperscript{33} dangerous because, though often accurate, they were wrong when it hurts the most (Wack 1985). His approach was to develop an expected future along with two others, developed from enduring and conflicting trends, that would challenge existing policies. Considering wild-card events helps clarify assumptions about events that are excluded from consideration in planning. Shell Central Planning does no central planning, but uses the scenarios in planning exercises with the executives in each of its major production, refinement, transportation, and sales operations as a common framework for creating their strategies and plans. Wack’s successor Peter Schwartz went on to write a book on the practice (Schwartz 1991) and establish Global Business Network, Inc. employing scenario planning. Several other companies make a business of scenario planning.

Scenario planning has the reputation of requiring extensive time and large financial resources, long and short-term impacts not being fully understood, and having weak theoretical roots. The absence of strong theoretical roots “has led to something of a ‘club members only’ philosophy among practitioners (Chermak, Lynham & Ruona 2001). In these ways, the reputation of scenario planning resembles the reputation of gaming.

Along with framing, the concept of policy design emphasizes the creativity, innovation and learning dimensions of the search for policy alternatives. Noting that complex military operations present wicked problems, John Schmitt, a U.S. Marine Corps reserve officer and academic, proposed a systematic concept for operational design as a prelude to detailed planning for military operations (Schmitt 2006).\textsuperscript{34} “Design can be thought of as problem setting—locating, identifying and formulating the problem, its underlying causes, structure and operative dynamics—in such a way that an approach to solving the problem emerges.” A complex network involving a large number of diverse stakeholders is a feature of such problems. The “individuals come from different organizations—each with its own charter, function, objectives and chain of authority. As a result, stakeholders will bring differing perspectives and agendas to the problem-solving process.” Human problem-solving involves individuals intuitively jumping back and forth between conceiving the problem and thinking of possible solutions. Group problem-solving requires close communication as different members of the group are at different stages in conceiving solutions. Therefore, problem-solving is fundamentally a social process. Schmitt recommends that the design process “should be compatible with natural cognitive and communication processes so that the methods they adopt are not at odds with natural human behaviors.” Games provide such a venue.

\textsuperscript{33} Typically using regression analysis.

\textsuperscript{34} Joint doctrine had called for operational design as part of the planning process. Schmitt helped improve techniques employed in current doctrine (Joint Staff 2017).
The process involves abductive reasoning—inferring best explanations from limited facts—to create a logic system that establishes a context for planning and execution. Schmitt’s process calls for designers to develop a counter-logic that would defeat the sequence of interactions envisioned to produce the desired state to understand the resilience of their scheme. The opposition in a game performs this function. To implement the design, Schmitt goes on to address:

➢ Conversational discourse, the basic mechanism by which the design team designs
➢ The design process, the general pattern of cognitive activities that occur during design
➢ The composition of the design team
➢ Systems thinking, the mental discipline the design team follows
➢ Model making, the central activity of systems thinking
➢ Intuitive decision making activated by conscious reasoning that builds the necessary insight
➢ Continuous assessment, by which the design team tests its conceptual models
➢ Structured learning, which describes the essential outcome of the design process

He suggests that the design team should consist of a relatively small group of key stakeholders with a compelling interest in the outcome of the situation, including the senior decision maker responsible for implementing the resulting plan to ensure that his conception of the problem is addressed and that the framework meets the “commander’s intent”. Schmitt concludes:

“To the extent that we face socially complex, wicked problems, we should design before we plan and execute. Design is essentially the process of rationally formulating the problem to be solved out of the mess that confronts us, and doing it in such a way that the logic for solving the problem emerges intuitively. We design by holding a conversational discourse among stakeholders during which an image of the problem and the solution emerges gradually through the collective intelligence of the group subjected to critical argument. During operational design, we think systemically—we imagine the problem as a system driven primarily by its own purpose, structure and processes, but also influenced by the broader environment within which it exists. We do this by developing, testing and modifying conceptual models hypothesized to explain the workings of the system in its environment. Because we cannot observe the physical causality that underlies the situation, we test our hypothesis heuristically through action. We observe the results of our action to see if they conform to the expectations of our
design, and we redesign accordingly. In this way, design provides the basis for assessment and for adapting our operations to the situation through learning.”

Schmitt’s operational design closely aligns with the elements needed to design rigorous and objective operational games, and conduct a cycle of research. Schmitt’s illustration of the design process employs influence models of the type discussed above that defy calculation, but clarify thinking about the elements driving the system and the relationships between them.

**Policy Capacity and Implementation**

Policy capacity includes not only competence in policy design advice but also competences in the implementation, coordination and evaluation of ongoing programs. Building on others’ work, Head emphasizes that:

“the collective or ‘social’ nature of working with wicked problems and adaptation strategies requires a ‘holistic and process-oriented approach’ that is ‘adaptive, participatory and transdisciplinary’. Working through an ‘open and heuristic process of collective learning, exploration and experimentation’, such an approach promises to be ‘efficacious in fostering collaborative behavior, reducing conflicts, building trust among all stakeholders and communities involved and ultimately producing better and more satisfying results.”

**Gaming as a Partial Technique for Addressing Wicked Problems**

Developing policies and strategies for wicked problems calls for mastering complexity, enhancing communication, stimulating creativity, and building consensus that leads to a commitment to action. Gaming is a powerful method for simultaneously doing each of these (Duke & Guertz 2004), but requires action to provide additional evidence and feedback to continually refine courses of action based upon new learning and evolving circumstances.

**Mastering Complexity**

Formulating models of the phenomena under study involves imagining a depiction of factors and elements believed to be relevant and the relations between them. Where the model involves a process with little or no feedback, and one cause produces a deterministic effect (including those that are statistically, stochastically, or strategically determined), isolating individual causes and effects and stringing them through the flow of the process allows one to calculate a normative prediction of the behavior of the system.

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35 This model may involve language and Boolean logic, mathematical symbols tied to the elements of the phenomena, or objects, as in object-oriented programming. The choice of “language” usually depends upon the skills and norms of the discipline that the analyst is using.
When interactions are complex, behavior is highly sensitive to context, and a single effect can be the result of multiple causes, though reductionist analysis is needed to address the constituent parts, it is inadequate for predicting the behavior of the overall system.

Well-designed games begin with the study of history and historical thought regarding the phenomena under study to inform the elements and interactions to incorporate into the game design. Game design and adjudication involve conjectures regarding factors having the greatest effects. Having subject matter experts from different disciplines along with decision makers involved in the game helps ensure that it includes a sufficient set of relevant factors. Both the game design and play contribute to framing the contingency accurately.

“... games are intensely stimulating, ideas and conjectures get tossed around and analyzed by a highly motivated group of people; a great deal of expertise is collected in a single room, expertise that is not often collected together; and people discover facts, ideas, possibilities, capabilities, and arguments that do not in any way depend on the game but nevertheless emerge from it. ... Players discover important facts that may never have occurred to them or are counter to what they understood (e.g. unprecedented acts excite attention, jurisdictional seams and overlaps), and ways that players not represented in their usual thinking affect the feasibility and acceptability of possible courses of action.” (Levine, Schelling & Jones 1991 pp. 23-24)

Games lift the participants up from the perspective of their daily endeavors to see a bigger picture and present interactions more clearly. As McCarty Little (the founder of gaming at the Naval War College in the late 19th century) observed:

A walk on the deck gives no idea where the ship is, but a glance at the chart in the cabin does. In like manner it is on the chart that the admiral plans and conducts his cruise. Even on the tactical field with the enemy in sight, the picture on the retina is a distorted representation, which in the mind must be reduced to a proper diagram...Even the actual witness to a battle does not have a clear idea of what has taken place until it has been reduced to a diagram. (Little 1912 p. 1219)

Enhancing Communication

Language uses a set of symbols that expresses ideas and allows people to think and communicate with each other. It can be verbal or non-verbal. Examples of language extend beyond written versions of verbal languages to include mathematical symbols and computer languages, and to maps and pieces used in gaming; which are more precise than spoken language. Gaming for strategy formulation employs natural discourse and social interaction enhanced by tangible symbols; underlying mathematical and computer languages in the background. used for adjudication are often beyond the ken of most game participants.
Bradley Fiske (a Naval War College graduate and Rear Admiral during World War I) identified the value of gaming for enhancing communication by providing a common context for communication among those within and beyond the borders of an organization.

“When the game board is not used people conferring on naval problems can do so only by forming pictures in their own minds, endeavoring to describe those pictures to others (in which endeavor they rarely perfectly succeed) while at the same time trying to see the pictures that are in the minds of others – and then comparing all the pictures. The difficulty of doing this is shown in a little paragraph in “The Autocrat at the Breakfast Table,” in which Dr. Holmes points out that when John and Thomas are talking there are really six persons present – the real John, the person John thinks himself to be, the person Thomas thinks him to be, the real Thomas, the person Thomas thinks himself to be, and the person John thinks him to be. The conditions surrounding John and Thomas are of the simplest kind, and he conversation between them of the most uncomplicated character. But when – not two people but – say a dozen or more, are considering highly complicated questions, such as the House Naval Committee discuss when officers are called to testify before them, no two of the twenty congressmen can form the same mental picture when an officer uses the word – say “fleet.” The reason is that very few of the congressmen hearing that word have ever seen a fleet; none know exactly what it is, and everyone forms a picture which is partly the result of all his previous education and experience; which is different... “(Fiske 1918 pp. 201-202)

He goes on to say:

No man ever lived who could describe a complicated machine accurately to a listener, unless that machine differed but little from a machine with which the listener was acquainted. But hand a drawing of even a complicated machine to a man who knows its language – and the whole nature of the object is laid bare to him ... So, when the forces representing a complicated naval situation are placed upon the game-board, all of the elements of the problem appear clearly and correctly to each person; the imagination has little work to do, and the chance for misunderstanding is almost negligible. (Fiske 1918 pp. 206-207)

Stimulating Creativity

In the free and safe activity of play, individuals can go beyond the limiting forces of everyday life (Huizinga 1949). Again, discussing naval gaming, Little stated:

“The game offers the player the whole world as a theater, and puts no limit to the forces, either in numbers or kinds. Any time of ship may be had for the asking, the only requirement being to state its qualities so they may be expressed in a game
convention. The ships can do what in time of peace is impractical to the real ships – for example they can ram him or destroy him with gunfire; they can run all sorts of risks, nay, they can be destroyed to prove the inefficacy of a poor plan, and in a twinkling they can be restored for a new trial. And all of these things are at the disposal of any group of officers gratis.” (Little 1912 p. 1219)

As in mastering complexity, competition fosters creativity when preconceived notions of what will accomplish objectives fall short.

Operational games also expose previously unrecognized logic hidden in the contingency.

“If I draw a face with a hidden picture there is no way for me to tell how hard it is to see the face except to show the picture to somebody.” ... “It is this peculiar element of collaboration, communication, and bargaining, that is involved in any crisis game, that cannot be captured by “straightforward” unilateral analysis.” (Levine, Schelling & Jones 1991 p. 32)

Building Consensus that Leads to a Commitment to Action

Operational games put people in roles upholding certain interests and positions and distribute resources as in real life. The fact of planning for a contingency anticipates that the day-to-day rules for existing interactions could change in threatening ways, and open new opportunities. These challenges and opportunities require a new consensus about how an organization is to proceed.

The shared gestalt communication and experience in exploring the feasibility of objectives and suitability, feasibility, and acceptability of courses of action that enhance the chances of accomplishing objectives provides a foundation for consensus on a way ahead. It also aligns the myriad of organizations required for a successful strategy.

People sensitive to a variety of responsibilities collaborate, applying the criteria that are relevant to their own interests, making estimate that reflect their own kinds of knowledge, and putting themselves in a mood to worry about probabilities rather than just a list of possibilities. They really live through a simulated crisis and not only learn things about their plans and their prediction but learn something about the nature of crisis. (Levine, Schelling & Jones 1991 p. 27)

When seeking consensus while using traditional perspectives, there is a danger that only easy-to-implement strategies consistent with extant policies will be discussed. The competitive aspect of gaming mitigates against this form of “group think” in reaching a consensus (Duke & Guertz 2004 p. 31).
“Now the great secret of its [the games] power lies in the existence of the enemy, a live vigorous enemy in the next room waiting feverishly to take advantage of any of our mistakes, every ready to puncture any visionary scheme, to haul us down to earth, ...” (Little 1912 p. 1230)

Those with differing objectives or approaches for achieving those objectives will provide evidence for whether the conjectures in the design and adjudication are correct and highlight factors not included in the design or adjudication that provide them an advantage. Competition in gaming also helps to ensure that the complexity of the contingency under study is fully explored and depicted in the process of reaching a consensus.

Ideally, the game should involve those who make decisions on the commitment of resources and courses of action. If not, it should involve deputized representatives who can commit to actions based upon the findings from a game.

**Continuing Assessment**

The game is only a partial technique for dealing with wicked problems (Levine, Schelling & Jones 1991 p. 22). Just as one cannot infer too much about the game of baseball from watching teams play once, the inferences taken from an operational game require further study – a cycle of research (Perla 1990 pp. 287-288). As Schmitt stated above, we test our conjectures heuristically through action, and redesign according to how well additional evidence aligns with our expectations. The most successful gaming efforts in the years between World Wars I and II by the German Army and U.S. Navy, and by the U.S. Navy in implementing concepts for the 1980s Maritime Strategy (Hanley 2014), involved taking concepts developed for and examined in games into field and fleet exercises, and using these exercises both to evaluate the feasibility, suitability, and acceptability of the concepts, and to collect data needed for follow-on gaming and analysis.

**Path Gaming and Seminars to Explore the Future**

The Chief of Naval Operations’ Strategic Studies Group provided examples of scenario planning and futures gaming that demonstrated both the value of limitations of such endeavors. Admiral Frank B. Kelso II became Chief of Naval Operations in 1990 facing demands for a peace dividend and, shortly after, for preparations for operations DESERT SHIELD and DESERT STORM. Recognizing that the decisions that he was making would affect the Navy for 30-50 years and needing a better justification for the Navy, he tasked his Strategic Studies Group (SSG) over the next two years to study trends driving the future security environment and its implications for the Navy and Marine Corps.

Noting that new technology took about 20 years to incorporate into major platforms, the SSG negotiated that time frame with the CNO. The SSG also noted that the energy industry, like
the Navy made multi-billion-dollar investments intended to last about 40 years. Therefore, the SSG studied techniques that major companies in the industry used in their strategic planning and adopted Shell’s scenario planning approach. Over two years SSG X and XI\(^{36}\) studied future trends and their implications for the security environment, national security, the Defense Department, and the Navy.

These studies involved extensive interactions with thought leaders in government, academia, and industry in the U.S., Europe, and Asia to frame issues driving the future security environment. Trends that the SSG found influential in 1991 included:

- Globalization of commercial enterprises and finance.
- Demographic pressures resulting from the world population increasing by over 2 billion people in 2010 from a bit over 5 billion in 1990 with 93 percent of the growth coming from developing nations. This growth would result in youth bulges\(^{37}\) in the Middle East, Central and South Asia, Africa, and Central America leading to severe migration pressures and civil strife. All the while developing nations would face significant increases in their populations aged over 65.
- A widening have/have-not gap with the rich getting richer and the poor getting more people.
- An explosion in information technology and global communication with political, economic, and cultural impacts creating more opportunities and challenges, and reducing the response time for formulating and implementing public policies.
- Regions of chronic tension, exacerbated by the above trends, becoming more unstable as nations seeking to redress grievances became free of Cold War constraints.
- Continued oil dependency and competition over resources.
- Environmental degradation affecting water, clean air, and unpolluted habitable spaces. Atmospheric “greenhouse” warming presenting “monumental uncertainty,” in conjunction with loss of biodiversity requiring unprecedented international cooperation to address.

\(^{36}\) The CNO Strategic Groups were comprised of typically six Navy officers selected for their potential to advance to three and four-star rank selected by the CNO. The Marines assigned two or three officers, and the Coast Guard Commandant selected one officer to serve with the group following the downfall of the Soviet Union as peacekeeping and transnational operations became prevalent. Each group served for a year, working on subjects tasked by the CNO. SSG X and XI were the tenth and eleventh groups. About 50 percent of the Navy officers were selected to Flag rank, about 20 percent of the SSG alumni advanced to three-stars, and 10 percent advanced to four-star rank, resulting in half of the Navy four-star officers in 2000 being SSG alumni, in addition to one Marine four-star.

\(^{37}\) A youth bulge is when over 20 percent of the population is 15-24 years old.
➢ Questioning whether the U.S. educational system would allow the U.S. to retain the extent of the technological lead that it had since World War II.

➢ A trend toward reduced ideology and increasing democratization, with significant eddies and counterflows resulting from religious and ethnic differences in societies with disenfranchised segments of the population.

➢ Arms proliferation decreasing in high-end platforms while increasing in missiles and less expensive weapon systems. The ability of small groups and individuals empowered by information technology, and globalized commerce and transportation to acquire weapons that could cause levels of mass destruction formerly restricted to major powers.

➢ Decreasing force structures and numbers of people under arms in developed states as major weapons platform and manpower costs increased.

The group also provided a short list of wild-cards to hedge against while conducting planning. These included:

➢ a global depression;

➢ use of nuclear weapons;

➢ catastrophic terrorism damaging U.S. democratic institutions, assassination of national leaders, large-scale loss of civilian life, or undermining the global economic structure;

➢ global warming or a major environmental disaster;

➢ pandemic; or

➢ an inexpensive alternative energy source that would fundamentally and rapidly change social and security interests. (Chief of Naval Operations’ Strategic Studies Group 1991)

The group considered an asteroid striking earth as another wild-card, but did not include it in the report. The group used these trends in path games to explore the interests and likely policies of major actors and implications for U.S. strategic vision, national security, defense resources, naval warfighting, and organizational issues. Like Shell, they then conducted scenario exercises to promote a common vision leading to consensus on policies and strategies to action.

Path Games

In the late 1980s, Mr. Andrew Marshall, Director of Net Assessment in the Office of the Secretary of Defense, sponsored “path games” exploring implications of the future rise of China. Charles Wolf, a leading economist at RAND, had projected that the growth of the Chinese economy since Deng Xiaoping’s reforms in 1979 could result in China’s economy
exceeding the U.S. in the foreseeable future. These games were similar to other games involving sides representing the major actors affecting outcomes in the world under consideration. Each move took five years. During each move, each team outlined its political aims, economic approach and actions (e.g. investment in social programs, national infrastructure, education, military, technology, etc.), international initiatives, and military policies and actions. Net Assessments games used an economic model to suggest national and global economic developments.

Noting that a principal uncertainty in the security environment of 2010 was associated with the actions of governments and social movements, for two years the SSG conducted path games based upon its understanding of major trends shaping the future security environment. The SSG employed its research into trends as a basis for having teams form their policies. Teams of Americans and foreign nationals expert in national economic and military policies and international relations represented U.S., Europe, Japan, Russia, and developing countries with an emphasis on China, the Middle East, and Central and South America. Each team would have a day to formulate its move, including diplomatic exchanges with other teams. After the teams submitted their moves, a control team would adjudicate the updated state of the world and provide a short newspaper describing developments over a five-year period to initiate the next move. Beginning five years in the future and having three five-year moves provided results out to the 20-year horizon. The convergence of interests on the Mideast was notable, though the mix of reasons for each major power’s interest varied.

The SSG used the results of the game to find that the policies and actions of the U.S., the major powers of Europe (Germany, France, U.K.), Russia, China and Japan held major sway over the strategic environment of 2010. No major power viewed armed conflict as a viable instrument for dealing with other major powers, particularly considering the implications of nuclear weapons use. The breakup of the Soviet empire was likely to leave a Russian/Central Asian core beset with economic, demographic and nationalities problems and unhappy with their reduced status. The Chinese historical vision of itself as the Middle Kingdom (spanning Manchuria, to Mongolia, to Indonesia) remained. These situations would provide the seeds for future conflict as the nations involved would try to extend their influence beyond their borders. The need to remain part of the world could temper Russian and Chinese designs to extend their influence. They concluded that conceiving the circumstances where major powers would become in armed conflict with each other by 2010 was difficult given the emphasis on economic growth. However, U.S. economic and security policy would have a large role in shaping the military policies and postures of traditional U.S. allies over the coming decades.

Regarding regional powers, they noted that concepts of the limited utility of armed conflict between nations had yet to take hold in the Mideast, Africa, South and Southeast Asia. Strongmen leaders could still devote major portions of their nations’ economy to military
expenditures and force their countries to war on their neighbors. Additionally, the Cold War thaw was bringing traditional Eastern European ethnic and national rivalries out of the deep freeze.

Regional powers would also serve as catalysts in the differing interests of major powers, affecting the security policies of major powers vis-à-vis each other. The Arab-Israeli conflict being a prime example. Even relaxation of tensions could give rise to other challenges. The unification of Korea (particularly if nuclear armed) would affect the regional balance of power in the Northwest Pacific. Harder to envision was the emergence of a sizable regional power or coalition challenging a major power with military means, such as a Sino-Indian conflict.

Regarding social movements, the combination of a growing disparity in wealth between developed and developing nations across short geographic distances with improved communications could foster movements within and between nation’s societies. Arab, Islamic, and Latin American militancy were examples that could provide future security challenges.

Seminars

Mimicking Shell’s use of scenario-to-strategy seminars, SSG X used the results of its research and gaming to develop scenario planning exercises for a wide variety of organizations involved in U.S. national security. They conducted scenario planning exercises with over 20 organizations, from the national security council and select U.S. government executive departments (Energy, Commerce, etc.), to allies, to various groups within the Pentagon, and think-tanks and the Pentagon press corps. The aims of these exercises were aimed at validating and complementing the research done by the SSG and identifying additional implications of the scenarios, and to begin generating a common vision as a framework for shaping/hedging national security policies. Individual seminars were four to six hours in duration with an average of twelve participants, including four SSG members. The seminars began with a detailed briefing by SSG members on the wide range of plausible future strategic environments to get the participants thinking in terms of the future circa 2010. Once the participants were familiarized with the issues bounding the future environment, they were asked to comment on specific implications of the future for their respective community and the naval services. The group used two approaches.

One team chose to focus on a wide-ranged, bounded, strategic environment designed for the year 2010. The choice was simply a plausible (neither optimistic nor pessimistic) future security environment. During the first half of the seminar the environment was briefed focusing on military, economic, and political descriptions and trends. The participants were invited to fine-tune their interpretation of the fairly general description during a focused brainstorming
session. In the second half of the seminar, four excursions involving Japan, Germany, the USSR, and Mexico were briefed and discussed in some detail. Using the previous discussion as the framework, participants were asked to look at these various strategic situations in order to identify the challenges, opportunities, and implications that would unfold during each excursion. The excursions served as a means to generate detailed discussions in order to highlight the forces that would shape future U.S. national policy, and defense and naval strategy necessary to deal effectively with unexpected events.

Two other teams presented a seminar that consisted of a briefing and an information gathering session. The objective of the briefing was to familiarize the audience with major trends and important issues that could determine the future. Each team used the same two unique strategic environments that had been crafted to accomplish this objective. These were not extreme boundary conditions, but were plausible and contained some common and some unique aspects. These futures were not predictive, but were tools to help the audience quickly identify both those aspects that were common to a wide range of scenarios, and those aspects that would shape unique outcomes. The briefings included a moderator-led discussion that attempted to identify and discuss those major aspects that were unpredictable but had the potential to dramatically change the course of events. The objective of the information gathering session was to harvest the audience’s ideas of the major aspects and trends that may shape the future, and identify implications, issues, and options.

A major finding of SSG X’s effort was that intelligence assessments provided an insufficient basis for national security and defense planning in that the foreign intelligence community was prohibited from assessing developments within the U.S. and U.S. actions were a dominant force in shaping the future security environment. SSG XI (1991-1992) picked up on SSG X’s work, focusing it more specifically on trends involving allies and potential adversaries with an emphasis on military forces. As with SSG X, they found that the role of the U.S. was a major determinant of the future and explored ways to shape the security environment as the U.S cut its military forces and the U.S. economy and population became a smaller portion of the world’s total. The Navy had just had its end-strength cut from a target of 600 two years before to 451 ships. SSG XI told the CNO that the Navy continuing to do business the way that the military-industrial-congressional enterprise (MICE) had done since WWII, cost growth and expected Defense budgets would result in a Navy approach 250 ships by 2012 (Hanley, Swartz & Steinitz 2016). The cost growth trends resulting from the structure of the MICE admitted reasonably accurate prediction absent significant changes.

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38 (Downes-Martin 2019) cites (Lehrer 2012) in questioning the value of brainstorming and suggests alternative methods more appropriate for conducting such seminars based upon recent research.

39 Increased DOD budgets following the terrorist attacks on 11 September 2001 and allowed the Navy to procure and maintain a modestly larger number.
SSG XI continued to conduct path games as part of their research, with even greater foreign participation – including Russian officials – but did not conduct the scenario-to-strategy seminars.

An Assessment of the Techniques

These SSG efforts followed many of the precepts for addressing wicked problems. Individually, in games, and in scenario exercises the group employed a wide variety of stakeholders from a broad range of disciplines to frame the future and understand the implications of various drivers. They were effective in mastering a complex issue, enhancing communication, stimulating creativity and creating a consensus on future developments and implications that were uncommon at the end of the Cold War (if familiar now). They were less successful at creating a commitment to action on the part of the Navy and the Pentagon.

SSG X and XI’s descriptions of major trends and their implications for the future security environment were largely accurate over the next two decades. The terrorist attacks on 11 September 2001 represented a limited version of one of their wild-cards, with detrimental effects on U.S. privacy and spill-over effects on democratic processes. The U.S. invasion of Iraq represented a strategic set-back in legitimizing armed aggression in an effort to advance national objectives, though their judgment of the limited utility of force for that purpose remained valid. Initiating armed aggression is never as easy or productive as some would wish. Their expectation that Navy operations would be in the littoral supporting land operations against weaker opponents remained true, with the caveat of growing Chinese naval power emerging toward the end of their horizon. They noted challenges contributing to migration and refugees, but did not explicitly address the political reactions from more developed countries that weaken democratic processes and respect for international law. In general, their effort demonstrated that researching trends and conducting path games to frame wicked problems inherent in future security could provide valuable insights into future the character of the future security environment.

However, efforts to implement change were less successful. SSG X recommended to the CNO that the Navy adopt Shell’s approach of conducting scenarios-to-strategy exercises with its various organizations and commands. However, the CNO had adopted Total Quality Leadership, a variation of W. Edward Deming’s Total Quality Management, and had established an office to promote the program that used different strategic planning techniques. Though some of their recommendations for items like reorganizing the Navy staff were realized, their findings on the need to change Defense acquisition paradigms and practices had little effect, as did their broader findings regarding cost growth of health care and Social Security putting ever greater pressure on Defense budgets, and the need for greater cooperation among the Services, government agencies, and the U.S. and foreign governments and their militaries to address
transnational security challenges that none could effectively address on their own. Those required to take action on the SSG’s findings were not involved or invested in their gaming and seminars. Insight is insufficient for implementation absent specific efforts to generate a broad organizational consensus and commitment to agreed action among those setting policy and controlling resources, particularly when confronting well established paradigms and processes.

Though the Navy did not fully embrace SSG recommendations, as Schelling pointed out, the intense common experience in joint problems solving provided SSG fellows with social networks that resulted in ongoing collaboration to implement their concepts as they advanced to three and four-star ranks (Levine, Schelling & Jones 1991 p. 25; Hanley, Swartz & Steinitz 2016).

**Revolutionary Naval Warfare Innovation**

In 1995, CNO Mike Boorda changed the mission the SSG to serve as the nucleus of what was intended to be a process for the generation of innovative naval warfare concepts underpinned by emerging technology (figure 3). The SSG expanded to include officers from the Naval War College and Naval Postgraduate School to bring younger minds to the effort and to man concept generation teams studying different aspects of naval warfare (e.g. power projection, force protection, command and control, logistics, etc.). The intention was for the Naval War College to game concepts generated by the SSG, Navy Doctrine Command and Marine Corps Concept Development Command (MCCDC) to further develop the concepts and conduct operational experiments, and the Naval Postgraduate School to conduct additional research and analysis. Systems and doctrinal concepts adding significant value would then go into the formal acquisition and doctrine publication processes to create new operational capabilities.

The first innovation SSG in 1995-1996 identified the promise of information technology, integrated propulsion systems, unmanned vehicles, and electromagnetic weapons (rail guns), among other things. They laid out a progression from extant, to information-based, to networked, to enhancing cognition through networks of human minds employing artificial intelligence, robotics, biotechnology, etc. for warfighting command and sustainment. They proposed a netted system of numerous functionally distributed and physically dispersed sensors and weapons to provide a spectrum of capabilities and effects, scaled to the

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40 Navy leaders had been directly involved in the SSG’s gaming of campaigns for implementing the Maritime Strategy in the early 1980s, leading to rapid changes in war plans.

41 For example, Admiral Ed Giambastiani, USN worked with Amory Lovins from the Rocky Mountain Institute to improve energy efficiency in his commands and Vice Admiral Dennis McGinn, USN worked with Lovins to improve energy efficiency in ship designs as Deputy CNO for Naval Warfare, and following his retirement became a fellow at the Rocky Mountain Institute and President of the American Council On Renewable Energy (ACORE).

42 CNO Executive Panel briefing to CNO Boorda, January 1995.
operational situation. To begin, they recommended airborne advanced radar, advanced hull forms, prototyping unmanned platforms, tactical ballistic missile (TBM) counterbattery systems using AEGIS-ship like cooperative engagement to provide dynamic control of fire support for ground forces ashore, and developing an undersea cooperative engagement capability (Chief of Naval Operations Strategic Studies Group 1996).

Admiral Boorda passed in the Spring of 1996 and the envisioned innovation process never came to be. While the SSG continued to generate innovative naval warfare concepts over the next 20 years, the linkages to Naval War College gaming, the Naval Doctrine Command (later Naval Warfare Development Command) and MCCDC, and the Naval Postgraduate School never materialized. Boorda had envisioned allocating on the order of $100 million per year to each of several of the SSG’s concepts. However, the OPNAV staff decided that all of the SSG’s concepts either required more study, or that current investments were sufficient (Hanley 2018). Over two decades later, almost all of the concepts proposed in 1996 are now in vogue.

**Figure 3: Naval Warfare Innovation Process**

**Gaming Naval Warfare Innovation**

The SSG’s couple of months from concept generation to gaming had always been a challenge for the Naval War College’s War Gaming Department’s schedule and processes. By the late 1980s, the SSG was designing and conducting their own games, with facilities,
Wargaming the Far Future

administrative, and some analytical support from the War Gaming Department. The SSG’s program typically called for three games. The first game was to introduce the SSG fellows to gaming and to current operational concepts. A second game was to explore initial concepts generated by the SSG. A third game was to evaluate refined concepts before recommending then to the CNO. Whether the SSG chose to conduct these scheduled games was each group’s prerogative.

The concept generation teams each set their own research agenda and spent the majority of their time visiting laboratories to enhance their understanding of emerging technologies. Getting the teams to focus on game preparations was challenging. Addressing the operational impacts of concepts for command and control, operations, and sustainment using greatly enhanced information technology was particularly challenging. Absent a clear adversary, the scenarios used for the games were fanciful.

Before the games the teams had not mastered the complexity of their concepts to the point that they had a common language or could draw a “diagram” of the type that Little and Fiske suggested. Though having many faults, the games were useful to the SSG for developing their language for mastering the complexity of diverse concepts working together, enhancing communications among the concept generation teams, and stimulating creativity. The kinds of insightful observations and that came from the games included:

> Red saved their most capable weapons for major Blue combatants. This allowed the minimally manned, small ships operating forward to conduct strike, reconnaissance, and freedom of navigation with relative impunity.

> One SSN equipped with an Advanced Deployable [underwater acoustic surveillance] System operating with each forward deployed battle group would allow rapid covert deployment.

> Tagging Red submarines, transporter erector launchers (TELs), and high value assets prior to their dispersal more effective than searching large areas.

> An ability to deploy unmanned underwater vehicles (UUVs) by air would be valuable.

> Innovative Blue forces were used primarily in traditional “force-on-force” applications.

> Using technical means to exploit or block enemy communications is challenging, particularly as encryption increases. Cutting off commercial service may be more effective, recognizing the legal challenges.

43 The author was the Deputy Director of the SSG during the period discussed here, responsible for the details of the SSG’s program within the Director’s intent.
➢ Need at sea transfer of missiles to keep platforms forward.⁴⁴

As part of an outreach initiative, the SSG suggested three types of games for broader Navy participation: The SSG efforts to employ computer-based games and to reach out to partner organizations to create games supporting naval warfare innovation had limited success.

➢ A tactical tic-tac-toe that developed by the Naval Postgraduate School would allow teams to play against each other, but with delays in communication and without perfect knowledge of opponents’ moves, to provide insights into the effects of asymmetrical knowledge. It would also get officers into the habit of playing games.

➢ Theater level games run by NWC that would allow Red and Blue teams to try innovative concepts against each other, with the NWC gaming staff providing adjudication. The SSG would monitor these games for promising concepts.

➢ A third kind of games would be put on the net, targeted at evaluating ideas provided by the Concept Generation Teams (CGTs). The CGTs would help create new models needed to evaluate their ideas properly. The models would be available to the Navy office responsible for assessments to further evaluate any concepts brought forward for demonstration.⁴⁵

The SSG’s outreach initiative came to naught as the naval warfare innovation process lacked funds and failed to organize coherent efforts.

In working revolutionary naval warfare innovation, the SSG fellows never truly accepted the need for analytical justification of their concepts. The concept generation teams used the analysis if it supported their positions, but ignored it if it did not.⁴⁶ The wargames were too cumbersome without giving clear results. An assessment from 15 years with the SSG was that though every SSG had an analytic component, overall, SSG analysis and games had been weak and except for a few cases had negligible impact on the final SSG product.⁴⁷

The SSG did pursue one initiative of employing the electronic game Fleet Command to explore different fleet designs. Though graphics were difficult to change, the game used Excel spreadsheets for platform characteristics that were relatively easy to modify. Other aspects of the game presented additional challenges.⁴⁸ However, though some SSG fellows fiddled with

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⁴⁴ Lieutenant Commander Brent L. Boston memorandum to Dr. John Hanley, Subj: SSG 2020 Wargame Observations, 19 April 1996.

⁴⁵ Dr. John T. Hanley, Jr. memorandum to Admiral Jim Hogg, Subj: Topics for Discussion with CNO, 12 January 1996.

⁴⁶ Alan H. Krulisch, “Thoughts on Technologists/Analysts,” 5 May 1998.

⁴⁷ Alan H. Krulisch, SSG Wargaming Review Follow-Up, 10 April 2010.

Fleet Command over the years, the group changed their exploration and evaluation exercises to techniques like Quality Functional Deployment to rank concepts rather than employ them in operational games.

Gaming is part of a wider ecology. In the 1980s, the CNOs and the Navy leadership paid close attention to war gaming as part of a cycle of research, resulting in rapid changes to war and contingency plans. In a speech to the International Seapower Symposium at the Naval War College in 1984, CNO James Watkins extolled the virtues of gaming and offered War College gaming to the heads of international navies (Hanley, Swartz & Steinitz 2016). As “non-traditional” security challenges came to dominate in the 1990s, military challenges and opportunities became even more wicked. The models and underlying language of gaming became more abstract, to the point where games became more like seminars. Effectively, this level of abstraction made gaming more like chess before the von Reisswitzs’ depictions, as von Müffling said, closed the gap between “the serious business of warfare” and “the more frivolous demands of a game.” For games to affect the serious business of warfare, or analogous situations in society and business:

- scenarios must be compelling,
- mental maps must be clear enough to know how the “terrain” affects speed of interactions of the units involved,\(^49\)
- scouting/intelligence and communications dictating which actor knows what, and when, needs to be accounted for,
- rules for the outcomes of interactions need to be established by knowledgeable umpires, using exercise and operational data wherever possible.

These are the features of Reisswitz the older and the younger’s that turned chess-like games into substantive war games. These are the features that need to be incorporated in a game to master the complexity of the contingency under study and create consensus and a commitment to action. The gaming environment will enhance communication and stimulate creativity even in the absence of the features needed to compel action.

The further into the future that games project, including games aimed at informing today’s resource allocations for decades out horizons, significant effort is required to ensure that above the above features are compelling to compete with established processes and programs. If the organization does not share a different conceptual depiction of challenges and opportunities, it will not change course.

\(^{49}\) In cyber gaming this includes physical, logical, persona cyber terrain. In bureaucratic games this involves the bureaucratic terrain.
Gaming to Change the Futures Paradigm

A major premise for futures gaming in the Department of Defense is that it takes 20 years to field the next generation of major platforms (aircraft, ships, armor, etc.). Acquisition process call for intelligence to projects threats into the distant future and significant efforts go into the Services developing future scenarios against which to assess the value of their investments. This system was developed during the Cold War when projected force structures were a major aspect in maintaining deterrence and the international situation was largely frozen by relations between the U.S., Soviet Union, and their allies and partners. Technology development and adoption is advancing at a super-exponential pace. Whether this pace can be sustained depends upon continuous innovation (West 2018). Rather than attempting to peer out to the distant future, the structures that underlie the MICE, particularly Defense program planning and acquisition practices need to adopt a paradigm of providing capabilities in months to years, rather than decades.

Gaming can play a useful role. Here the stakeholders are the military with its acquisition professionals, industry supporting the military or that the military needs to support it, and their legislative authorizers and appropriators in the roles of champions, sponsors, gatekeepers, and transition authorities. The games would be addressing the wicked problems involved in rapidly acquiring military capabilities.

Again, sound practice will require games to be part of a cycle of research. The cycle should include experimenting with concepts that show promise in games, and further modeling and analysis. Given the complex nature of the acquisition system resulting from the interactions of many stakeholders operating under different rules and incentives for providing value, using agent based models and genetic algorithms could suggest system rules and values leading to better outcomes.

More effort needs to go into studying the systems for preparing for war as DoD puts more effort into analyzing “war proper,” to paraphrase von Clausewitz.

References


50 (Gulovsen 2018) provides a discussion of role theory in technology transition into R&D.


About the Author

John T. Hanley, Jr. served as a nuclear submarine officer after receiving A.B. and M.S. degrees in Engineering Sciences from Dartmouth College. Following active duty, in 1977 he joined the Navy Reserve, and worked with a small consulting firm on fleet exercise analysis. This led to his becoming affiliated with the Chief of Naval Operations Strategic Studies Group for 17 years where games provided a major technique for exploring and evaluating concepts. The effects that his modeling and analysis work were having on Navy strategy convinced him to pursue a Ph.D. in Operations Research and Management Sciences at Yale University while working with the SSG. He wrote his dissertation on war gaming and graduated in 1991. Following the SSG he served as Special Assistant to Commander-in-Chief U.S. Forces Pacific, at the Institute for Defense Analyses, and in various senior positions in the Office of the Secretary of Defense and the Office of the Director of National Intelligence. Following his retirement from government in 2012 he has returned to the study of serious gaming and supporting various projects as an independent consultant. Dr. Hanley is a Non-resident Research Scholar at the Naval War College.

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Brand New World
(with apologies to Aldous Huxley)

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“He who is everywhere is nowhere” (Seneca the Younger)

The future cannot be predicted with any degree of certainty or accuracy. A wargamer is well able to construct and consider a future operating environment but must consider both how this is accomplished and what benefit such an endeavor produces. The futurist brings methodologies that allow for the identification of variables that can be fashioned into a plausible representation of the future. The key in wargaming the future is thus the fusion of the talents of the futurist and the wargamer in the construct of a game that both represents a plausible future and permits the identification of the governing factors which shape that future. Identification of these governing factors can support intelligent speculation upon what action must be initiated in the present in preparation for what is to come. Work must be undertaken to specify the best practices necessary to fuse the fields of the futurist and the wargamer in the art and science of gaming the future.

Frederick the Great, a student of Roman literature, may well have adopted his famous “He who defends all defends nothing.” from Seneca. If so, we may take the liberty to say that “He who prepares for all contingencies prepares for none.” And yet, prepare one must. This implies a sense of the future and a reasonable appreciation of the competitive environment that will exist and the advantage that must be acquired for success. Thus, preparation for the future requires the identification of ends, the selection of ways, and the securing of the means based upon the projected conditions for success in a future operating environment. The key is to “learn fast enough to sustain a competitive advantage.” (Mason 2009 p. 1)

What then is the future? The answer to this question is to be found in understanding the past. History can be understood as the marriage of events and their causes which merge and emerge to produce the trends that comprise the present ... the here and now. Trends are “concrete forces that...have high impact on the strategic environment and are highly predictable over the planning horizon” (OPNAV N51 2010 p. 2). Examples of trends are such major muscle movements as Demography, Technical Proliferation, and Information as a Weapon. The present is the synthesis of these past trends and their consequences which have been modified by the friction of an historical context (political, economic, military, cultural, etc.) that both limits and shapes the extent of what goes forward. In recognizing this dynamic, the future is understood to be a continuation of this process marked by the sensitivity, variation, and uncertainty which are characteristics of a complex process....a process determined by the
interaction of time, historical context, available material, operative ideas, and human action that makes for a capricious path forward. This complex process means that it is easy enough to identify the current general trends and an approximation of the principles that drive them, but difficult to gauge the resulting trajectory in time. This is so because, as obvious as general trends can be, they are connected by interlocking dynamics that are immersed in change, disruption, and hidden details so as to prevent precise calculation.

Thus, the future represents an evolving contingency marked by the extremes of uncertainty, sensitivity, and variation with confluences at critical junctures which can exaggerate or suppress estimated deviations and deflect expected trajectories. The attempt to predict the future is marked by certain miscalculation, accident, and frustration. The secret to considering the future is to forsake the standard of perfection and seek plausibility based upon a defined spectrum of probable outcomes. In this endeavor, wargaming can be of assistance.

As a wargamer considers applying his art to the problem of the future, he quickly realizes that the problem is not “can I wargame the future?” but “how do I wargame the future and to what benefit?” A wargame that considers the future can be designed with any competitive environment desired and with a proposed problem to be addressed. You want to examine a future interplanetary war driven by conflict on Mars? Simply construct the environment and state the problem. In short order, a scenario and supporting design can be assembled and the study can commence. SPI’s “BattleFleet Mars” from 1977 is an instructive example.

However, the problem here is obvious. Because the game is separated from all but the most universal of trends and is finally based upon construct, supposition, and speculation, the results of the game are of dubious benefit to an analysis of future environments and their requirements. This is so despite the fun one may have had commanding a battle fleet of spaceships. Again, the problem is not “can” I wargame the future but “how and for what benefit.”

At this point, a synthesis of skills must be proposed. Separated, the futurist and the wargamer are devoid of the necessary skills to examine the future and extract both insights and direction. The futurist is one who possesses the skill and foresight methodologies necessary to both construct and evaluate an ever receding set of plausible alternative futures based upon general trends and associated assumptions that exhibit both a rate and level of change. The wargamer can then take these proposed futures, abstract problem, hypothesis (if...then), and objective statements based upon the projected operational environments, and design the vehicle necessary to consider this dynamic context and the associated proposed responses required to operate successfully in those environments. In a word, the wargamer can employ the work of the futurist in a construct that permits the examination of a future and the responses to that future given a definition of what constitutes success. This is “how” to wargame the future.
Complexities will abound in this process because of the need to coordinate intelligence estimates, political, cultural, economic, and demographic trends, government policy, scientific and technical progress, and shifting relations in power. Thus, a futurist and a wargamer must experience a fusion of both purpose and talent in projecting the future environment and designing a wargame to consider it. The wargame will become a kind of solvent in which disparate elements, estimates, and speculations about level, kind, rate of change, and interaction among variables will have to co-exist. A good futures wargame will require many coordinated qualifications that address assumptions, account for factors, and define contingencies. The futurist and wargamer will have to live in each other’s fields and this confluence should have the added benefit of strengthening the understanding and reinforcing the cooperation between these two fields of practice.

Like the wargamer, the futurist relies upon a stable process for considering the future but is confronted with a spectrum of ways in which that process can be employed in the service of trends and objectives. An initial consideration is to distinguish between forecasting the future, which entails following a collection of trends with estimated deviations and arriving at a point, with the development of alternative futures, which entails developing a collection of alternative strategic environments that bound a region of plausible outcomes each characterized by an overarching descriptive title that is developed in detail in the accompanying scenario document. Figure (1) provides an example of the possible alternative strategic environments that might emerge in a hegemonic world in which economic or military power is the driving force (the scope) and the extremes (the scale—dominant or straitened) of the US position in such a world are the matters to be considered.

![Diagram](image)

**Hegemonic World**

- **Economic**
  - Dominant: Front Row America
  - Straitened: Place In the Sun?

- **Military**
  - Dominant: Trump Card
  - Straitened: Sleep of Reason...

Figure 1. An example of U.S. alternative strategic environments in a hegemonic world.
Peter Bishop (Bishop 1998 pp. 29-42) poses a series of questions and answers that act as a guide to the selection of a methodology for thinking about the future. Without exploring the deep value contained in this approach, several highlights will serve to establish some parameters. A defining idea is that the best way to think of the future is not to expect to be right, but to avoid being surprised. This strengthens the desirability of considering alternative futures rather than trying to achieve a precise forecast. Thus, one is led to consider the value of probable, plausible, and preferable futures. He states that a probable future is one in which surprises don’t greatly affect the trajectory of time; a plausible future incorporates the consideration of and emphasis upon selected variables which expand the range of outcomes; a preferable future is the definition of an optimum future state in which advantage and benefit are maximized. The latter represents an interesting condition in which context, material, and ideas coalesce to define a consensus goal which informs concerted action. This suggests a systematic way in which action today determines outcomes tomorrow. In a word, while it is not possible to obtain an accurate prediction of the future, it is certainly possible to deliberately influence the future and achieve what is preferable to a degree. The point here is not that this idea is new, after all planning is an ancient art. The point is that by systematically considering alternative futures, assumptions can be refined, implications can be anticipated, and a design and priority of work can be arranged and coordinated such that a preferable future is more likely to result. Peter Bishop concludes by emphasizing the importance of the result of this process ... the establishment of a general direction for fundamental change.

From a wargamer’s perspective, how might the identification of this advantageous fundamental change be achieved and the path to attainment be established? One course of action, which can be considered in the fusion of the futurist and wargamer’s methodology, involves the identification of the future operating environment and the advantages required for success (futures process) combined with the ability to formulate, examine, and assess the direction to be taken, the advantages to be gained, and the exploitation to be achieved (wargame). A wargame will permit a close inspection of the core principles needed to influence the environment and obtain advantage. These core principles are the governing factors which drive the dynamics of the future environment. Governing factors delineate the operational functions and trends that must be capitalized upon to achieve success. The definition of success and its associated metrics provide the basis for assessing the misdirections and distractions that can be induced by the kaleidoscope of future events, patterns, and tendencies exhibited in the competitive operating environment. Knowledge of this dynamic, if not understanding of the mechanism, is what can convert governing factors into operational acts of persuasion or imposition that generate conditions for exploitation. Thus, while the core principles specify the dynamics of an environment, the governing factors are those elements that can be manipulated, combined, and arranged to impose, persuade, induce, or deceive an adversary into a commitment that can be exploited. This places an adversary in a counterintuitive position
where direct actions arrayed against him can organize an environment in unpredictable ways, cause risks to be exaggerated or obscured, turn strength into weakness, and cause counter action to be miscalculated and so generate transitory moments in which counter strikes can prevail. This is the “benefit” derived from a wargame that considers the future.

Thus, a productive fusion emerges. While the futurist identifies the trends that will produce an operating environment, the wargamer sets this environment in motion driven by appropriate dynamics to identify the governing factors whose proper arrangement and utilization become the key to understanding and anticipating the conditions required, the preparation necessary, and the consequences expected in gaining advantage and success in the future operating environment. This is the “how” and the “benefit” fused. This process is made more powerful when several alternative futures are examined in an integrated series of wargames and governing factors common to a set of or to the whole of the alternatives are identified. Figure (2) below is a preliminary illustration of the proposed fusion between the art and science of the futurist and the wargamer.

Figure 2. The fusion of the art and science of the futurist and the wargamer.

The phases of this process establish a construct in which identified trends and attendant uncertainties are converted into a classification of prioritized criticalities and resulting projected environmental, operational, and functional consequences.

Phase I (Synchronize Complexity). From the perspective of the present, categories of trends and uncertainties are identified and ordered by the power and ability to drive change. This
becomes the basis for the development of a decision trajectory in which the futurist selects among weighted alternatives, evaluation of effects, and forward direction to define an emerging baseline future.

Phase II (Synthesize Complexity). Having established a baseline future, trends and drivers are now combined, organized, and arranged into constructs which produce alternate strategic environments (e.g. The Political World, The Technological World, The Resource Constrained World, etc.). These scenarios are developed using a planning process such as proposed by Jay Ogilvy (Ogilvy, J. 2015 pp. 1-10) and that creates environments which should be constituted to cover a spectrum of possible futures and may focus on plausible, preferable, and portentous futures which permit an examination of alternative possible strategic environments that are created by emphasizing different combinations of trends found in the baseline future.

Phase III (Classify Complexity). With the completion of an integrated series of wargames that examine the selected alternative strategic environments, assessments will produce the identification and isolation of the resulting governing factors which represent the key operational functions and trends in that particular environment. With governing factors in hand, the classification of the criticality and operational consequences in that environment can be identified. Finally, the identification of those governing factors that are common to all or a set of the strategic environments examined can be assembled.

With these three phases accomplished, a feedback mechanism is employed allowing for action to be initiated that can shape the strategic environment and influence the attainment of the preferable future. Incorporating the newly won understanding of the common governing factors into the previously constructed baseline future permits an approximation of what must be done to obtain a preferred result. Alternatives (What if?), meaning (So what?), implications (What’s next?), and imperatives (What must be done?) can be assessed and evaluated. From this, a resulting composite strategic baseline future environment can be constructed that contains both what is predictable and what is uncertain. This composite future environment becomes a basis for the action needed to identify “how to fight” in that environment, what capabilities and capacities are required, and what force structure is needed to operate, prevail, and successfully exploit that strategic environment.

The ability to generate, consider, examine, and respond to the Brand New World is dependent upon the fusion of the art and science of the futurist and the wargamer. Isolated, the futurist can propose environments based upon trends, uncertainties, and related dynamics; the wargamer can design and play “BattleFleet Mars”. But, the study of future environments without the ability to examine dynamic responses, propose outcomes, and consider initiatives is merely academic; the play of a game without an environment grounded in plausibility, oriented against a real problem, adopting an assayable hypothesis, and considering specified objectives is merely fun. Separated, the future process and the wargame lack animation; fused,
the combination is one of power and utility. The futures wargame will harness the ability to examine the science of the necessary with the art of the possible in a future operating environment. Most importantly, the futures wargame could be instrumental in dispelling the illusion of certainty that sometimes emerges in a bureaucratic rationality burdened by limited understanding and capacity, constrained information and vision, and driven by external urgencies that compress both time and deliberation. The more an organization can represent a future competitive environment and consider the dynamics of that space, the more likely that organization is to get the Brand New World “roughly right” instead of “precisely wrong”. It is much more profitable to shape a response to the former rather than the latter. Seneca the Younger would be pleased.

The question is now the practical one of how the skills of these two fields can be fused in the execution of a futures wargame. A way forward suggests itself....and Connections can lead the charge. The Marine Corps will host Connections ‘20 and will propose a workshop topic of “Practical Futures Wargaming” for discussion which can have as its basis the work accomplished in Connections ‘19. As part of that effort, academic and industrial futurists will be invited to explain the art and science of their field and consider the use of these principles in wargame design. A supporting line of effort can then be subsequently initiated in which a core group of futurists and wargamers can engage over the course of several months to design, execute, and assess a simple, focused futures wargame that will permit the concept to be examined and demonstrated. A report of progress, problems, and potentials can then be produced and delivered to Connections ’21. In this way, the value of this fused approach can be practically considered, a methodology proposed, and the relationships necessary to continue the work can be forged.

References
About the Author

**Dr. William J. Lademan** is a retired Marine infantry officer. After service, he spent over a decade in academia and the chemical industry before joining a consulting firm as a wargame designer. Currently, he is the Technical Director of the Wargaming Division, Marine Corps Warfighting Laboratory, charged with the execution of the Wargaming Program in support of examining Service concepts, combat development, and operational plans. He is also involved in the planning for the construction of the Marine Corps’ purpose-built wargaming center and the development of the Next Generation Wargame it will facilitate. He is a life-long lover of baseball, books, historical miniatures, and the wargaming hobby.

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Wargaming the Future Requires Rigorous Adherence to Best Practices

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“Games have one quality that separates them qualitatively from straightforward analysis and permits them to generate insights that could not be acquired through analysis, reflection, and discussion. That quality can be illustrated by the impossibility theorem: **one thing a person cannot do, no matter how rigorous his analysis or heroic his imagination, is to draw up a list of the things that would never occur to him.**” -- Thomas Schelling

Abstract

Because the future is uncertain and ill-defined, wargaming is an ideal tool with which to examine it. For the same reasons, wargaming must be applied simply and effectively. And a wargame that scrys even the furthest and dimmest future is still just a wargame, albeit with different variables involved. Technology will become ever more important and must feature in our games, but the future will still be shaped by humans. Wargames are people-centric in terms of their play, control and analysis. Computer-assistance (artificial intelligence, machine learning, agent based modelling etc.) has a role to play in supporting our wargames, but we cannot (yet, if ever) computerise the vital human ingredient. Rather, we should adopt a ‘back to basics’ approach to ensure that wargames make an effective contribution to future-gazing. Professional wargamers must ensure that they design, develop and execute their games applying wargaming best practice rigorously. This paper suggests that the following characteristics should feature in wargames that examine the future: appropriate adjudication; appropriate supporting technology; wargaming within a wider context; small, cheap and frequent wargames; rigorous analysis; the primacy of player decisions; freedom to fail; simplicity; including ‘soft’ and human factors; adversarial; oppositional; effective control; and fun. Perhaps surprisingly, chance and uncertainty are less important characteristics.

Introduction

Wargaming the future is hard! Gaming situations decades ahead intensifies the uncertainties inherent in every model, parameter and assumption. The technologies and factors involved will be different to today’s, and the combination of possibilities could easily cause our games to spiral out of control. ‘Black Swan’ events and discontinuous trends are, by definition,
unlikely to be identified and acted upon. However, wargames that examine the future are still just wargames.

The ‘so what’ from this is that to effectively wargame the future we must adopt a ‘back to basics’ approach to apply wargaming best practices ever more rigorously. The practices we suggest in this paper are based on the ‘Guidelines for good wargaming’ in the MOD Wargaming Handbook (MOD 2017). However, we have expanded these according to a forthcoming book (Longley-Brown 2019) and re-ordered them into an approximate priority order that relates to their application when wargaming the future. All points discussed are practical suggestions that pertain to all wargames. They are not new or revelatory, but they are writ large when we attempt to scry a dim and indistinct future. All must be considered and, unless there is good reason not to, rigorously applied when wargaming the future.

### Appropriate and ‘deliberative’ adjudication

Adjudication is discussed under ‘Control’ and ‘Transparency’ in the Wargaming Handbook (MOD 2017). We think it warrants not only a separate discussion, but that it is top of the prioritised list of characteristics to ensure effective future-gazing wargames. Figure 1 shows adjudication approaches and methods, models and tools (MMT) that can be applied to wargames. A glance tells you that, when wargaming the future, we are on the left-hand side of the ‘real-world applicability’ area, considering ‘wicked’ (messy) problems that demand creativity and original thought. On the ‘levels of discovery’ continuum, we are trying to increase initial understanding, but hopefully eliciting the odd insight along the way. Wargaming towards the left side of Figure 1 suggests that appropriate adjudication approaches are ‘consensual’ and ‘free.’ Should any ‘semi-rigid’ adjudication be used (and we think that a stretch target), it is essential that this be presented in a deliberative style. I don’t know if ‘deliberative’ was coined by RAND, but I first heard it used by Stacie Pettijohn at Connections UK in 2016. It means ‘relating to or intended for consideration or discussion.’ In the vast majority of the wargames delivered by the authors (certainly the analytical ones), we present semi-rigid ‘outcomes’ completely transparently, and only as a starting point for informed group discussion, with an opportunity to moderate the outcome according to the collective examination and the wargame’s aim and objectives.

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51 The outcome is discussed in a committee of several, or all, players and Control staff and a decision reached, ideally by consensus.

52 The outcome is determined by a lead adjudicator, but again after an informed and open discussion.

53 Based on look-up tables, but presented for discussion and potential moderation.

54 OED.
But this deliberative approach should also be applied to consensual and free adjudication. Firstly, by bringing the players into the adjudication process, it makes it clear that no outcome in the game is assumed to be valid, and must be discussed transparently. Just as important, the deliberative approach forces discussion. This as opposed to ‘open’ adjudication which is simply a transparent presentation of an already-determined outcome. As well as engaging everyone in the adjudication process, the forced conversation: assists player recall; enhances data capture; and reinforces the nature of the wargame as an act of communication.

**Appropriate supporting technology**

The MMT examples towards the left side of Figure 1 include role-play, argument-based, human-in-the-loop (HITL) determination and moderation. There is limited scope for Operational Analysis (OA) and almost certainly no role for computerisation (subsuming decision-making, adjudication and control functions wholly into a computer) until artificial intelligence (AI), machine learning (ML), agent based modelling (AMB) etc. advance considerably beyond their current state - and possibly not even then. Computer assistance will feature with respect to
data capture, distributing situational awareness etc., but these functions are discrete from computerised models that adjudicate outcomes, determine statuses etc. The point is that the most appropriate MMT when wargaming the future are manual and human. This, perhaps obvious, statement must be explicitly recognised to pre-empt the pro-technology biases prevalent in wargaming. Clearly, the future will be fundamentally shaped by emergent technologies, but the attributes of those cannot be programmed into a computer or turned into algorithms with any validity whatsoever, so considering their impact in wargames must remain a human function. MMT should include role-play because, while the future will be shaped by technology, the influence of humans will remain the predominant factor – until the machines eradicate us all.

Wargaming within a wider context

Wargaming towards the left-hand side of Figure 1 will increase our understanding and elicit observations and insights. This reinforces a basic truism of wargames: they raise questions, and do not provide answers. It is particularly important to recognise this when wargaming the future, and to ensure that any wargame is tightly bound into a wider ‘cycle of research’. Questions and insights arising from wargames are inputs into this wider cycle of research. As with all the points discussed in this paper, that should be the case now. But wargaming the future demands an even more long-term and enduring programme of activities. Any Integrated Analysis and Experimentation Campaign Plan (IAECP) must ensure the ‘campaign’ aspects. As now, the IAECP should interleave trials, field or at-sea exercises and other forms of analysis with wargames – but the timescales required and inevitable variances along the way demand a robust, enduring and stable programme of activities based on bold visions of the future. One direct read-across from other areas of an IAECP that we have found useful are ‘capability cards’. A lead SME (champion) is responsible for developing a specific capability or technology. During the wargame s/he can brief this prior to play starting, during execution and/or during post-game analysis. This informs player decisions and enables a greater understanding of the impact that capability might have - accepting that we are still addressing the vagaries of far-future technologies. However, we struggle to achieve the cycle of research now; such a long-term IAECP will be even more challenging.

Small, cheap and frequent wargames

One way to mitigate the vagaries of budget constraints and politics on such a long-term IAECP is to hold small, cheap and frequent wargames. Outputs from these could include:

55 Peter Perla introduced the “cycle of research” (Perla 1990) and updated this in Zones of Control (Perla 2016). Albert Nofi supplemented this (Nofi 2011) in the end-piece to the 2011 edition of The Art of Wargaming (Perla 2011). Cdr Phil Pournelle developed the concept further (Pournelle 2014).
generating scenarios and vignettes for subsequent examination; shaping and focusing future IAECP effort; and identifying topics for ‘deep dives’ or specific analysis. Any of these outcomes could feed into any part of the IAECP, including subsequent wargames. Player and SME time is always at a premium, with participants reluctant to devote lengthy periods to gaming. Instead of running a 2-week wargame, an alternative approach might be to run a series of 1-day games. These might start with a high-level game where players ‘world-build’ the scenario they will then wargame within. The next event could be executing a scenario to create a baseline (maybe using just contemporary capabilities) and identify key areas of interest. These two events require all players, and get everyone into the future world (which they helped build). Subsequent days could then concentrate on different environments (space, air etc. - some call these ‘domains’). These only require players and SMEs germane to that environment, plus a representative of the other environments for completeness.

Furthermore, restricting game play in this way limits new technologies and variables to a manageable number, pertinent only to the environment or facet of the future being examined on that day. Hence, ‘small’ applies to a bounded number of ‘subjects of analysis’ as well as the number of players.

Alternatively, a series of small, iterative games, each using the same starting situation, should elicit plausible ‘arcs’ (paths), and factors and observations that occur consistently enough to justify further examination with increased confidence in them, and which warrant greater effort. The current tendency to hold large, infrequent and expensive wargames does not deliver enough observations and insights to enable effective comparison and derive commonly occurring factors.

**Rigorous analysis**

Eliciting the required observations and insights demands rigorous analysis pre-game, in-game and post-game. Analysis starts on day 1 of project initiation and is constant throughout. But it is aspects of the in-game analysis that we want to highlight, in particular facilitating discussions and prompting data capture. Wargames are an act of communication. Getting all players to express their views, and then capturing these, can be a challenge. As well as mitigating the issues of group biases, dominant personalities etc., it is important that assumptions are explicit and captured: there will be many of these, and they will underpin the analysis, so they must be clear and apparent.

We also find it necessary to include in-turn agenda serials that explicitly demand the consideration and discussion (thus assisting capture) of observations and insights. These interventions detract from the story-living nature of a wargame, and so need consideration as players often do not want to be distracted from the developing narrative. The agenda items we use, either in-turn and/or at the end-of-turn, are:
➢ Asking ‘What if?’ questions. This elicits insights, including ‘known unknowns.’

➢ Asking ‘So what?’ questions. This drives innovation and elicits insights, including ‘unknown unknowns.’

➢ Critical Thinking. This ensures that assumptions are challenged and biases are mitigated, as well as injecting diverse thinking and alternative perspectives and outcomes.

➢ Consequence Management. We insist on exploring the second- and third-order effects of the players’ decisions and in-turn actions. This frequently reveals unintended consequences, and forces discussion of the potential impact of in-game activities on human terrain at all levels.

Furthermore, we have found it useful to constantly ask the simple question ‘Why?’ every time a player announces a decision until the necessity for them to explain their rationale is instilled and they do this automatically. It is tempting for players, analysts and Control staff to rush to find out what the adjudicated outcome of a decision is, without pausing to examine the crucial reasons why the decision was taken, the factors considered and the options rejected. All of these must be communicated and captured, even though this can break the story-living flow of the game.

The primacy of player decisions

The analytical and in-game data capture approaches discussed above are predicated on qualitative outcomes and insights. The quality of these depends on having the right players making the decisions that, along with their rationale and the insights elicited, are captured. Wargaming the future demands an even more rigorous approach to ensuring a high-quality player contingent. We find the following necessary:

➢ Careful selection. Too many wargame players are selected using the sole criteria of whoever is available. More attention is required in this crucial area. As well as a thorough consideration of what cells and posts are required, it is crucial to have the right person allocated to the right job. Achieving this will have a cost implication, but is critical.

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56 Aka Red Teaming. Both terms are extant, but the experience of the authors is that most people use ‘Red Team’ to refer to the enemy cell. Properly, that is the Red Cell, but the use of ‘Red Team’ as a moniker for the enemy is so widespread that we find it easier to use Critical Thinking to avoid confusion.

57 Stephen Downes-Martin notes that this is similar to the ‘S-why’s’ method in common use in management consulting. It’s an example of a good technique from elsewhere that wargamers should pay attention to.

58 Participant selection is starting to receive the attention it deserves, but more work is required. See for example (Bastian et al 2015, Brynen 2015).
➢ **Diversity.** This across and within player cells. It is often the least likely participant who tables the ‘killer insight’ or identifies the unknown unknown. Such insights must be enabled by facilitators (whose task it is to ensure everyone’s voice is heard) and sponsor (whose task it is to staff the wargame). As many areas of expertise should be covered as is practicable within the game’s objectives. While it is probably not feasible to cater to all of these, we find that it is particularly important to include the social and political sciences to counter-balance the assumption that future-gazing should focus on technical factors.

➢ **Briefings.** It is incredibly difficult for players to take the cognitive leap into the future, and any assistance to this end pays dividends. Who can truly project themselves into an immersive environment that features a world beyond NATO, 3D printing obviating shipping routes or 100% non-fossil fuel energy? Briefings as to what the future might hold can help players get into the required mindset.

➢ **Role-player preparation.** We have already discussed the importance of role-play. In order to actually put players into role (as opposed to the less-effective normality of asking people to merely play a role), significant effort is required to properly develop briefings and guidance for role-players.

Beyond all that, and with the right people in the room, it is then incumbent on the wargame facilitator, Game Controller, Game Director and sponsor\(^{59}\) to ensure that player decisions determine the course of the wargame. This is current best practice, but often skewed by personal or institutional agendas. Any instance of this will curtail the open-mindedness and innovation required when future-gazing.

**Freedom to fail**

The ‘safe to fail’ open-minded and innovative mindset must further be engendered by making it absolutely clear that failure is not only permitted, but is preferred. Exhorting players to try everything they can possibly imagine, testing plans and assumptions to the limit, encourages players to break through their imagination’s glass ceiling into *terra incognita*. If we do not achieve that, our hide-bound assumptions that the future will be an extrapolation of current trends will limit our ability to elicit the required insights.\(^{60}\) Encouraging players by overtly recognising innovation over ‘victory’ works well, as do simple measures such as awarding a prize for the weirdest idea that might actually work.

\(^{59}\) See (MOD 2017) for explanations of these roles.

\(^{60}\) See (Downes-Martin 2015).
Simplicity

The future is complicated enough already, without adding unnecessary complexity by way of superfluous wargaming mechanisms. Einstein, who knew a thing or two about the future, told us to ‘Keep everything as simple as possible, but no simpler.’ The ‘So whats?’ are: tend towards the left-hand side of Figure 1; examine topics in chunks that are small enough to be manageable; and keep any wargame that examines the far future as simple as is sensible.

‘Soft’, non-kinetic factors and human factors

Until the point when humans are assimilated into the Borg collective, farmed to power the Matrix, succumb to the Daleks or the Vogons destroy the Earth to make way for an interstellar by-pass, the future, like warfare, will remain a predominantly human endeavour. Clearly, technology will increasingly feature, and might even be the principal factor in many wargame scenarios, but we ignore soft, human factors at our peril. Too many current wargames do this, somehow envisaging conflict that is not fought among the people. Such games, conducted in a sterile, kinetic environment risk undermining our understanding of conflict, not enhancing it. This will be the case as far into the future as we care to gaze. Wargaming the future must include representation and consideration of soft, non-kinetic factors.

Adversarial

‘Adversarial’ is at the top of the list of characteristics in the Wargaming Handbook, so why have we relegated it to so low a position? This is not because it is unimportant; it remains critical that our plans and grand schemes are exposed to a live adversary, trying to impose his or her competing agenda or world view on us. If we did not do this, we would not be

61 This might be a compressed version of lines from a 1933 lecture by Einstein: “It can scarcely be denied that the supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience” (Robinson 2018).

62 The Borg are a civilisation of cyborgs (hence the name ‘Borg’) which seek to conquer or ‘perfect’ all life. The Borg have a singular goal, namely the consumption of technology and to ‘raise the quality of life’ of the species they ‘assimilate’. www.stratrek.com

63 The reality perceived by humans is actually the Matrix, a simulated reality created by sentient machines in order to pacify and subdue the human population while their bodies’ heat and electrical activity are used as an energy source. www.matrix.fandom.com/wiki/The_Matrix

64 The Daleks are one of the most feared races in the universe. Their creator, Davros only has one intention: destroying all life apart from Dalek life, www.thedoctorwhosite.co.uk/dalek/

wargaming. Furthermore, we must ensure that neither side has an inbuilt technological advantage.66

Adversarial is placed low on the list because, if we do not get the basics right, any future-gazing wargame is likely to be sub-optimal. Hence the most wonderfully adversarial game play will likely be nugatory. Wargaming the future must feature innovative and determined adversaries, playing their anticipated capabilities to their full potential. However, the games must privilege the characteristics discussed above over adversarial game play.

**Oppositional**67

So, too, with oppositional. We have discussed Critical Thinking, which is a primary mechanism for injecting oppositional factors. The point to add is that all players must be Critical Thinkers, scrutinising their own, and everyone else’s, plans and assumptions. The ‘Critical Thinking’ agenda item must be an invitation (demand) to all players – not just nominated Critical Thinkers – to employ the technique.

**Effective control**

All professional wargames are controlled (verb), usually by a Control (noun) organisation. The function of Control is to steer the wargame minute-by-minute to achieve the objectives (while taking full account of player decisions; a primary balancing act). But these objectives – which should be front and central – are too often forgotten, subverted or subject to mission creep. In wargaming the future it is even more important than usual to work towards well-considered and bounded objectives because the enormous number of potential variations and deviations from these can lead to a wargame that drifts into topics that are not relevant to the subjects of analysis being examined.

**Engaging – even fun!**

Although last on the list, the necessity to ensure that wargames are engaging, even ‘fun’ – if you’re allowed to use that word. We do not wargame for fun, but they can be fun. They must at the very least be professionally satisfying. Wargaming the future relies heavily on players’ imagination and inventiveness. If players are not engaged, these characteristics will not feature, with a resultant failure of the imagination and the likelihood that outcomes will be a linear extrapolation of current trends - something that history tells us rarely happens.


67 This is Clausewitzian ‘friction’, which has been defined as: the propensity of unexpected delays to occur during armed conflicts. See (Simpson 2016).
Exclusions

There are two characteristics of a successful wargame that we feel have a very low priority and, arguably, should not feature at all in analytical future-gazing wargames. These being ‘chance’ and ‘uncertainty’, we are sure that their exclusion will raise howls of ‘heretics!’ In our defence, we think that there is so much uncertainty and chance when future-gazing that to introduce more seems, at best, pointless and, at worst, dangerous. Chance and uncertainty must feature in educational/training wargames, and might have a place in near-future analytical wargames, but we do not think it sensible to divine probabilities and percentage spreads for capabilities that are, at best, conceptual prototypes. We recently wargamed novel technologies in the Arctic in 2045. One of these was autonomous submarine swarms. During an attack by one of these, a series of poor dice rolls resulted in no effect. This was not the expected outcome, which had to be emphasised to mitigate the players having witnessed the capability underperforming, and rating it poorly. We find it best to avoid such chance outcomes (which are based on questionable quantification) and present - as part of the deliberative approach - the expected, or assumed, outcomes. The future holds enough uncertainty; we should not amplify that and undermine our analysis.

Conclusion

Wargaming is an ideal tool for the task of scrying the future, but must be applied simply and effectively, and in conjunction with other techniques as part of an IAECP. And a wargame that peers into the far future is still just a wargame, albeit probably with different factors and variables involved. While technology will become ever more important and must feature in our games, the future will still be shaped by humans - until we reach that hypothetical point where the machines take over. Wargames are people-centric in terms of their play (players), control and analysis. Computer-assistance (AI, ML, ABM etc.) has a role to play in supporting our wargames, but we cannot (yet) computerise the vital human ingredients. Rather, we should adopt a ‘back to basics’ approach to ensure that our wargames make an effective contribution to future-gazing. Wargamers must ensure that they design, develop and execute their games applying wargaming best practice rigorously. This paper suggests what this best practice consists of, and how it might be applied.
References


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Graham Longley-Brown has over 20 years of experience in the design, development and delivery of professional wargames for analytical and training purposes. He was the lead author for the 2017 MOD Wargaming Handbook; wrote the current Course of Action (COA) Wargaming section for the British Army’s Planning and Execution Handbook; and is about to publish Successful Professional Wargames: A Practitioner’s Guide. He is a co-founder of Connections UK. A British Army Officer since 1986 (and still in the Reserves), he has used wargaming for serious purposes throughout his career, often as a lone champion of the technique. He was the UK Joint Services Command and Staff College Directing Staff Subject Matter Expert for wargaming from 2000-2002. Since leaving the Regular Army in 2003, Graham has designed and delivered wargames for the UK, European and Gulf State Staff Colleges, the UK Army (at all levels), RAF, Royal Navy and Royal Marines, the NATO Joint Warfare Centre, UK Force Development and experimentation, Dstl, the American, British, Canadian and Australian Armies Programme, the Royal Brunei Armed Forces, the Pakistan National Defence University, the US Army in Europe and others.

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Wargaming the Uncertain Future

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War, Games, and Uncertainty 50 years from now

“The future’s uncertain/And the end is always near.”
Jim Morrison

Introduction

This paper addresses the question “How might wargaming influence military thought fifty years in the future?” We make an assumption that wargaming can influence military thinking; while arguments can be advanced in favor of (and also in opposition to) that view, they are not entertained here: we simply presume an affirmative answer. The next matter is how to use games to this end.

When attempting to address uncertainty in national security matters, one might imagine using simulation games to answer questions about technologies (which is better: a faster submarine or a deeper-diving one?), or about political-military issues (which country will most threaten the United States in 2070?), or about strategies (what should American cyber strategy be?), etc.

The nay-sayers would then object that “you can’t get anything out that you don’t put in,” “the future is too hard to predict,” and that “when the future comes, it will be too hard to understand.” Especially in games, one can certainly come out with facts that one has not put in, but it is more than plausible that a fifty-year time horizon is too long for the prediction of technology or international affairs.

Therefore this paper is not about using games to answer questions; at a 50-year time horizon, games are unsuitable for such an effort. The famous interwar Naval War College games (see also below) are said to have had predictive value, but on a time-scale of half as long, and arguably during a period of slower technological change.

Instead, this paper will address the use of games not to reduce the uncertainties that people will face, fifty years from now, but to increase their ability to deal with them.

68 For example, the inventor of chess (were there to have been such a unitary person) did not “put in” the fact one should put one’s Bishops on adjacent squares, nor yet did s/he “put in” the fact that Bishops are stronger if so deployed; rather, s/he put in the along-the-diagonal move of the Bishop, and the rest follows as an “emergent property.”

69 Or so it is commonly said, but maybe not. As pointed out by Randall Monroe, spaceflight is now older than airplane aviation was when spaceflight started.
The fifty-year time horizon

Some people, while granting the ability of wargames to influence thought, have expressed skepticism that the effort requires, or can even tolerate, a fifty-year lead time. But for an effort to influence thought, fifty years’ head start might be about right. John Forbes Nash Jr. identified his Equilibrium in a 1950 paper, but the idea did not gain serious influence until the publication of Robert Axelrod’s *The Evolution of Cooperation* thirty years later. In fact one could argue that the whole game theory enterprise (started in 1944 by von Neumann and Morgenstern), theretofore associate primarily with cute examples and disappointing results, finally gained influence about then.

Another important point is that people play games when they are young, and are important (while also perhaps still playing games) when they are old, about fifty years later. Admiral John Richardson (31st CNO) matriculated at the Naval Academy in 1978—forty years ago—and General James Mattis, who resigned as Secretary of Defense while this paper was in preparation, enlisted in the Marine Corps (while a college student) in 1969—forty-nine years ago. Given that wargaming can (and often does) start in one’s college years or earlier, a fifty-year lead time is not out of the question.

How people benefit from playing games

This paper is about games that will be of benefit by shaping patterns of thought.

So, if the games to be addressed in this paper are envisioned as having value because they benefit the people who play them, we have the more general question “How do people benefit from playing games?” A comprehensive answer would probably be a whole paper in itself, but let us list a few ways. Games help people exposing them to:

➢ Uncertainty, in accord with the topic and goals of this paper;

➢ Other players—thinking, scheming, conniving, unpredictable, inimical (not in a moral sense, but in the sense of having goals opposed to one’s own) human beings in their own right;

➢ Chance elements such as cards, dice, etc.;

➢ The need to envision a future, make a plan to get to it, and to know when to keep or abandon that plan;

➢ Given some long term objective (the game’s definition of victory), the experience of perceiving, working toward, and then perhaps abandoning shorter term goals;

➢ The experience of making, and then perhaps abandoning, agreements and coalitions;

➢ The observation (via repeated play) that things need not turn out as they did;

➢ The difference between a correct choice and a successful one (or, at any rate, the opportunity to argue for or against the proposition that there is such a difference);
➢ What it’s like to lose.\textsuperscript{70}

Some of these can be experienced in other ways, but games provide a comparatively cheap, easy, and repeatable source of all of them. Of note, a person could, in our society, reach high levels of educational and cultural attainment with zero exposure to any of them. Many do, and some may rise to important national security positions. They will do a better job for having played games.

**Interwar wargaming at the Naval War College**

As is well known, the Naval War College conducted surface naval wargames, played with ship models on the floor of a large room, during the period between the World Wars; these are seen as having been highly influential. Like most accounts of them, that of Miller is quite positive, crediting the games with the debunking of the “through ticket” option of a direct strike on the Philippines from Hawai’i (and thus the creation of the alternative “island-hopping” concept, which was actually used) and the invention of the light cruiser. Miller repeats Nimitz’s claim that the only aspect of the war against Japan not predicted by the games was the kamikaze, while also saying elsewhere that Japan’s Long Lance torpedo did not appear in the games either.

Miller commends the games for great training value, but touches on this point only intermittently and without giving great detail as to how individual officers benefitted from having played; his emphasis is on institutional learning.

Nor does he allude to the games’ role, if any, in the great intra-navy debate of the time (far greater than any argument about the “through ticket” vs. “island-hopping”): the long and bitter dispute\textsuperscript{71} over whether or not aircraft carriers would supplant battleships as the Navy’s capital vessels and main striking force.

We do not know how these games represented uncertainty, especially regarding Japanese capabilities. “Urban legend” and Subject Matter Expert opinion present three somewhat contradictory views:

➢ At all times, the games’ presentation of Orange incorporated the best available knowledge concerning the Imperial Japanese Navy.

➢ Aware that their information was imperfect, the games’ creators deliberately included Japanese capabilities (or incapacities) not supported by intelligence, just to see their effects.

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\textsuperscript{70} I am indebted to Dr. E. McGrady for this entry.

\textsuperscript{71} Finally settled only by the Japanese, 7 December 1941.
➢ So as to prevent students from gaining unfair academic advantage from their predecessors’ experience, and/or to provide them with an opportunity to excel, the War College deliberately introduced variety by including unsubstantiated, or even counterfactual, details regarding the Japanese Navy.

The truth of the matter may never be known, because a great deal of material was apparently thrown out in the 1970s.

Games that play people

Nowadays, statements like “I’m working on a game” are frequently taken to refer to computer games, i.e., programs (or “apps”) that act as opponent, referee, board, and pieces for a person to play against. Except in the cases of traditional games that have been ported to the computer (e.g., chess), these games generally embody—and may even conflate, for all anyone can tell—uncertainty in the forms of chance, hidden information, and hidden rules. Many people find these games enjoyable to play, but their educational and experiential value is reduced by the fact that they are, almost literally, “black boxes” whose hermetic nature precludes post-game analysis because the conditions, the probabilities, and maybe even the rules themselves are unknown.

In a game played by two humans, a computer could be invaluable as the moderator of sighting and shooting, and it could have a play-back capability for after-action analyses. But its “black box” nature would inevitably engender a player belief that it contained deeply buried and ineffable processes, to which all events (including, especially, defeats!) could be ascribed, to the exclusion of actual learning.\(^72\)

Defenders of such games are quick to point out that their ultimate unknowability is realistic, because life itself is unknowable in much the same ways. Perhaps that’s true, but if so, one could just go back to learning from life itself and not bother with games that are no better explained than life.\(^73\)

Uncertainty, 2070-style

When considering the uncertainty of future war, especially in the middle-distant future that is a few decades from now, we tend to focus on the uncertainty caused by our inability to predict how technology will develop over that span of time. However, the effect of this

\(^{72}\) It is for this reason that the author has resisted all attempts to computerize his game SUBHUNT, co-designed with CNA’s Dr. Yousi Ma.

\(^{73}\) Also, and with particular reference to computerized war games, the idea that the player should learn from experience neglects the fact that real-life people enter into their wars with a large background knowledge gained from training, doctrine, and the like. They are not just pushed into a seat in an airplane, tank, ship, or command post and told to start learning.
technology uncertainty is easy to overrate, because by the time the war starts, we will have a far better idea of how technology has developed, and in fact we will probably have developed quite a bit of it ourselves.

So let us look only at the big picture, in which we can see two major sources of increased uncertainty, if not of change in the nature of uncertainty itself. We shall call these “Low Entropy” and “Schrödinger’s Tiger.”

Low entropy

In the decades since the Second World War, conventional weapons (to say nothing of nuclear ones) have become vastly more lethal—almost entirely because of huge increases in the probability of hit—and far fewer in number. Entropy being the negative of the sum over states of p*ln(p), the great decrease in the number of entities brings about a decrease in the number of end-states, and thus of the entropy. Luck no longer “evens out” and uncertainty increases. An early version of this form of uncertainty was visible in WW II carrier battles, in which the numbers of airplanes were small (dozens, vice hundreds in the air war over Europe) but the damage they could do was considerable and because of the delicacy of aircraft carriers, the variation in outcomes was actually small—“no effect,” or “mission kill.” Entropy is also lowered (or, perhaps, it comes into existence at a lower level than is normally appreciated) because of the interdependence of probabilities that might, at first blush, appear to be independent.  

Schrödinger’s Tiger

Schrödinger’s Tiger is uncertainty caused by our ignorance of ways in which one thing will (or will not) operate upon another: in future warfare, this uncertainty will be profound. In a measure-countermeasure duel, one side will win, but we have little means of predicting which one. This effect is most clear in cyberwarfare, and second-most in electronic warfare, but in fact it probably extends to physical weapons themselves, where the struggle between stealth and sensors, difficult or impossible to replicate in a test, much less an exercise, becomes close to imponderable.

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74 The path-breaking and sadly neglected “Configural Theory” of Timothy J. ("Jim") Horrigan (Horrigan 1990) addresses this topic, primarily in regard to combat models.

75 The idea and the illustration are based on the Schrödinger’s Cat example in quantum physics, wherein the unfortunate feline is contained in a box that may or may not have, based on the random decay of a small radioactive sample, been filled with poison gas. Uncertain as to the creature’s fate, we are invited to think of it as having a probability (e.g., 50%) of being alive even though we know that it is either fully alive, or fully dead.
All together, now

Now consider the union of these two forms of uncertainty (plus any residual technology uncertainty that may remain): the upshot is that we have a sequence of interactions whose entropy, already low because of the small numbers of entities involved and the small numbers of end-states they can take on (mission-killed or no effect), is further reduced by the fact that some of the outcomes are in fact pre-ordained as Schrödinger tigers.

Moreover, post WW II war has become complex politically. In WW II, a large number of nation-states aligned themselves on two sides, but in today’s world (and probably even more so in the world of fifty years from now), relationships are not nearly as clear.

Finally, and bringing us to the realm of games rather than other uncertainty-dispelling activities (like jigsaw puzzles), the principle source of uncertainty in future wars will be the other side. In past wars, decision-makers felt great uncertainty about the weather, the positions of their own forces, the intentions of their subordinates, the state of their supply, and so on. Modern computing and communications have all but eliminated those uncertainties (and will certainly have done so completely by the time another fifty years have passed), leaving only the uncertainty that is introduced by the opponent. The pundits’ caricature of video-game-like “push-button war” leaves much to be desired, but one thing it gets right is that future wars are on a collision course with games, and much of the reason is the elimination of sources of uncertainty that games never represented particularly well in the first place.

Conventional wargaming does not lend itself to addressing opponent-created uncertainty of the Low Entropy and Schrödinger’s Tiger types, but other games do, and wargames could as well, if we were willing to conduct wargames somewhat differently from how they are conducted now.

Realism, validity, and all that

“Realism” is a frequent goal (or chimera, or shibboleth) in wargaming. It corresponding to “validity” in Modelling and Simulation, except that the wargaming community shows more awareness that realism (whatever it is) must be present at the outset, vice the M&S community’s apparent belief that validity is injected toward the end, in a “validation” step. By normal standards, realism and validity are unattainable for wars of 50 years hence: in light of the great rate of technological change, it would be futile to try to game future wars, a half-

\[76\] It took a while, and it need not have turned out quite as it did. In 1939, for example, France nearly came to the defense of Finland against the USSR, but in the end Finland was aligned with the Axis and both France and the USSR counted themselves among the Allies. H.P. Willmott has argued, with typical extravagance, that the Second World War did not begin until 1943, prior to which there were only widespread regional wars that involved overlapping sets of belligerents.

\[77\] Some might argue that they are unattainable for wars of today, or even for wars that now lie in the past.
century in advance, by deeming some set of weapons, technologies, or even warfare areas to be ascendant and then designing a game about them or their future incarnations.

But there is no accepted standard of realism and/or validity. At one extreme, some hold that to be realistic or valid, a game or simulation must reflect all relevant facts. This is probably unattainable in any case and certainly cannot be had in a game about war in fifty years. At the other extreme, it is sometimes said that the game should at least be able to produce the historical outcome. That’s probably a good idea, for a historical game, but is it a standard of realism? What if the game can produce the historical outcome, but nothing else? What if historians agree (as in the case of the Battle of Midway, or even of Waterloo) that the historical outcome was unlikely? And what if, as in a game about the future, there is as yet no historical outcome?

I favor an altogether different standard: a game is realistic and valid insofar as the thought processes that it fosters in the players resemble those exercised by the participants in real life. On this basis we can jettison all attempts to define future wargaming in terms of the weapons and other technological features of the far-future landscape, which we cannot know and thus cannot simulate faithfully, or perhaps at all. Instead, we will try to focus on the thought processes that will occupy future commanders’ attention, and then create games that will foster those processes.

The plan of the work

In sum, we have concurred with the premise that wargaming can help dispel uncertainty, but we have reached the paradoxical conclusion that while a fifty-year lead time is too long for the prediction of technologies or capabilities (either friendly or enemy), it is about right for beginning to train decision-makers.

Therefore, the work will proceed as follows.

First, let us identify several extremely simple games (not necessarily wargames, and in fact probably not wargames, because of the simplicity requirement) that embody particular uncertainty-related thought processes that we deem likely to be needful in future conflict.

Second, let us combine these games into one or more larger games, which might be wargames, albeit possibly very different from those to which we are accustomed. The combination need not contain each constituent, though each should be considered in its creation.

Third, we must play these games, not only the final creation also the constituents and—above all—get others to play them, and record their reactions.

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78 Richard Westerman, personal communication ca. 1990, and E. McGrady, personal communication ca. 2015.
Fourth, iterate steps two and three, generating multiple games whose play we feel will benefit national security decision makers fifty years from now, especially if those individuals (presently somewhere in the grade school to college age range) start playing them now.

**Seven Easy Pieces**

“I don’t believe any game that can’t be played as a parlor game.”—Martin Shubik

Certain games now extant seem to me to be relevant to wars of fifty years from now, especially with regard to uncertainty. This section will examine them. For want of any other organizing principle, they are presented in the order of their invention. Probably not by coincidence, the first five are especially accessible because they do not use proprietary game sets; rather, they are played with commonplace chips, cards, coins, dice, and chess pieces, or with parts easily made on a copier. Most are also basic, or even rudimentary, in their rules: part of their interest is the complex play that their simple rules can engender.

To keep game-rules from getting in the way of the real point(s), this section only describes the games; the Appendix gives the actual rules.

**Kriegspiel**

*Kriegspiel*[^79] is double-blind chess, played with a referee. Its Deep Inner Meaning stems from the moves’ dual nature: they are explorations as well as attempts to take pieces or to checkmate, and in most instances the exploratory aspect is predominant. Illegal moves become supremely important, as their rejection (by the referee) provides information without cost or commitment; the King, being subject to check, becomes a sensitive probe of the other side’s position.

In some implementations, there is another channel of information: the ability to overhear the colloquy between the referee and the other player. For years I thought this was a bug, but the books by David Li made me decide that in fact it is a feature.

More recently, a commercial version of the game, dubbed *Infochess*, has been marketed to the military-analytic world as instructive in decision-making.

**Colonel Blotto (a.k.a. GOPS, Goofspiel)**

The “Colonel Blotto game” was propounded by Émile Borel in 1921. In it, the two players secretly pre-allocate resources (notionally, soldiers) to each of several competitive endeavors,

[^79]: Invented by Henry Michael Temple in 1889 (https://www.chessvariants.com/incinf.dir/kriegspiel.html). The word is German for “wargame,” but modern German, at least, would apply a declension to the first syllable, rendering the word as “Kriegsspiel.”
and then each endeavor is won by the player who devoted the most resources to it, and the winner is the player who won the most endeavors.

The similar game GOPS (Game Of Pure Strategy) was invented by Merrill Flood (who would go on to create the famous game-theory game Prisoner’s Dilemma) when he was an undergraduate in the 1930s (Tucker 1985). A deck of cards is separated by suit; each of two players receives one suit, one suit is laid out face-up on the table, and the fourth suit is set aside. Players “bid” for the face-up King by each placing a face-down card next to it; these are revealed and the player who placed the highest card wins the King. Play then proceeds to the Queen and so on down through the whole face-up deck. Scores are then totaled—13 points for the King, 12 for the Queen, and so on down to 1 for the Ace—and the higher score wins.

There are many variants, e.g., one in which all bids are made before any are revealed, and commercial versions have been marketed. A great deal of academic research has also been done.

There is no reason that only two people can bid on a card, and—especially given the kinds of user interface now readily created on the Internet—Colonel Blotto has become a multiplayer game, not only in just-for-fun contests but also in relation to lines of academic inquiry.

Various RAND-based “Tactical Air Games” can be seen as extensions of Blotto. In them, the two sides each have a quantity of airplanes fungible across a set of missions such as Bombing, Air Defense, and Fighter Escort. Each turn, each side secretly allocates airplanes to these missions. Then their choices are revealed, and certain recipes are applied to determine the numbers of survivors. For example, each side’s Air Defense planes each neutralize two Fighter Escorts; un-neutralized Fighter Escorts destroy one enemy airplane, effective next turn. Airplanes assigned as bombers drop their bombs, each of which adds one point to its side’s score. Then any and all surviving airplanes are, regardless of their earlier roles, assigned new missions for the next turn. Such games have received quite some attention over the years, on account of the existence of solutions, some of which are “mixed,” i.e., the player needs to resort to some form of randomization to implement them.

So Long, Sucker

This fiendish game, designed by a distinguished group (Hausner et al 1964) that included John Forbes Nash, Jr. (subject of the book and movie A Beautiful Mind, and a winner of the Nobel Memorial Prize in Economic Sciences in 1994), forces the players to make and break coalitions. There’s no way around it, and because the game involves no cards, dice, or other chance elements, some say the players ought to be able to see the betrayal coming.

80 See for example Dahl & Bakken 2002 and Dresher 1961.
Yet often they did not. Shubik’s account is worth quoting at some length:

“Hausner, McCarthy, Nash, Shapley and I invented an elementary game called “So Long, Sucker” where it was necessary to form coalitions to win, but this alone is not sufficient. One also has to double-cross one’s partner at some point. In playing this game we found that it was fraught with psychological tensions. On one occasion Nash double-crossed McCarthy, who was furious to the point that he used his few remaining moves to punish Nash. Nash objected and argued with McCarthy that he had not reason to be annoyed because a little easy calculation would have indicated to McCarthy that it would be in Nash’s self-interest to double-cross him.”

During the game’s brief life (primarily among Nash and his colleagues at MIT and RAND) there were tales of couples who required separate taxicabs for the ride home. Anatol Rapoport devotes an entire chapter of his book *N-Person Game Theory* to a play-through of a simplified version of the game.

**George Gamow’s Tank Game**

Closer to wargaming, George Gamow invented a game that he called “Tin Soldier” and others called “Gamow’s Tank Game” (1951): played on hexagons with toy tanks and the trappings of a wargame, e.g., terrain types of Woods and Clear, its only point of non-triviality is its double-blind play. Gamow conceived of the game because he wanted something that could be played by (not just on, but by) a computer of the day. The game seems to have been a flop in that sense, but it represents a landmark of gaming in that it combined double-blind play with wargaming.

**The Multi-Armed Bandit**

The *Multi-Armed Bandit* game was conceptualized by Harold Robbins in 1952. The proverbial “one-armed bandit” being a slot machine with a fixed distribution of payoffs, Robbins’ hypothetical multi-armed bandit was an ensemble of slot machines, with fixed but presumptively different payoff distributions. At least one of the arms has the property that its expected payoff exceeds the cost of playing: the player’s task being to win as much money as possible, s/he must combine experimentation (the goal of which is to find the most fruitful machine) with exploitation (the goal of which is to milk the putatively best machine of its coins). Robbins created the problem as a vehicle for his various ideas on the design of experiments, and he and others have propounded many variants for that purpose.

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81 Shubik, op. cit., quoted by Mirowski, page 344. Mirowski remarks that Nash’s “construction of rationality would dictate that nobody would ever voluntarily play this, or any other, game with him.”
For many purposes, a mere Two-Armed Bandit will suffice. Notionalized as a single machine, it has right and left arms with presumptively different payoffs, at least one of which is net-positive on an expected-value basis. A fully general solution of this game (i.e., an “effective method” for arriving, with any desired confidence less than unity, at a decision as to which arm is preferable) long eluded solution, and may to this day. Even greatly restricted versions (e.g., one in which all payoffs are either $0 or $1, and the arms differ only as to the probability of returning $1) are sufficiently difficult to assign to graduate students in Decision Theory.

The point of these “bandit problems” is that they encapsulate the task of conducting experimentation and production at the same time. In the real world, one example might be oil-prospecting, in which the goal of producing a lot of oil from known reserves is (or was once) combined with the goal of finding plentiful new reserve areas to exploit.

In the world of military procurement, similar problems abound. During the Rickover era, for example, The USN’s numerous one-off submarine designs embodied experimental new ideas, but they also had to be useful as undersea platforms in their own right.

There is even experimentation in combat, as related by Zuckerman in connection with his study of the bombing of Pantelleria.\textsuperscript{82} the target was to be destroyed, but knowledge was to be gained as well. Morse and Kimball describe some in-combat experimentation with an anti-ship missile that might be subject to jamming; there is an anti-jam device available, but it ought not to be used if it is unnecessary. So there begin simultaneous campaigns of anti-ship warfare and experimentation, rendered even more complicated (and game-like) by the consideration that once the enemy realizes his jamming has been defeated, he may discontinue it; therefore there needs to be continuing occasional use of non-anti-jam missiles, to be sure that the jamming has not ceased.\textsuperscript{83}

\textit{The Awful Green Things From Outer Space}

This commercial game (originally published in 1979) has the look and feel of a wargame, albeit perhaps not a very serious one. The board depicts a spaceship, whose human crew must try to fight off an infestation of The Awful Green Things—or, \textit{in extremis}, abandon ship.

Cartoon artwork and extremely fun play may distract from the game’s unique and instructive feature, which is that the humans’ weapons’ effects on the Green Things are initially unknown, and can be found out only by use. (In terms of game mechanics, the implementation is a chit-drawing system.) Some previous wargames had used such a thing, often called “untried

\textsuperscript{82} Zuckerman, pages 187 and 196

\textsuperscript{83} Morse and Kimball present this example as hypothetical, but maybe it is not, and in any case the Allies and the Germans engaged in similar measure-countermeasures throughout the Second World War, as related by R.V. Jones.
units, but the in a historical game the potential for doing so was is limited by the history that the game represents: departure would be (in the words of a noted game designer and critic) “abhorrent.” In *The Awful Green Things*, however, there is no reality to which the design must be faithful, and the weapons effects can vary wildly from game to game. Some of them even act to the Green Things’ benefit.

**Zendo**

Despite the Eastern trappings of its name and first-edition (2003) packaging, *Zendo*’s topic is a decidedly Western version of logic and inquiry.

There are multiple players and a Master. The playing pieces are small plastic pyramids of various colors and sizes. In play, small numbers of pyramids are set out in groups, called *koans* after the famous riddles of the Zen Buddhist masters. Before the game, the Master has secretly written down some regularity, e.g., “Contains no yellow pyramids” that is present in some groupings and not in others. This is called the “Buddha Nature.” The players are trying to deduce this Buddha Nature by creating koans and seeing how the Master grades them.

At the start, they do so simply by observation: the Master has created two set-ups, one of which follows the Buddha Nature and one that does not. The players then (in turn) proceed to create their own set-ups, which the Master marks as conforming to the Buddha Nature, or not. Finally, they reach the stage of being able to propound a possible Buddha Nature in words: a successful attempt wins the game; an unsuccessful one receives a refutation from the Master, in the form of a counterexample.

Much of the game’s character stems from the lack of any list of possible Buddha Natures: some few were suggested, but they were intended as illustrative and the Master is urged to invent his or her own. In this way, *Zendo* differs fundamentally from the well-known *Mastermind*, in which the player strives to deduce which one of a large number of well-defined set-ups the Master had selected, and can do so algorithmically. In contrast, *Zendo*’s free-form structure forces the players into inductive reasoning, which is standard in real-world inquiry but

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84 In the non-themed second edition of the game, the Buddha Nature is simply called a “rule.” I can understand objections to the term “Buddha Nature,” on the grounds of “cultural appropriation, but I object to the substitution of the word “rule” in that it gives the impression that “*Zendo* is a game where you have to guess the rules,” which is misleading at best and untrue in reality. So here (and in teaching the game to groups) I used the terms “Buddha Nature,” and “koan.”

85 The second edition goes to the opposite extreme, furnishing so long a list that only the most fanatically motivated player would even consider memorizing it and creating a pruning algorithm for eliminating entries. The use of this list forestalls what is surely the number one failure mode for Masters: the creation of a Buddha Nature that is too difficult. See also later commentary in the text. But, conceptually, it alters the game from being inductive to being deductive, and inductive games are all too rare.

86 Knuth presents sophisticated algorithm.
Wargaming the Far Future

quite rare in games,\textsuperscript{87} as well as obliging them to understand such concepts as \textit{counterexample} and \textit{equivalence}.\textsuperscript{88}

Players, and (even more so, novice Masters) sometimes have difficulty with these ideas, usually culminating in the complaint “that’s not the Buddha Nature, but I can’t think of a counterexample.”

\textbf{Commentary on the Easy Pieces}

\textit{“In the whole range of human activities, war most resembles a game of cards.”}  
\textit{Clausewitz}\textsuperscript{89}

Pursuant to the discussion of our fifty-year time-horizon, the first thing to notice about the “Easy Pieces” is that five out of the seven are even now over a half-century old, and yet they retain their interest and importance.

The second thing to notice about the Easy Pieces, if at all possible, is what it like to play them. A common—almost standard, even among game-players—reaction to a new game is to say that the right course of action is obvious.\textsuperscript{90} Yet each person’s idea of the “obvious” is likely to be different, and not all are winning choices. The Appendix contains rules and/or a playable description for at least one variant of each of the first five games, and all are recommended.\textsuperscript{91} The role of the referee (needed in \textit{Kriegspiel}, \textit{Gamow’s Tank Game}, and \textit{Zendo}) requires a clear

\textsuperscript{87} An exception is Robert Abbott’s “Eleusis” (1956), presented by Martin Gardner in his July 1959 column in \textit{Scientific American}; a major revision appeared in Gardner’s column of the October 1977 column, and John Golden’s derivative Eleusis Express (2006; \url{http://www.logicmazes.com/games/eleusis/express.html}) resembles \textit{Zendo} even more strongly in that the game ends when somebody discovers the Buddha Nature. Some readers may also know Abbott’s uncertainty-related boardgame \textit{Confusion} (Stronghold games, 2012), in which the players do not—initially—know how their pieces move.

\textsuperscript{88} A \textit{counterexample} is a set-up of pyramids that refutes an incorrectly-gguessed statement of the sought-after Buddha Nature by showing a difference between the guess and the real thing. There are in general two ways in which it can do this: by conforming to the guess, but not the Buddha Nature, or vice-versa. In some specific instances, however, the guess may include the true Buddha Nature, or vice versa, in which case only one form of counterexample is available. For example, if the Master’s Buddha Nature is “contains no blue pyramids” and the player has guessed “contains no blue or green pyramids,” then the only form of counterexample is a Buddha Nature-compliant set-up that contains a green pyramid. Two statements of a Buddha Nature are \textit{equivalent} if—no matter how differently they may be worded—they create identical sets of compliant and non-compliant set-ups. For example, small, medium, and large pyramids are marked with 1, 2, and 3 pips respectively, so “contains no medium-sized pyramids” is equivalent to “the product of the all the pyramids’ pips is odd.”

\textsuperscript{89} Book I, chapter 21, tr. Howard and Paret.

\textsuperscript{90} This response is also standard in training exercises that offer choices to the participants.

\textsuperscript{91} The legendarily divisive \textit{So Long, Sucker} may be an exception. It should be played only by those who can attain total separation between their real selves and their player-selves (including especially the player-selves of the other players), or by complete strangers who will never meet again and are unarmed.
head and complete knowledge of the rules but should not be avoided: it is almost invariably described as “at least as fun as playing.”

A third thing to notice is the games’ distinguished roster of creators. Four out of seven games have designers known for multiple achievements in mathematics, physics, computer science, and/or economics.

**Stylization**

Most or all of the Easy Pieces, so disparate in many ways, embody *stylization*. Stylization can be described as the elimination of most detail and the extreme simplification of what remains.

For example, an argument could be made that the venerable game *Diplomacy* (1961) should appear as an Easy Piece, possibly to the exclusion of *So Long Sucker*. But the latter is simpler, clearer, cleaner, less asymmetric, and more to the point—in short, it is more *stylized*. Of note, the *Two-Armed Bandit* and *Zendo* are both stylizations of the research process, but they accentuate different aspects thereof.

The overt wargames, Gamow’s *Tank Game* and *The Awful Green Things*, are not as simple as the other games, but in accentuating the opponent’s agency in creating uncertainty they take on a complicated task, and are arguably as stylized as the other games, just less simple. The same could be said of *Kriegspiel*.

**Certainty for its own sake**

In *Zendo*, the players’ only goal is to dispel their uncertainty about the “Buddha Nature” the Master has propounded. Discussions of the game tend to take the form of scientific and/or mathematical discussion, starting with the ideas of example and counter-example, and moving to the notion that there is a “space” in which the possible set-ups (koans) are points, the Buddha Natures are [hyper-] planes, and a newly built set-up is most productive if it has a fifty-fifty chance of being deemed to follow the Master’s secret Buddha Nature. The quick recourse to real-world lines of reasoning is highly attractive to some players and highly repugnant to others; there does not seem to be much of a middle ground.

This effect is nowhere more visible than in discussions of how to handle a Buddha Nature such as “All the blue pyramids are big” when a koan has no blue pyramids. Mathematically trained players assert that if there are no blue pyramids, then all the blue pyramids are big (because there are no non-big blue pyramids) so the statement to be true, or “vacuously fulfilled,” whereas players who have experience with database programming invoke the idea of

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92 For the use of this word in application to games, and for the goal(s) it represents, I am indebted to my former CNA colleague Kevin Brown.
mu, which is neither true nor false, and those familiar with Bertrand Russell’s “King of France” example will categorize the proposition as false.

The surprise at the conclusion of almost any game of Zendo, especially one involving beginners, is the simplicity of the true Buddha Nature, as compared to the hypotheses that the players have entertained along the way. It is not unusual for the players to use all sixty pyramids and then some (obtained by dismantling set-ups that they expect to be able to remember), only to find that the Buddha Nature was as simple as “contains at least one pyramid of each size.” This occurrence brings out an important point about Low Entropy—it can be a lot lower than it looks.

Maybe all of this goes to support a contention that “Zendo [just] teaches people how to think,” with the “just” inserted by those who do not consider the teaching of thought to be worthwhile, compatible with a parlor game, or necessary for future national-security decision-makers and their present youthful selves. But experience with the game, and accounts of it, suggest that nearly all people are, if nothing else, sorely in need of being taught how to think. At the anecdotal level, members of the WW II generation often cited high school courses in Geometry and/or Latin as how they had learned to think. Now the latter is seldom taught and the former has been debased, so a substitute is needed, and a game will do.

Certainty as a means to an end

Kriegspiel, Gamow’s Tank game, the various Bandit games, and The Awful Green Things are a step closer than Zendo to real-world situations in that any resolution of their uncertainties is a means to an end, not an end in itself. They embody the kind of uncertainty that we have characterized as Schrödinger’s Tiger: reality is completely determined, but the player doesn’t know how. Just as Schrödinger’s original cat was truly dead or alive inside its box, but the outside observer could not tell which, the player of Kriegspiel or Gamow’s Tank Game does not know the positions of the enemy pieces, the player of a Bandit game does not know the payoffs of the arms, and the players of The Awful Green Things From Outer Space do not know which weapon-effect chit is associated with which weapon.

Infochess, the commercial variant of Kriegspiel, adds a great deal of complexity by giving the players a budget that they can spend on pieces’ special abilities before the game begins. Plans for quick wins are thwarted mostly by even quicker wins.

93 Kriegspiel, the Tank game, and Zendo create and maintain this uncertainty through the agency of the referee, and the Bandit games have something similar in theory, and certainly in classroom practice; The Awful Green Things does without a referee, through a clever chit-drawing game mechanic.

94 Actually, at the beginning of the game, s/he does, because the pieces are placed in their conventional set-up. Part of the fascination of this game is how this certainty decays, and then begins to return toward the end of the game, as pieces become fewer and checks become more frequent.
As a learning tool, *Kriegspiel*’s (or *Infochess*’s) starting point in chess can be problematic. Non-chess players feel that they are disadvantaged, and chess players sometimes assert that their expertise should be heeded, despite the major departures from the game they know. Either or both groups may be right, but in the on-side metagame of playing *Kriegspiel*, this debate can be salutary because it simulates the endless wrangles between soi-disants Subject Matter Experts and their skeptics.

Contact with the intelligence world\(^{95}\) suggests an important variant on the Bandit games. In it, one is dealing not with the actual Bandits or their multiple arms, but with a number of Tipsters, who supply the players with probabilistic recommendations regarding Bandit arms.\(^{96}\) Even though the Bandits and their arms do not change, the Tipsters’ recommendations do, because they themselves are basically also Bandits, only they pay off in recommendations, not in money. As is the case with the arms in the original game, it is stipulated that at least one Tipster has a distribution of advice whose outcome will result in a net positive return over the long run.

In a *Colonel Blotto* variant in which the prize cards are presented randomly and the conflicts are resolved (and revealed) one at a time, the player faces a new source of uncertainty—the order in which the cards will appear. While s/he might be tempted to argue that this change has no real effect (by mentally making allocations in advance, and then enacting them regardless of the order in which the prize cards appear), s/he would self-disadvantage by so doing, because s/he might (and almost certainly would) do better to make each allocation in light of which cards the opposing player had used up already.

Gamow’s *Tank game* and *The Awful Green Things* also involve wargaming’s usual source of uncertainty—the outcomes of individual attacks, customarily determined by mechanisms using dice, cards, or coin-flips. The player will likely notice that his or her reasoning therefore entails two entirely different forms of probability, i.e., of uncertainty. One is (to take the *Tank Game* as an example) the coin-based probability of one tank defeating another; the other is the Schrödinger-type probability that a given hex, non-adjacent to any friendly tank, contains an enemy tank. But the playing field is small and the tanks are few, so the outcome of one encounter can and does condition the future positions of the tanks,\(^ {97}\) and thus the outcomes of later encounters. For example, Blue could destroy a Red tank in a Woods hex and then take possession of that hex—which constitutes advantageous terrain and thus makes Blue more likely to win the next combat—but Red knows that, so s/he could strongly suspect that when the Blue tank disappeared from view, it went into the woods. In Horrigan’s terminology, the

\(^{95}\) For a short and on-point example see *Wilderness of Mirrors* by David Martin.

\(^{96}\) Concatenation of multiple layers of Tipsters would, apparently, create a layered neural net!

\(^{97}\) If not, actually, their current positions!
entire configuration of the board and its past matters, and no analysis is possible at any level other than that.  

**Creating uncertainty**

So far we have addressed players’ (and real-world people’s) efforts to dispel uncertainty, but the disappearing-tank example points up the fact that in warfare (unlike in science) there can also arise the desire to *create* uncertainty. To that point, there is now an unstated assumption that nearly all the uncertainty of future war will be created by the enemy.

Players of Gamow’s *Tank Game* and *Kriegspiel* can, through their maneuver, try to create uncertainty, and even to create incorrect certainty (i.e., they can try to be deceptive), as to the location of their forces. *Blotto* players give the opponent information every turn, but the wise *Blotto* player will keep in mind what the opponent does and doesn’t know.

In *Zendo*, the Master has considerable scope not simply for uncertainty, but for deception. For example, s/he could decide on two Buddha Natures, and make her original setups, subsequent pronouncements, and counterexamples, consistent with both of them. Only one of them is the real one (i.e., the one s/he has written down), there is at least an even chance that the players will focus on the other one, and perhaps more than an even chance if the counterexamples can be constructed in a cunning manner.

*So Long, Sucker* is notably for producing uncertainty without any double-blindness, randomness, or unreadable written-down facts: the players mystify one another through their very acts, and by *lying*.

**Three’s a crowd**

*So Long, Sucker* and *Zendo* stand out as being multiplayer, vice two-player, games, but they are multiplayer games in different ways.

In the former, the multiplayer nature of the game is related directly to its whole point—the making and breaking of coalitions—while in the latter, the cooperation is rare but so is direct conflict. Any out-smarting tends to involve, one way or the other, the referee. The opposing players are usually considered simply as a collective, especially when deciding whether to try to

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98 Mathematically, Horrigan defines a “configuration” as “a mapping of a set onto its power set.” His examples are quite convincing, and sometimes highly counter-intuitive; it is my belief that they hinge upon the interplay of these two forms of uncertainty, which I identify as the classical and the Bayesian notions of probability (the former being that probability is defined by long-run frequency, and the latter being that probability is defined by degree of belief). Horrigan explicitly does not endorse this interpretation (personal communication).

99 Normally no such excesses are necessary: the players will have plenty of difficulty with a simple Buddha Nature and straightforward counter-examples.
end the game by guessing the referee’s Buddha Nature, or to wait for one more round of play and then do so.

Though multiple people may, e.g., in a classroom setting, be exposed to the same Bandit(s) at the same time, the Bandit “game” is really a one-player dynamic puzzle, which people might compete (or cooperate) to solve.

**Low Entropy**

Our presumption that future war will have “low entropy,” while pessimistic from many standpoints, has the silver lining that it argues against one form of uncertainty frequently encountered in games: what might be called combinatoric uncertainty, i.e., the uncertainty created by a plethora of combinations, typically (in games) “exploding” exponentially as a function of the number of future turns that must be considered. Chess and Go embody this form of uncertainty, which is why they remain of interest as games even though they have no chance elements (other than assignment of the first move) and provide their players with complete information.\(^{100}\) The real world is doubtless more complex than any game, but even now, real-world decision-makers’ accounts of their difficulties do not cite “mind-boggling numbers of possible outcomes” as the source of their difficulties.\(^{101}\) And, finally, if the boggling of the mind were a problem, computers would be able to help.\(^{102}\)

Thus it is not a drawback of the “Easy Pieces” that, except for Kriegspiel, they do not embody the combinatorial catastrophe so strongly present in many other games; in fact, is an advantage.

That said, let us consider the Easy Pieces’ entropy in comparison to that of games in general.

*Kriegspiel’s is higher than that of Chess, and therefore not low. The Awful Green Things, the Tank game, and Zendo are also about average for parlor games.*\(^{103}\)

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\(^{100}\) Shannon approximated the number of possible Chess games at \(10^{120}\). He put the number of “sensible” games at \(10^{40}\); the number of sensible Kriegspiel games would be higher, because a great many things that would be completely nonsensical in regular Chess are very possible in Kriegspiel.

\(^{101}\) Au contraire, they frequently cite “information overload,” a misdiagnosis that goes beyond the topic of this paper.

\(^{102}\) Google’s Project Alpha Zero has lately made amazing inroads into Chess and Go, traditionally viewed as bastions of combinatoric complexity—especially Go. Of note, Alpha Zero has beaten the combinatorics not by brute force (as did the earlier Deep Blue, which defeated a world chess champion), but by the use of multi-layered neural nets that arguably deal in abstractions, as do people when faced with insurmountable complexity.

\(^{103}\) Based on the number of player-turns in a typical game, it has been estimated that the number of playable Buddha Natures is only about a million.
Colonel Blotto, So Long, Sucker, and the Bandit games have notably low entropies. We can do some calculations. In Blotto, there are 13! ways to assign one’s bidding-cards to the target cards, which is “only” about six billion. In So Long Sucker there are a chess-like number of possible moves available to a player at any one time (Shannon estimated 30, for chess), but games seem to be shorter than chess games. If a Sucker game goes 20 moves, there are $20^{30}$, or a “mere” $10^{39}$ possible games.

**Agreements**

The two multiplayer games’ contrasting views of “the other players”—as potential partners/marks in So Long, Sucker or simply as other game populants, as in Zendo—have direct translations into real-world terms. There are rivals with whom we might compete or cooperate, and there are faceless others who operate in the same space as we do. In the presumably multipolar world of fifty years hence, the ability to wheel and deal in multisided situations may be very important indeed.

**The most dangerous game**

In Colonel Blotto, Gamow’s Tank Game, The Awful Green Things, and So Long, Sucker, uncertainty is created by the other player(s)—thinking, scheming, conniving, conspiring, and even mendacious creatures that they are. (In Zendo, contrastingly, the players are all trying to solve the same problem, with the competition being the race to be the first to do so.) And right here we have major benefits of game-play: the discovery of other people’s “agency” through the realization that they can and will act on their own in a competitive, if not inimical, manner, and the revelation that their actions therefore cannot be predicted with confidence, if only because they will resort to randomization when it suits them.\(^\text{104}\)

With other players involved, uncertainty can arise even in a “game of complete information” such as Colonel Blotto or So Long, Sucker.

Of the games discussed in this paper, So Long, Sucker is also unique in that it can (and, in practice, always does) entail the making (and breaking) of cooperative agreements. In fact, the necessity to do so was evidently “baked in” by the geniuses responsible for the rules, and apparently the point of the game.\(^\text{105}\)

\(^\text{104}\) To people used to playing games, these points seem obvious. But they are not, most especially to non-game-playing people newly exposed to games or, even more so, to conflict in the real world.

\(^\text{105}\) Given their stature and (at least in the case of Nash) predilections, it is tempting to speculate that the game is the simplest possible game to have this property.
Comparison of the Easy Pieces

Table 1 summarizes the similarities and differences we have identified in the “Easy Pieces” games.

Table 1. Traits of the Seven Easy Pieces

<table>
<thead>
<tr>
<th>Traits</th>
<th>Awful Green Things</th>
<th>Bandit Games</th>
<th>Colonel Blotto</th>
<th>Kriegspiel</th>
<th>So Long, Sucker</th>
<th>Tank game</th>
<th>Zendo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Players</td>
<td>2</td>
<td>1</td>
<td>2 or more</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2 or more</td>
</tr>
<tr>
<td>Entropy</td>
<td>Not Low</td>
<td>Low</td>
<td>Low</td>
<td>Not Low</td>
<td>Low</td>
<td>Not Low</td>
<td>Not Low</td>
</tr>
<tr>
<td>Schrödinger’s Tiger</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Player-created uncertainty</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Chance elements (dice, etc.)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Reason to seek certainty</td>
<td>Means to an End</td>
<td>Means to an End</td>
<td>Means to an End</td>
<td>Means to an End</td>
<td>Means to an End</td>
<td>Point of game</td>
<td></td>
</tr>
<tr>
<td>Agreements/Betrayals</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

It is worth noting that, by comparison to the real world, all of the games are so small that their entropy should be characterized as “low,” or maybe even “extremely low”: the “low” and “not low” descriptions given here are relative, not absolute.

Inasmuch as we are on the hunt for a wargame that will deal with uncertainty, it is important to verify that each of the games embodies at least one of the two forms thereof—“Low Entropy” and “Schrödinger’s Tiger”—that we have identified: they do. If any did not, we should question that they belonged on the list. And here the Bandit games shine, because they (uniquely) present the player with both forms of uncertainty.

Looking at the table, we can see that all seven games are “needed” in the sense that no two columns are the same. (The closest match is, as one might expect, between the wargame-like entries, *The Awful Green Things* and the *Tank Game*: these differ only in that the former does not have player-created uncertainty, and the latter does.)

Other games

Certain other games were considered as “Easy Pieces,” but did not “make the cut.” These include *Stratego*, *Poker*, *Battleship* (especially in its harder variants, e.g., the one in which five shots are fired each turn, and the report says only how many of them hit, not which ones), Chess itself, a plethora of commercial wargames other than *The Awful Green Things*, and any and all word games. Though these might inculcate some of the same lessons as the Easy Pieces, they are less *stylized*, i.e., they do not do so in ways that are as direct and obvious, and their
rules are more complex. But there is nothing wrong with them, and to play them would be better preparation for 2070 than not to play them.

Another category of games was omitted, perhaps too quickly—games that do not have turns, being instead played in real time. A number of commercial games have this trait, as does the venerable trading game *Pit*. Future reality being turnless, perhaps these games should have been included, but it was felt that some might find their free-form (and typically hectic) nature off-putting. On the other hand, future warfare is likely to be free-form and hectic.

Finally, and in contrast to a great many of today’s commercial games and nearly all games played under the auspices of the DoD, the Easy Pieces do not put the players into any role; even in the wargame-like *Tank Game* and *Awful Green Things*, the player is in no sense role-playing the tank platoon commander or the captain of an alien-infested spaceship. Role-playing games (of all kinds) can be instructive in many ways, but I do not see any as being applicable to a time fifty years in the future; arguably, we do not even know what roles will exist at that time.

**Games for Fifty Years From Now**

“It’s hard to make predictions, especially about the future.”—Yogi Berra

At last we now turn to the main business of the paper, which is to combine elements of the “Easy Pieces” into games that will help players (and maybe others) learn to deal with uncertainty in war. The examples presented here are meant to be inspirational, not exhaustive or definitive. It is important to note that none of them have been tested: this project’s next order of business would be to do so.

Again, all of the Easy Pieces have extremely low entropies as compared to the real world; the designations of “low” and “not low” given in Table 1 and in this section are relative. When we combine a game of “low” entropy with a game of “not low” entropy (as we do in most, but not all, of the cases below), we get a game of “not low” entropy.

Of the Easy Pieces, only *Blotto* and *So Long, Sucker* did not have the kind of uncertainly we have called Schrödinger’s Tiger; it is clear that if either of two games contains a Schrödinger’s Tiger, the other must be as well.

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106 Notable and arguably on-point examples include *Light Speed*, its successor *Stellar Conflict*, and *Ice House*, the game for which the *Zendo* pieces were originally created. Additive to their disconcerting real-time nature (and perhaps in inevitable consequence of it), these games have a dexterity component that can be off-putting. That said, they are recommended—especially the ultra-simple *Light Speed*, not only on the basis of fun value but also because of their novel (and realistic) use of real time.

107 Parker Brothers, 1903—credits include the mystic Edgar Cayce!
Tiger then their combination will as well, and on this basis we find that all of the combinations presented here will have Schrödinger’s Tiger-type uncertainty.

\textit{Blotto + The Tank Game}

This game is a Blotto-enhanced variant of Gamow’s \textit{Tank game}. In it, the players each receive a deck of cards, from which they select a poker hand for each tank. (There being ten tanks on a side, two cards will be left over.) In each instance of combat between two tanks, a die is rolled. On a 1-3, combat is resolved per the usual Gamow rules (to include the case in which a tank in the woods automatically wins against a tank in the open), on a 4 or 5, combat is resolved by declaring the tank with the higher poker hand the winner, and on a 6, combat is resolved by declaring the tank with the lower poker hand to be the winner. These resolutions are all done by the referee (who will need a “cheat sheet” showing all the tanks’ assigned hands), and the participants are informed only of the outcome, not the means by which it was reached.

In a slight variant, the players compose the hands but the referee randomly assigns them to tanks. It is thus up to the players to deduce which of their tanks is which. This ignorance regarding one’s own forces is surprisingly rare in regular wargames, despite the fact that nominally equivalent units were in fact often grossly unequal, and part of a commander’s skill was to build up an appreciation of his forces’ individual strengths and weaknesses.

As a combination of games deemed as having “low” and “not low” entropy, this game has entropy that is “not low.”

\textit{Bandit + The Tank Game (cf. Kriegspiel + The Awful Green Things)}

This game works exactly like \textit{Blotto + Gamow}, except that the hands are dealt randomly and the players are not informed of them, bringing to the forefront the problem of building an assessment of one’s own forces.

The effect is similar to that which would be obtained from a less-imaginable confluence of \textit{Kriegspiel} and \textit{The Awful Green Things From Outer Space}: enemy forces’ positions, and all forces’ combat potential, start out unknown and can be found only during the play of the game.

Like \textit{Blotto + The Tank Game}, this game’s entropy is “not low,” and for the same reason.

\textit{Bandit + Zendo}

In this game, players use the \textit{Zendo} pieces to construct their own Bandits. The Buddha Nature, unknown to the players but known to (and created by) the referee, is the function according to which the arrangement of the pieces (i.e., the “koan,” in first-edition \textit{Zendo} terms)
is mapped onto the payoff structure of the resulting Bandit. Each turn, the player can pay to create a new bandit, or can “pull the lever” of an existing one.

The effect is a not-low-entropy non-combat game of Research and Development.

**Bandit + Zendo + Gamow**

See also above, and add the *Tank Game* by turning the Bandit probability into a hit probability for the tank.

This would be a long game, with new tanks created and flowed onto the battle board during play, as players try to discover how their koans relate to the tanks’ performance in combat. Tanks could share koans, or a koan could be unique to a single tank. Ideally, the workload would be divided between tank warriors, who use the tanks in the Gamow part of the game and report on their performance, and tank designers, who try to develop ever-better koans.

There is room for the use of additional concepts drawn from traditional wargaming, such as offensive and defensive “factors,” movement speeds, ability to operate in the woods, all learned only by the experience of constructing koans and trying them out.

At the outset, the players have no understanding of how their koans related to their tanks’ capabilities; this understanding would be gained only by experience. Such a level of ignorance is of course unrealistic, but this game (like all the games presented here) is not supposed to be realistic: it is *stylized*, to highlight certain aspects of uncertainty in war. The closest real-world parallel would probably be electronic warfare in the Second World War, when basic physical effects (e.g., atmospheric absorption) were being discovered at the same time as enemy countermeasures. Another parallel would be the German V-2 ballistic missile program, which was discovering basic science and technology (e.g., servo control during the boost phase and supersonic airflow during the descent).

Uniquely (so far), this game combines two games of “not low” entropy, for which reason (and also simply judgmentally) it qualifies as “high entropy,” relative to other games, and also quite lengthy Players often find high-entropy games to be confusing and/or annoying, but in the present instance it would be salutary to point out that the game’s entropy is far less than

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108 Here the *logistic function* $p = \frac{1 + e^{-Y}}{1}$ would be handy, for its ability to turn any real $Y$ into a $P$ on $(0,1)$. The $Y$ could then be something like “3 times the number of pips on blue pyramids,” for example.

109 Numerous implementation details would have to be worked out. I see the referee as looking at the koan, calculating the parameter(s) it confers upon its tank, and writing them down. The players could then take a picture of the koan for reference, and return the pyramids to the box for future use.

110 This is a standard reaction of people, even experienced board gamers, when first exposed to wargames: there are too many choices, and the connection between cause and effect is too difficult to make.
that of the real world. Also, there is an a priori argument for having at least one high-entropy game in the collection.

**Free Set-Up Kriegspiel (cf. Kriegspiel + Blotto, Kriegspiel + Bandit)**

Depending upon how one looks at it, this game is a mash-up of Kriegspiel and either Blotto or the Bandit idea. It is played just like Kriegspiel, except that the players are free to set up their pieces other than in the standard way, subject to the following constraints:

➢ All pawns are in the front rank (as usual);
➢ The two Bishops are on different colors; and
➢ The King is between the two Rooks.

These constraints are those of the non-blind, random-set-up chess variant Chess 960. The purpose of Free Set-Up Kriegspiel is to further reduce the players’ knowledge of each other’s pieces’ locations and to introduce the creation of a novel tactical set-up as an element of player choice. If Stratego had been one of the Easy Pieces, this game would be Stratego + Kriegspiel.

**What of So Long, Sucker?**

Among the Easy Pieces, So Long, Sucker stands out for its lack of chance elements and of spatial maneuver, for being a “game of complete information,” for emphasizing negotiation, and for having exactly four players. No other game (among the Easy Pieces) combines these traits, and few have any. The closest is Zendo, which can have four players, has no chance elements, and does not have any overall spatial structure, though the individual koans are strongly rooted in spatiality.

As an atom, So Long Sucker is thus a noble gas, unable to be combined with other Easy Pieces to create a larger game molecule like those considered so far in this section. It is to be played as-is, for the lessons that it (and it along, of the games seen here) can convey.

**Observations and Conclusions**

This section remains to be written after the games—especially the concatenated games of the precious section—have been played.

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111 [https://en.wikipedia.org/wiki/Chess960](https://en.wikipedia.org/wiki/Chess960) The 960 refers to the number of possible set-ups for each side. (Verification of this fact is left as an exercise for the reader.) A generalized castling rule is needed: in currently accepted practice, the King ends up in the first rank and either the c file or the g file (as usual), with a Rook next to him and on the file closer to the middle of the board; the usual strictures regarding previous moves, Check on squares over which the King must pass, etc., Note that in some cases of castling, either the King or the Rook may not need to move.
Appendix: The Easy Pieces’ Rules

“No, no! The adventures first, explanations take such a dreadful time.”
The Gryphon in “Alice’s Adventures in Wonderland”

*Kriegspiel*

A number of Internet sites offer the rules of Kriegspiel. The following is taken from “Kriegspiel - Cincinnati style,” by David Moeser, an article that appeared in the March 30, 1977, issue of J’ADOUBE!, The Cincinnati Chess Magazine.

The idea of Kriegspiel is this: The player on move attempts either to make a legal move, or to make moves called “tries” which have as their prime objective the obtaining of insight as to what the real position is. Any move or “try” which really is a legal move stands as that player’s actual move in the game.

On his own board, each player’s own pieces are “official,” and the Kriegspiel version of “touch move” applies to them. They’re for real, and their position must be identical to that shown on the Referee’s set. The opposing pieces have no formal standing. Each player may set up pieces of the opposing color anywhere he wants, or not set them up at all; and he may move them any time he wants. (The Referee must completely ignore opposing-color material on each player’s board. It isn’t “official” and it may be on “wrong” or even absurd squares. The Referee must not allow himself to be confused by it.)

The Kriegspiel “touch” rule applies only to each player’s own material: The Player isn’t allowed to touch his own material except for the purpose of making a try. That is, “trying” to make a legal move. If a “try” is legal, it stands as the Player’s real move. If it isn’t a legal move, the Player is not required to move (or try) that piece again.

The best procedure is for the Referee to require players to acquit (let go of) the piece they make a “try” with, and to say nothing until they do so. This requirement eliminates the kind of sticky situation where the Referee blurts out some information but the player says “Oh, I didn’t really mean to play that move!” and insists on the right to take it back because he’s still holding onto the piece.

After each legal move is made, and before the Opponent begins his turn, the Referee records the move, makes it on his own set, and makes the announcements required by these rules. It’s important that the Referee announce all the information required by the rules -- and nothing else. All announcements must be heard by both players. Also, spectators must not talk openly about the
game, for even casual comments can give away valuable information. Finally, the Referee must endeavor to be 100% correct, or else the game is likely to be ruined.

Announcements

If a “try” is a legal move, the Referee simply announces that the Player has moved. “Black has moved,” he says. Or “White to move.” After a while the Ref’s likely to abbreviate this notification to monosyllables: “White.” “Black.” “White,” he’ll say. However, if a “try” isn’t a legal move, the Referee says “No” or “Illegal,” and that try must be retracted. If the move is impossible, and the player must know it for some reason (like trying to capture one’s own pieces), the Referee’s appropriate response is “Nonsense.” The “Nonsense” announcement discourages a Player from wasting time or attempting to use the Referee to mislead the Opponent.

The player continues to try to make a move until he finds one that’s legal. When a legal move is completed, the Referee announces whichever of the following information is appropriate:

1. If a capture has been made, the fact of the capture and the square the captured piece is to be removed from. (Keep this wording in mind for an *en passant* capture.)

2. Whether the captured material was a “pawn” or a “piece” -- but if a piece, not what kind of piece.

3. If a check has been made, the fact that the Opponent is now in check, and the direction of check with respect to the Opponent’s King: whether that King is in check on a file, on a rank, on the long diagonal, on the short diagonal, or by a Knight.

4.

a. If any of the pawns of the Player on move can capture anything, the Referee announces that the Player now has a “pawn capture,” which means that at least one of his pawns can legally capture something (anything) of the Opponent’s. The Referee does not tell where on the board any such capture is. The Player may now try to make captures with his pawns, or he may not. He may make tries with pieces, then tries (either possible moves or possible captures) with pawns, go back to pieces, then go back to pawn tries, etc.

b. Due to the pawn’s unique capturing power (its capturing “vector” is different from its move), a Player who attempts pawn captures when the Referee has not announced there are any is trying nonsense. In this
instance the Referee announces “Nonsense” so the Opponent isn’t unfairly confused. (For example, the Opponent would be led to believe the Player still has a lot of material on the board when he really doesn’t.)

c. Knotty point: If a Player is in check and has a pawn capture on the board, but no such pawn capture will remove the check, does the Referee announce the pawn capture? Answer: no.

d. As long as at least one pawn capture is on the board, the Referee must announce that a pawn capture is possible -- and continue to do so every time the Player on move has a pawn capture available. (Note: This is because announcements apply only to the move on which they’re announced.)

The following rules elaborate on certain prohibitions:

1. If a piece (non-pawn) can capture something, that is not announced.

2. Promotion of pawns is not announced. Each player should be supplied with extra “promotion material” at the beginning of the game.

3. The Referee may not give a count of material on the board during the game.

4. On the Referee’s board such moves as castling or pawn promotion must be made silently and without any noticeable delay, so as not to reveal the nature of these unique movements. It’s in the players’ interest to do likewise. This is why the players should have promotion material available at the start of the game!

Influenced by the writings of David Li, I would point out that the “Pawn tries” rule absolves the player of having to figure out the order in which s/he would like to make the tries, given that the first legal try will succeed. The more traditional rule allows the player to ask “Pawn captures?” to which the referee will answer “No” if none are possible and “Try” if at least one is possible, whereupon the player must try at least one diagonal-move pawn capture. This dialog gives information to both sides, as do the referee’s oral responses to each attempted move. Li (and others, I believe) firmly consider the use of all of this information to be fair game, though now it is eliminated by the use of computer referees that officiate games on the Internet.
Colonel Blotto

Wikipedia gives a copyright-free set of rules to this game, under the name of Goofspiel:112

Goofspiel is played using cards from a standard deck of cards, and is typically a two-player game, although more players are possible. Each suit is ranked A (low), 2, ..., 10, J, Q, K (high).

One suit is singled out as the “prizes”; each of the remaining suits becomes a hand for one player, with one suit discarded if there are only two players, or taken from additional decks if there are four or more. The prizes are shuffled and placed between the players with one card turned up.

Play proceeds in a series of rounds. The players make “closed bids” for the top (face up) prize by selecting a card from their hand (keeping their choice secret from their opponent). Once these cards are selected, they are simultaneously revealed, and the player making the highest bid takes the competition card. Rules for ties in the bidding vary, possibilities including the competition card being discarded, or its value split between the tied players (possibly resulting in fractional scores). Some play that the current prize may “roll over” to the next round, so that two or more cards are competed for at once with a single bid card.

The cards used for bidding are discarded, and play continues with a new upturned prize card.

After 13 rounds, there are no remaining cards and the game ends. Typically, players earn points equal to sum of the ranks of cards won (i.e. ace is worth one point, 2 is two points, etc., jack 11, queen 12, and king 13 points). Players may agree upon other scoring schemes.

So Long, Sucker

From http://en.wikipedia.org/wiki/So_Long_Sucker, with editing by Brian McCue.

**Players**: This is a game for four players.

**Equipment**: The game requires a table; four colors of poker chip, seven of each color, and a “can” to contain chips that have been put out of play.

**Starting a game**: Each player has his or her own color. Give each player 7 chips of his or her color. Randomly select one player to be the first player to move.

112 https://en.wikipedia.org/wiki/Goofspiel#Game_play
Definitions (rules and explanations come later):

➢ A pile is a stack of chips on the table. It can be a single chip, or more than one. A new pile is started by putting a chip on an empty space on the table.

➢ A capture is an event that destroys a pile. The causes and effects of captures are described in the rules below.

➢ A prisoner is a chip in the possession of a player of a different color. Prisoners are taken by capturing piles; they can also be handed around.

➢ A prisoner chip can be killed by the player possessing it. It goes into the can and is no longer part of play.

➢ A player is defeated if it is his or her move, but s/he cannot play because s/he has no chips and nobody will give him/her one. A player wins when all the other players are defeated—even if s/he has no chips and it is his or her move.

➢ Oddities: New players often find this game confusing, and one of the reasons is that it differs from other table games that they may have played. To banish unconscious false assumptions, some of these oddities are listed here:

➢ The ability to move does not circulate around the table, clockwise or counterclockwise, as in many games. In some cases, the player who just moved gets to pick who has the next move, and in others there is a rule determining who has the next move.

➢ Players can come into possession of other players’ chips, and play them. Thus there is a distinction between the color of the chip just played, and the color of the player who just played.

➢ There is no set number of piles.

And now, the actual rules...

Moves: A player moves by playing a chip, of any color, from his or her possession onto the playing area, either onto the top of an existing pile or onto a bare spot on the table, creating a new pile.

Determining who gets the next move: Normally, the last player to have moved can give the move to any player (including her/himself) whose color is not represented in the pile just played upon, or, if all players have chips in that pile,
the move goes to the player whose uppermost chip in the pile is farther down than anybody else’s uppermost chip. Exceptions:

➢ If the pile has been captured (see below), the player whose color made the capture gets the next move.

➢ If a player is defeated (see below), the move returns to the player who gave the defeated player the move. If doing so defeats that player in turn, whoever gave that player the move will get the next turn, etc.

Captures: A pile is captured when its top two chips are the same color. The player of that color must kill one chip of his or her choice out of the pile, and take the rest; those not of his or her color are then his or her prisoners.

Actions taken outside of the move sequence: Any prisoner in a player’s possession may be killed or transferred to another player at any time. Such transfers are unconditional and cannot be retracted. A player may not transfer or kill chips of his or her own color. Players must keep their chips in view at all times. Players can confer freely, but only at the table and during the game—no secret or prior agreements are allowed. Coalitions, or agreements to cooperate, are permitted, and may take any form. There is no penalty for failure to live up to an agreement.

Defeat: A player is defeated if s/he is given the move, but cannot play because s/he has no chips. However, defeat is not final until every player holding prisoners has refused to come to the rescue by transferring chips.

Defeated players’ chips remain in play, but are ignored in determining the order of play. If a pile is captured by the chips of a defeated player, the entire pile is killed, and the move rebounds to the capturing player.

The last undefeated player wins the game. A player can win even if s/he holds no chips and all of his or her chips have been killed.

Chapter 18 of Rapoport’s *N-Person Game Theory* describes the game and gives a short and not entirely satisfying example.
Gamow’s Tank game

The rules and board are given by Thornton Page (Page 1952, pp 85-86):

[The] game is played with three identical boards, one for each of the players and one for a referee.

The board ... represents a tank battlefield by a lattice of hexagons, ... some of which are hatched to represent wooded areas of low visibility. The white hexagons represent open fields, and the size of a hexagon represents the “radius of action” of a tank in battle.

Each player starts with ten markers representing tanks at his back line, and “a move” consists in displacing any number of tanks into any of the adjacent hexagons. Each player sees his board only and must infer from the play where his opponent’s tanks are located.

If two opposing tanks arrive on adjoining white hexagons, “a battle” is announced by the referee, who spins a coin to decide which tank is eliminated. When a moving tank comes into contact with two enemy tanks simultaneously, it must “shoot it out” first with one of them, and then, if victorious, with the other.

A tank in the woods obtains a clear kill on any tank which moves into an adjacent white hexagon; a coin is flipped to determine the survivor if another tank moves into the same hexagon in the woods. The objective of the game is to kill off all the opposing tanks, retaining the maximum of one’s own tanks.

The black and white circles are the two sides’ tanks’ starting positions. Dark hexagons (notable for their early appearance) are “woods.” Page appears to have taken certain conventions for granted, e.g., that the sides move alternately, and probably that White moves first.

The Two-Armed Bandit

The main text describes a “multi-armed bandit,” but even a Two-Armed Bandit is non-trivial and instructive. So as to avoid a player objection of “Why are we playing this?”, at least one arm’s expected-value payoff should be positive, and it’s probably best if both are, with different distributions. In classroom play (such as the author administered to the CNO’s Strategic Studies
Group, circa 2000), the player(s), after due discussion, tell the instructor “Right” or “Left.” The instructor has pre-created a list of the bandit’s responses, and s/he simply goes down this list, telling the players what payoff they receive in each case.

Here is a sample list, suitable for classroom use (on students who have not seen this paper!).

Simply ask the player(s) to choose an arm, and report the outcome. The right arm has the occasional seductive high payout, but the left arm is in fact slightly preferable. For the record, the left arm’s payouts are the sum of two six-sided dice, while the right arm’s are the product (die – 1) x (die – 1). It would not do to roll the dice in the player(s) presence, because it is known that small numbers of dice are involved, the game would then change to one of deducing the payouts’ recipes.

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**Zendo**

The rules of *Zendo* can be found at [http://www.koryheath.com/Zendo/](http://www.koryheath.com/Zendo/).
References


Nasar, S. 1998. “A Beautiful Mind”, New York, Simon and Schuster, and subsequent editions as well as a major motion picture. In this biography of John Nash, Nasar follows Poundstone in her account of events at RAND, and therefore perpetuates his apparent conflation of double-blind chess with other games also called Kriegspiel.


Stravinsky, I. 1918. “Five Easy Pieces” (Cinq pièces faciles, a collection of piano pieces for four hands, i.e., two players). There is a 1970 movie of the same name.


**About the Author**

Brian McCue found a copy of Joseph Morschauser’s *How to Play Wargames in Miniature* in the library of his junior high school, and has now been a wargamer for over fifty years. In consequence, he has worked in the defense analytic community since the mid-1980s, and at the Center for Naval Analyses since the mid-1990s. He is the author of the book *U-Boats In The Bay of Biscay* as well as of numerous papers and articles in the field of operations research, mostly about the U-boat war. In CNA’s field program, he was been on the staffs of several US Navy Commands, notably Pacific Fleet, Second Fleet, and Submarine Forces. With CNA colleague Yousi Ma, he created the game SUBHUNT, which has been played over a hundred times and has become part of the Undersea Warfare Development Command’s training program for Theater Undersea Warfare watchstanders. Brian holds a Bachelor’s degree in Mathematics from Hamilton College, and Master’s and Ph.D. degrees from the Massachusetts Institute of Technology.

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From World War 3 to Starsoldier: Gaming design and gaming the future

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Principal, Monks Hood Media

Abstract

How do you design a game on the far future? Well, to begin with, far future games are like any other game: they require players to find that the scenario and mechanical elements of the game credibly reflect the expected world. Games that don’t make sense don’t get too far. The challenge for far future games is that the number of possible variables, and the interaction between those variables, greatly complicate creating a plausible set of scenario and mechanical elements. Techniques such as variable fixing, abstraction, player design, and futuring can be used as ways to mitigate against the complex interactions in future game scenarios. In operational and tactical wargames designers also confront the same challenges for design and adjudication that they confront in present day games. The art of designing adjudication processes is balancing the physics, with known weapons systems characteristics, and the environment the system is designed to work in. With the added challenge of applying these to unknown, future, systems. A good designer keeps both the laws of physics and player reactions in mind when choosing a way to move from today into the future.

Introduction

Most wargames are set at a particular time and place. Professional wargames are typically set at either the present or some reasonably close time in the future. For military wargames the time frame for future games breaks into three broad time zones: within the FYDP113 (5-6 years or essentially the present day), beyond the FYDP (10 years or 2025), and the glorious far future (20 years or 2035 or whenever the JCOFA114 runs out)115. These time horizons are defined by our need to prognosticate both our own force structure, as well as those of our adversaries. Since the pace of change makes projecting to 2035 difficult, anything beyond the 20-year time horizon is considered more or less science fiction.

113 FDYP = Five Year Defense Plan
114 JCOFA = Joint Country Force Assessment
115 Yes, I know that 2035 is not 20 years from 2018, however everyone likes round numbers and eventually it will roll over to 2040, probably sometime around 2022.
So, it’s hard to wargame futures beyond the 20-year mark. But can we do it anyway? Yes. In this paper we will explore why it’s difficult, and what designers can do to overcome those difficulties.

The two games that illustrate many of the items we will discuss here are World War 3 and Starsoldier (Dunnigan, 1974, Walczyk 1977). One is a strategic game on a future (for the time) global Soviet-US war, and the other is a far future tactical game. They bracket the strategic and tactical and they each say something about abstraction, prediction, and how games can tackle the unknown.

Far future wargames are the same as any other game. They need to be playable; players need to believe the game is accurate and fair, and they need some way to realistically adjudicate player actions. But they are different because the game designers have to project the scenario into the far future, and describe how those projections will interact in a believable way. Which can be challenging.

The future ain’t what it used to be

Organizationally and politically it gets hard to game beyond certain time horizons because no one can agree on what the baseline assumptions are. It’s hard to agree on allies, enemies, organization, threat forces, national strategy, and, probably the most important one, how much money everyone is spending. I can do a lot of things with a sizeable fraction of a big economies’ GDP.

One of the main reasons we have problems wargaming beyond 20 years is the need for an accepted joint threat assessment. The size, technology, and systems laydown of the threat can determine what we need to program for (buy), which can cause arguments. That is why we have a DoD wide accepted threat laydown that extends into the near future. Otherwise any decisions you make about programmatics will result in an argument over underlying assumptions, not about capabilities or investment you need. This limitation on the ability to wargame into the future in DoD should not be underestimated.

I believe this is where the term “it’s just science fiction” comes in. All of these variables, and a lack of definitive sources for speculation, make everything seem “made up.” Which makes it

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116 SPI = Simulations Publications Incorporated.
117 Yogi Berra
118 GDP = Gross Domestic Products, military spending is typically expressed as a fraction of GDP, which gives you a topline budget, which then tells you about how many ships, aircraft, and brigades you can afford.
119 The Joint Country Force Assessment (JCOFA) supports most acquisition and capability development by providing force structures out several years. This gives everyone a consistent baseline to model and argue from. See, for example, [Army 2019]
difficult to resolve arguments about what should get funded. And, truthfully, most far future games are focused in some form on helping understand today’s and tomorrow’s budgetary decisions.

This raises the question of “why” you are designing the game. Are you trying to predict budgets? Understand some of the lesser known factors that affect decisions today? Set up a baseline for future speculation? Convince people that the future will be one thing or another?

The “why” question will determine the central focus of the game and constrain your approach toward the future. At the same time, the requirements imposed by designing a futures game will also shape and inform what “why” questions your game can focus on.

The practical issues also deserve some consideration.

The scenario is the first, and biggest problem. How do you specify what the world is like in the far future without losing your players or sponsors? All of the PMESII\(^\text{120}\) variables relevant to the game subject will need to be laid out in ways that are both sensible and believable. Sometimes you may need to invent radical new futures, how do you do that without looking twee?

First, there is not only the relentless advancement of civilian technology, but also the complex, interactive, and non-linear ways in which innovations in technology get used. Giving everyone a high bandwidth communications device can easily be predicted\(^\text{121}\) to improve communications, but it’s difficult to predict that it will change almost every aspect of society and personal relationships.

Second, it is difficult to predict the most important variables such as growth in GDP and productivity. Sizing militaries can be done as a percentage of GDP, but when GDP predictions are uncertain sizing becomes difficult.

Third is the problem of politics and social re-alignment. For example, what American foreign policy might look like in the future. Ten years ago, that would have been a much more “certain” prediction than our current experience would justify. And then there is the problem of

\(^{120}\) PMESII = Political, Military, Economic, Social, Information, Infrastructure. I’ll also talk about PEST: Political, Economic, Social and Technological which is a more elegant way to frame these variables in futurist discussions.

\(^{121}\) It’s impossible to ignore the desire of the clients for a crystal ball that tells them what decisions they should make now. All games have that predictive requirement laid onto them, as does modelling and other forms of analysis. All games run the “now” out into some “future” (scenario) and sees what might happen. In reality any prediction is going to be more like a psychic prediction than a metaphysical guarantee that something will happen in the future. The attribute that I find most valuable about predictions is whether they are interesting. Do they suggest something new to the viewer, do they expand the scope of the possible? This means that obvious predictions, while probably helpful to the staggeringly unimaginative, are less than helpful for decision-makers. I want something that stops us and makes us think, which is all you can reasonably expect from most games.
predicting how social systems will evolve, including what people will want, and how they will react, in the future.

Changes in any one of these areas can produce a cascading effect that has implications far more widespread than the initial change. And they interact to produce even more changes. Identifying the most consequential impacts of future change is critical if you don’t want to have your game go off the rails from the very start.

My favorite example of cascading effects is miniature autonomous vehicles. In order for anything small to go a long way or stay aloft for a long time you need some sort of energy source. Well, that’s easy, let’s just assume a breakthrough in battery technology. We now have the ability to put a tank of gas into the form factor of an AA battery. Now our small swarming drones actually have tactically relevant ranges and loiter times (and comms and AI but I digress). But batteries like that will change everything. You now have enough energy to power flying cars. Autonomous robots become untethered from power supplies. You no longer have to worry about flying drones, but walking, skipping, swimming, jumping ones too. Long-range, high-speed items like missiles or ISR vehicles are able to use bigger batteries and go long distances really fast. Make a bigger version of these batteries and now you have laser cannons on ships, or aircraft, or individual soldiers. Many, many things have now changed in your world. If all you do is put them in drones in your game, you’re going to get a lot of questions about where else they could be used. Better to have identified that in the beginning.

The small drones are your primary technology, but the batteries are your essential change that occurred in the world. Secondary effects are everything that would logically follow from that essential change. If the change is what I call a “singularity” the changes will be many, hard to predict, and have a lot of impact on the different between now and your future. High energy density batteries are an example of a singularity.[a][b]

These challenges are often seen as insurmountable. And they do make specific predictions quite difficult. However, sometimes you don’t get much of a choice. If you have to do it you can come upon some general principles:

➢ Gaming the future is about understanding the future, not predicting it. This gets around the social issue by focusing on understanding, not predicting. Holding games to a strict predictive requirement misses what they do best. In fact, this aligns with the use of science fiction writers by DoD to help understand the future.122

122 There have been a number of efforts to harness science fiction writers to help the military. These include the USMC’s Science Fiction Futures efforts [MCWL, 2016] and SIGMA (http://www.sigmaforum.org/) a science fiction writers’ think tank.
➢ There are forces that drive the future, if those forces are specified then you can begin to estimate what will happen. There are several techniques that can be used, including trend analysis and extrapolation. No matter what you do the farther out you go, the less sure you can be. I call these forces “variables” and there are a lot of them. We manipulate these variables to create the game scenario and mechanics.

➢ Secondary and unintended consequences dominate in creating a credible future game. There are more players than designers in a game, and they will work assiduously to identify gaps and unexpected relationships in your scenario. When you introduce new technologies or changes in social structures you need to get at least some of the secondary impacts right, or you could lose credibility in your game.

➢ Games are more than just scenarios. In thinking about future games, the natural tendency to emphasize scenarios is magnified by the challenges in identifying which changes you want to have occur in your game scenario. You should not get overly fascinated by scenario.

A prediction of how we would move about in 2000. 123

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123One of a series of French postcards issued between 1899 and 1910 predicting what it would be like in 2000 and documented in (Asimov 1986).
Much of the challenge in designing far future games is knowing the limitations of the medium of games and considering all of the variables, including left-field surprises and things you didn’t think about. But it’s not impossible because there are ways to deal with these challenges. Game design tools such as abstraction, player-led world building, and scenario development techniques can be used. Designers can incorporate an explicit set of assumptions into their world model. And players can be given a sandbox within which to experiment on different world outcomes. You can also use futurist methods to help structure and build the scenarios.\footnote{In this paper I’m going to focus on a game design perspective in building far future games. For a futurist perspective, and some futurist tools that are helpful in the process of scenario building see (Aguilar-Millan 2019).}

We will examine the problem of gaming far future conflict, from projecting the current world to 2100 to tactical designs like Starsoldier. We want to understand how designers cope with the expanding range of unknowns as we get further into the future. Designers should also maintain a sense of realism so the players can enter the world of the game. They need to do all of this while admitting that the future may be far stranger than they, or the players, can imagine. While the far future is a big challenge, games can begin to take us there.

**The definitions game**

Whenever we write or talk about gaming it’s always useful to define what we mean by “game.” In this paper I’m talking about any manual game, to include tabletop, role-playing, or other forms of games. As long as it falls within what I call the context of “professional games” and is not simply a seminar dressed up as a game, I’m including it in this discussion. Professional games are games conducted by people who have a serious intent, and often work on or around the subject being gamed. Wargames are one example of professional games and I’ll concentrate a bit on them here.

Perhaps a more difficult concept to define is what I mean by “future.”

I’m talking about games that reference longer time horizons than we usually experience in games: 20 to 100 years out. Once we get to 20 years out many of the existing weapons systems will be hitting their service life. Agreed upon threat projections, including future threat technologies, also run out at around 20 years. At around 50 years most of the decisions being made today regarding large platforms (aircraft carriers) will have run their course. New decisions will have been made, and a sufficient number of new decisions will have been made that things will get fuzzy in terms of predicting what the DoD force structure will look like.

Clearly military capabilities for both blue and red are a challenge when you get beyond 20 years out. And a real challenge beyond 50. But equipment is not the biggest problem we have with these longer time horizons. The biggest challenge is how we deal with changes in...
technology, particularly how new technologies change the way societies and organizations are built, organized, and act. At the 20-year mark we can more or less assume that social organizations will resemble what we have now. But beyond 20 years social and organizational variables come into play that expand the number of possibilities dramatically.

This discussion begins to give hints at some of the “what” that we will need to deal with. Not only do we need to have some way of accounting for military force structure and equipment, but we will also need to have some way to account for economic, social, organizational, and political changes that may occur.

Another definition we need to clarify is what I mean by game design variables. I break games down into the following components:

➢ Objective. What you are trying to accomplish with the game.
➢ Scenario. The world the game will be played in.
➢ Mechanics. How the players relate to each other, and the game.
➢ Materials. The physical representation of the game.
➢ Venue. Everything about the game that is not the actual game. (Room, food, support, etc.)
➢ Control. How the players will understand how to play the game.
➢ Players. Who is playing the game.
➢ Observation. The observation and analysis of the game.

In this paper I’m particularly interested in the scenario and mechanical elements of the game, and how they should be manipulated in far future game design.

**Game objectives**

We are always taught to begin with the objective, or purpose, of the game when designing games. Are there “valid” objectives that work for future games, and thus “invalid” reasons to want to do a future game?

I contend that games on the long future are just like any other game. Any game, other than historical games, posits a situation that has never existed and does not exist now. Even “present day” games involve players reacting to something that has not yet happened,

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125 Given the ubiquity of big data, automation, and continuous surveillance this may be an incorrect assumption for 20 years in the future.
otherwise they would be playing a historical game. In that sense all games address the unknown future.

The farther out you get in the scenario the more variables come into play and the more uncertain the game “predictions” get. There are two types of predictions: the scenario and the players actions. I’d contend that the only prediction that has any potential for being false is the scenario-mechanical prediction. The players actions are what the players would do in the game under those circumstances. The player actions are only invalid or incorrect as much as the scenario-mechanic they are placed in is invalid or incorrect.\(^\text{126}\)

And, consequently, the game objectives are only off the rails if they specify a set of conditions that are off the rails. Understanding how players will react to a specific set of circumstances is a perfectly fine objective. Specifying a set of circumstances that is strange, wrong, weird, or incomplete is what causes the game results to be suspect.

Game objectives can constrain us to a certain future, scale, or set of interactions, but if they require us to project the scenario or interactions in an invalid way they bring the whole game into question.

How do we specify variables in such a way that we don’t have the game run off the rails?

**Scenario variables**

In developing a game on the far future there are almost an infinite number of scenario variables to consider. We can bin them into some general categories, and develop some ways of dealing with them.

**Technology**

This is the most difficult variable to deal with when constructing future scenarios. We simply don’t know what new technology will arise in 5 years, much less 20 or 50. What are some of the ways for dealing with future technology in games?

**Fixed**

There is a simple way of dealing with almost all of the variables we will discuss, including technology. Keep them fixed. By “fixed” here I mean keeping the relative ratio of technology fixed so that what relationships apply today will apply in the future. For example, there has been no great breakthrough in air defense that renders all flying equipment useless.

\(^{126}\) Here I’m assuming good faith participation by competent players. Players can always engage in bad faith or idiotic play, but even then their actions will still be their actions and as such are still “valid.” For a discussion of some of the alternatives to good faith play, and their consequences, see (Downes-Martin 2015)
Turning variables into constants is a great way to simplify any equation that you need to solve. If you keep all your variables fixed then you are gaming the present.

Fixing the technology variable is useful for games where the central issue is not technology but the reaction to changes in other variables. For example, in a climate change game I designed I kept technology fixed amongst all of the players. We assumed that as technology got more advanced, everyone got more advanced equally and no inequalities due to technology occurred. That allowed them to concentrate on climate and social reaction as the variable as opposed to creating some sort of research/industrial arms race.

I would argue that the ratio of technology advantage between great powers is rapidly approaching unity and in the future significant differences will be very difficult to justify. Access to technology, particularly on longer time scales, is already pretty transparent. Social factors including tactics, training, and other “soft” capabilities may be different, but it’s not like one side’s going to have radar and the other is not (here I’m talking almost exclusively about peer competitors). Competitors may choose to invest differently (see below) but their access to the basic technology will be very similar. This makes holding the technology ratio constant between participants sensible.

Turning technology into a constant does not mean that technology does not change. Instead technology does not appear to change functionally for the players. It more or less does what it’s supposed to do (communicate, kill, save, heal, target, explode, etc.) in the same way it always does. Nothing revolutionary has happened, so players have a pretty good idea of how to use their systems and capabilities in the future.

In addition to not having any technological singularities, constant technology implies that the relative progress between players is fixed. No player has garnered any sort of amazing breakthrough that will dominate the battlefield. This is something we assume for almost all of our conventional wargames: we assume that one or the other adversary has not developed the capability to completely shut down the oppositions systems, power, and reconnaissance so that they are sitting in the dark with no way to talk to each other. To do otherwise would simply give one force an immediate victory with little learning going on.127

This works particularly well in strategic games where the unit of maneuver are fleets, armies, and strategic forces. In strategic games we are more interested in the interaction between powers than the minutiae of battle.

127 Unless you were playing out how to manage a situation like that. What would Red do? What would Blue do? How would the situation unwind with individual units continuing to resist, the central government attempting HA/DR, and the adversary attempting to exert some sort of coup-de-main without actually having destroyed any units? It’s an interesting question.
It can also work for operational and tactical games as long as you realize that other variables, like speed, range, and detectability come into play as well. I may not have to define the technology, but I do have to say that whatever it is lets me go Mach 5, at 10 feet off the ground, and it makes me all aspect invisible to radar. The constant is that we have not strayed from multi-mission platforms, and its manned (because it has to be manned). To keep the ratio the same the same general capabilities would have to be available to all the other peer competitor players.

Abstracted

As I described in the previous paragraph, we don’t necessarily have to specify technologies to actually use them. We can assume certain trends have continued and something, who knows what, is providing that capability. We have not projected specifically rather we have defined capabilities for the future battlefield and given them parameters.

Let’s take air-to-air missiles as an example. Ranges for these missiles have tended to increase over time, and we could assume that they would continue to increase over time. This would provide more stand-off lethality for aircraft, meaning that, unless there were countermeasures, then the battlespace would be expanded for air combat. SAM systems ranges will expand, again, pushing out the boundaries of the IADS and battlespace.

One form of abstraction is common in some space games (GDW 1977) and Larry Bond’s Naval games (Bond 1996, Bond, 2008). In those games the designers specify “technology levels” for basic weapons systems and then use these tech levels when determining outcomes. So, for example, in Harpoon (Bond 1996) missiles and jammers are ranked according to their generation, with the missile and jammer generations being compared to affect hit probabilities. The game Traveller (GDW 1977) used various levels of technology and capability to characterize a diverse array of future technology, from ships to computers to computer programs. Higher tech levels gave advantages in combat.

Starsoldier (Walczyk 1977) represents another form of abstraction for tactical ground combat. The basic premise is that throughout history the battlespace has expanded due to faster movement, longer ranged weapons, and greater lethality. Along with this troop density has decreased. Extrapolating these variables gives him individual squads occupying hundreds of kilometers of terrain, fighting with long range lasers, flying at high speeds, and tossing nuclear grenades. Remove the specificity (lasers, flying, and nuclear grenades) and you get extended range direct fires, rapidly moving elements, and wide impact area weapons. That is another
way to abstract the key elements of combat and extend them into the future. And it makes a clever point about future combat.\textsuperscript{128}

\textit{Speculated}

\begin{quote}
As \textit{Starsoldier} demonstrates with its’ nuclear hand grenades you can always go for it and actually specify the technology. Though given the rather long history of getting it wrong (Man-portable hundred-kilometer lasers?) you always risk becoming another failed prognosticator.

If you must do it then there are some principles you can consider. The underlying issue is deciding what the objective of the game is, and build your scenario variables to focus on that. Try not to go beyond your essential variables with either your primary systems (high energy density batteries) or your secondary effects (flying cars). In a game designed to examine how naval forces will fight in the far future it is not necessary to understand how the belligerents are governing themselves. In a tactical game the size of the fleets may not be all that important. But you will need to evolve naval concepts, and other elements of warfighting that impact naval forces, because those affect your objectives.

If, as you refine the objectives, you determine that understanding how navies will operate for extended times in the vicinity of hostile coasts is important, that further focuses your scenario. How Naval forces will operate in a contested air environment will become important. You can imagine many different ways of dealing with that, from submarines to unmanned systems with low signatures. Again, refining the objectives will further reduce the number of variables you have to speculate about. If, ultimately, it’s about future surface vessels then you’ll need to understand what they look like in your time frame. How they will operate may be up to the players. Likewise, you’ll need ISR and air superiority/strike capabilities. But you don’t need to specify everything from ground forces to space systems.

Reducing the variables to just those that matter to the objectives makes it easier, and more realistic, to speculate about how that limited variable set will evolve over time. Other variables may affect your variables, and that means you cannot predict with even a limited variable set. But at least you have reduced both workload and reality to something manageable. And you have also decreased the number of secondary effects that either you, or the players, will need to account for.
\end{quote}

\textsuperscript{128} A similar concept was proposed in section 3.7 of [Downes-Martin 2018]. There the idea was to enable unclassified gaming of classified topics through the generalization of capabilities.
How do you treat that limited variable set once you have it? Again, there are some principles you can consider:

➢ Everything is connected, all your variables depend on each other and are interrelated. Specify one new idea for the future and you risk being buried under a cascade of consequences, or at least player complaints.

➢ You can’t design most games without some disconnects. Not every design decision will affect every other element in the game. Separating connected from disconnected variables will matter for how the design is received. You want to make sure you connect the most visible, to the players, variables and cut out those that don’t matter for the game play. For example, in the tactical naval game you may be able to ignore possible interactions with ground forces, but you may need to maintain connection with space forces, requiring you to specify more detail about space.

➢ If you cross a singularity you have to own all of the implications that matter to gameplay or your players will rebel. The most common singularity that seems to be discussed today is strong AI. But there are also others. High density batteries, cheap fusion power, quantum computing/cryptography are some other examples. Cross one of these thresholds and you will have a lot to explain in your scenario.

➢ Black Swans and other unexpected or unknown effects can be included in the game, but only if they relate to the objectives. Has a deadly plague killed millions and resulted in a complete overhaul of the international system? That may be relevant for a future public health game, but may be totally irrelevant to a tactical naval game.

➢ Secondary effects can dominate technological breakthroughs. The thing you are interested in (small drones in my example) may be inconsequential compared to everything else that will happen (revolution in the transportation system).

➢ We always underestimate information systems.[c] Information is frictionless. It can move, be manipulated, and change easily. We are only beginning to understand the implications of big data. What if you knew the entire history of every soldier on the battlefield? Their relationships, their families, their likes, dislikes, and so on? While information is difficult to manage as part of game mechanics, it is important to be aware of its potentially disruptive role in the future and how you might need to incorporate some of those disruptions into games.

➢ Social constraints often limit what we think we will do. Test ban treaties, legal restrictions on information sharing (a big deal prior to the IRTPA129 bill (Congress 2004))

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129 IRTPA = Intelligence Reform and Terrorism Prevention Act. For the role of the PATRIOT Act see (Thompson 2008) and for subsequent acts see (Savage 2017).
and restrictions on chemical and biological warfare greatly reduce the scope of what is possible in terms of the US and its allies developing weapon systems.[d] In the future other restrictive regimes on things like AI, autonomy, and genetic engineering may have similar effects. Removing these restrictions may get you a lot of capability, with many secondary effects as well. If one side removes the restrictions and the other side does not (the west vs. the threat) then the resulting asymmetry may be difficult and expensive for us to adapt to.

➢ The future is cynical. I believe that to accurately predict the future we can’t be cynical enough. And the more cynical we are the more accurate we will be. Information enables lots of things, but it can just as easily bog things down and derail decisions. Organizational structures designed to increase participation and ideas can have the opposite effect. Technology that seemed marvelous can become an expensive albatross that drives every other aspect of operations. And so on. In my view a bit, or a lot, of cynicism increases the believability of scenarios.[e]

Social and Organizational

How society is organized, what people believe, and how they act can be more of an influence on the future than any one technology. You can argue that technology is simply the enabler for the real social change that comes with the adoption of the technology. In military terms this means changes in organization and unit command and control, how forces are deployed and employed, and how weapon systems are integrated and used. I would argue that the biggest development in military operations since World War II has been the increasingly restrictive rules of engagement that militaries operate under.\(^{[1]}\) As force became more and more capable of overwhelming targets, the need to be more precise in the application of that force became more and more important.\(^{131}\)

There are several aspects to social variables that you need to consider when building far future scenarios:

- How society has evolved. Is the United States still one country? Does everyone connect via neural implants?
- Military organization. Do we still have COCOMS? What does a squad/platoon/company look like? Who is in charge of the naval battle and when?
- Social constraints on warfare. Have rules of engagement become more restrictive? How do civilian communications systems, including whatever passes for press, work on the battlefield?
- Doctrine. How do various technologies integrate into the basic elements of maneuver (BCT, CSG, AEF, etc.)?\(^{132}\)

The social variables you need to define will depend on the scale and scope of the game. A game looking at great power competition for the sea floor will necessarily require you to define a whole lot of large-scale social variables. A game on cognitive hacking and gray zone operations will require an even more refined definition of what society will look like in the future. Squad and platoon peer combat operations will only need to define the structure of the future squads and platoons, their weapons employment doctrine, and the nature and roles of their next echelon headquarters.

As was the case with technology, the scope of what the designer will need to define will depend on the game objectives and the topic that is the focus of the game. Keeping the scope

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\(^{131}\) Admittedly this breaks down for some peer competitor scenarios, nuclear war being the worst case, but even there the rules are increasingly becoming more restrictive in considering what is and is not a legitimate target for “respectable” nation states. You can no longer just carpet bomb your way to victory (if you ever could). See, for example, (Cooper 2014).

\(^{132}\) BCT = Brigade Combat Team/CSG = Carrier Strike Group/AEF = Air Expeditionary Force.
narrow and the topic well defined will significantly decrease the workload on the designer. It will also minimize the number of unintended consequences from secondary effects that you forgot to include.

**Economic**

Economic considerations are overwhelmingly important in any strategic game that projects into the future. The nature of GDP growth will determine a lot of things about the world. Putting that trajectory into a game is fraught with peril.

The most basic problem is identifying a good source of worldwide GDP growth data. Even if you do find one, don’t expect it to be consistent with any other projections. The UN has information,\(^{133}\) as does the World Bank,\(^{134}\) and others. Most of these projections are for GDP growth rate, and only go out to 2050 or 2060. Beyond that you’d have to linearize, and in many cases you’ll need to do a linear projection using data from the last year available. Even a small compounded number taken over a long time can give you some very interesting results. One conclusion you quickly come to if you do a simple projection of GDP growth is that the world is going to get a lot richer by 2050 and even richer by 2100. What, exactly, everyone is going to do with all this wealth is an interesting question for the social assumptions in your game?

A linear projection of GDP is not necessarily what will happen. Certainly not everywhere and in a consistent way. The big problem is that if you deviate from the projections you need a convincing argument as to why you deviated, because GDP growth can be such a driver for the rest of your scenario.

Two of the things GDP growth is a driver for are size of military forces, and failed states. Both of these are usually of keen interest to military gamers (one more than the other). At the strategic level military budgets can be expressed as a percentage of GDP. Remember Pres. Trump’s focus on percentage of GDP spending by NATO allies (MacAskill 2018)? If you take his goal of 4% and apply it to a linearized GDP growth for Russia and China you quickly realize who we should be worried about. And it’s not Russia.

While you may contend that in the future military effectiveness may not be based on size, it is based on dollars. If I have all the money I need, then I can buy really fancy stuff even if I don’t have a large military. This means that your projection of military capabilities into the future will very much depend on your economic projections.


\(^{134}\) https://datacatalog.worldbank.org/dataset/global-economic-prospects
The difficulty in making these projections is that things may change. There may be a significant retrenchment in China’s economy, or a revolution or counter-revolution may derail their progress. Anyone doing linear projections of Japan’s GDP growth rate in the 1980's where it was 3-5% would have made a significant error as its now around 1-2%. This was due to many different factors including the real estate bubble, bad banking loans and a bad economic policy (Abe 2010).

Placing these economic wildcards into the game has to be done in ways that are consistent with the game objectives. It is easier to decrease the economic projections than it is to make them more optimistic, simply because there are more things that seem to go wrong with economies than things that go right. The economic projections can also be tied to the desired force levels, or force level ratios, for the primary antagonists in the game. If you say you want to examine a situation where the US is significantly outgunned, then increase the economic drag on the US from poor policies, and increase the adversaries’ economic acumen. Even small changes over time will create significant disparities.

The problem is easier if only one or two countries are involved. For example, if we want to look at what an intervention in Morocco in the far future might look like, projecting GDP and military force size for Morocco will occupy a relatively small percentage of your overall design time. Doing that for every country in Africa becomes a much heavier lift, and doing it for all 195 countries in the world will take you some investment of time and resources.

But you are not done when you have your GDP projections. While you projected in constant dollars, what, exactly, does that dollar buy? Let’s take a P-51 Mustang as an example. In today’s dollars the Mustang would cost 722K to buy. The comparable F-35A would cost around 100,000K to buy, or 138 times as much. Whether 138 P-51’s could defeat one F-35, or provide the same capability, is debatable, but the fact that they are two very different capabilities is not debatable. And they cost two very different amounts of money. This “capability inflation” is also something you have to account for when designing strategic games that project into the far future. Otherwise you may over-estimate the numbers of far more capable platforms.

For aircraft this suggests that you need to add on an extra multiplier of 1.6 times the number of years. If you wanted to get fancy you could plot these numbers and fit a curve to them, but since you are extrapolating into the future, I am not sure how much the curve would

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135 December 2018 dollars from Bureau of Industry and Security, Department of Commerce calculator https://data.bls.gov/cgi-bin/cpicalc.pl?cost1=50000&year1=194401&year2=201812. F-35A’s costs vary depending on year of production and number produced, but this is a current estimate for overall unit cost (Zazulia 2018). P-51 cost is from (Wagner 1990).

136 A lot of it depends on what you think of the F-35. The P-51 was an outstanding aircraft.
tell you. And you will need to plot the same curve for other weapons systems of interest, such as ships, missiles, and vehicles.

Finally, if you are doing a strategic game that requires the players to make decisions over the course of extended time periods, you will run into the problem of constant dollars and inflation. Keeping everything in constant present-day dollars will confuse players as they watch their buying power erode due to inflation, while you are busy jacking up the prices of all the fancy future toys they can buy. Using rolling dollars will make more sense, but require you to inflate everything each move, which will require a lot of calculations and updating. At this point everything will need to move onto a computer, as players calculate their budgets and you manage the economy behind the scenes.

Calculating inflation values within a game turn is also possible, and perhaps necessary, think 10-year turns, but will involve some sort of averaging.

Eventually you will wind up with an economic simulation. Unfortunately given that you need to manage the environment and scenario for your game objectives and mechanics, it will be an economic simulation of your own design. Doing a full-blowen economic simulation will require time and resources, and will need to be done in such a way that the game controllers can manipulate it.

All this means that in games where you are concerned with the future strategic balance you have to make some calculations. And those calculations are not as reliable as you might want them to be. The best suggestion is to find the most believable data sources, make straightforward projections, and don’t forget to include everything in assessing systems cost and the dollars available to buy them. And budget for the required time and cost of programming aids for both you and the players.

**Continuous vs. Singular scenarios**

I’m using the idea from mathematics of a continuous curve or a progression in contrast with a mathematical “singularity” to describe the different approaches you can have toward scenarios. In most cases you will have some sort of continuous trajectory between the present and your game future. This keeps everything making sense, and reduces the number of objections you get from players and others that “you’re just making all this up.”

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137 In Stephen AM’s paper (Aguilar-Millan 2019) he refers to singular events as Black Swan events (risky) and Wild Card events (uncertain). Here I’m focused more on the impacts that these sorts of events have on world building, and anything of sufficient impact to change the overall trajectory of your game world I simply refer to as a “singular” event.

138 One time a player said to me after a ruling “you just made that up” to which I replied “what do you think I’m doing? I made everything up.”
A continuous progression of variables over time assumes that everything will more or less behave in the future the way it behaves today. For example, with technology we assume that the AI singularity does not happen, that small, cheap, efficient batteries are not developed, and fusion energy does not come online. If any of these do happen, it will radically change the way the world operates, so we exclude those. Likewise, in politics we would assume that western democracies stay more or less the same politically, liberalism takes over in increasing numbers of countries, and the usual suspects remain as the usual threats. For the US to suddenly become an aggressive, colonialist, power would be a singular event that would change everything, so we eliminate it as a possibility.\[h\]

On the other hand, there are cases where you do want to try and introduce singularities and see what happens. Surprisingly this poses more challenges to the designer than the players:

- Singularities cause unexpected and secondary consequences to proliferate. You have to spend some time hunting those down, and either killing them or including them in your scenario.

- Singularities can shut down certain parts of your future, which you need to account for when designing the game. For example, even a small nuclear exchange would likely change the way that nuclear weapons are governed. You can’t just include something like that in a game without acknowledging the potential secondary consequences.

- Many singularities generate additional missions for the players. In an extreme warming scenario there will be the potential for many failed states simply due to heat effects. This will require attention and resources from the players. If that is not part of your game, don’t include it or find a way to direct the players’ attention elsewhere.

The last principle on speculative variables is don’t be twee. Hand waving, fictionalization, and sheer speculation without basis will not impress either the sponsors or the players. The best speculative scenarios arise from an underlying principle and branch out from there. Just like Simonsen did in Starsoldier when he plotted troop density and battlespace size. Figure out what your controlling variables are and then how the current capabilities will evolve according to those variables. And stick with the laws of physics. Your world will at least appear realistic to the players.

**Mechanics**

No matter what year the game is set in everyone wants to specify and discuss the scenario. That’s why we started with it. However, game mechanics are just as important. And in future games they can be the controlling variable in determining how the game progresses toward the objective. Game mechanics can mitigate or support many of the issues we described in the introduction to the scenario section. They can be used to minimize the need to be accurate in
your future scenario world, and they can allow for multiple people to work together in creating the world.

Participatory world building

One of the most common mechanics used in future games is to have the players participate in building the world. In this type of game, the players have some sort of say in the details of the future scenario. This can either be done “in game” or “out of game.”

In game

If I’m doing a game on how the world will look in 2070 I don’t need to start in 2069 and have the players adapt to the world as I have specified it. It is a lot easier if I get the players to construct the world of 2070 for me. This has the added advantage of letting the players “own” the world they have constructed, making them much less interested in “fighting the game” than if they were presented with a pre-scripted world.\(^\text{139}\)

In this sort of game players are typically given some set of constraints, usually a budget, and then they get to choose how they will develop in the next round. This could range from how a country might develop over a decade to how the Army’s platoon will evolve beyond the FYDP.

This sort of mechanic works best for when the players are focused on how technology and weapon systems will evolve, with the players either designing and buying, or just buying, the new technology between rounds of tactical operations.\(^\text{1}\) In this sort of game asymmetries can develop between different technological approaches, which is pretty much what you want to see play out in the game.

This is different than keeping the ratio of technology the same, here it’s the operational deployment and employment of the technology that the players get to decide on.

For example, if plasma projectors were invented both sides would quickly (within years) have access to plasma technology. One side might choose to build giant plasma firing skyships at enormous cost and difficulty while the other side built plasma pistols. Other countries with access to plasma technology might take a pass, because they simply could not afford it. The ratio of the technology is the same, but the budgetary, operational, and organizational implementation of the technology is very different.

\(^{139}\) I hate the term “fighting the game” which suggests that the players’ reaction to the game elements are somehow disruptive or not wanted. Designers can make mistakes, players are professionals in the same industry and have their points of view. Their points of view should count as part of the game, either through modifications to the game or notes taken during the game. Designers should not be defensive any more than players should be disruptive.
After the players plan and buy and program then the fun stuff happens: they get to see how the stuff they bought works in conflict. The players then repeat the process.

**Out of game**

In the previous mechanic players built the game world within the framework of the game. But you can also have them simply build the game world, then play it, without making it part of the game.

Some possible mechanisms include:

- **Game before the game.** This option is frequently used when technology is a game focus. Here the players get together and play one or more games prior to the game. This process iterates the game world to a point where players are both familiar with it, and satisfied with the technology they developed. Then they play the real game.

- **Wise persons rule.** In this structure the players play the game, while a panel of experts decide what the technology and systems will look like. The subject matter experts either meet before, during, or at both times to decide what capabilities will be used, what the capabilities can do, and how many of them there will be. When it works this form of game can elucidate very interesting insights by combining the engineers and the budgeteers in the same room and forcing them to look the warfighters in the eye and explain why they are getting fewer of what they need, but no matter because it won’t work in the first place.

- **Parallel games.** This is perhaps the hardest to pull off, and in some ways is the holy grail of operational level gaming. Here the strategic game is played so that it can inform and shape the operational level game. In far future games the strategic game can be the long-term game, one that will set the basic conditions and parameters for the operational game. This is a very risky proposition because if one side “loses” the strategic competition for money, technology, or systems then the operational level players may find themselves at an unacceptable disadvantage. The game can end before it begins (like in real life).

**Scale**

Another mechanical factor to consider in designing long future games is the time and space scales. Time, space, and friction\(^\text{140}\) are linked in games. To understand this all you need to do is

\(^{140}\) By “friction” I mean any mechanic that limits the players ability to exploit time and space. This can range from terrain (slows movement) to command and control (limits ability to move each turn) to zones of control (limits movement and forces combat (sometimes)) along with supply. Frictional mechanics can produce reasonable results in situations where other factors create chaos (for example, closed terrain limiting vehicle movement to something reasonable for the scale).
screw up the scale in an operational/tactical game and watch vehicles teleport around your too-small mapboard.

We can break down scale issues according to the type of time jump the game posits:

➢ Operational/tactical games. These games will almost always be set at some fixed time in the future, which means that assumptions about technology, doctrine, and terrain will dominate scale considerations.

➢ Strategic games. Strategic games can take on two forms:
  o Fixed future, game focuses on implications of that fixed future.
  o Variable future, game focuses on the evolution of the game world.

How long should the turn be in game time?

There is a significant difference in the way to answer this question depending on whether the game is strategic, or operational/tactical.

Strategic

For strategic games the time scale of a turn determines the type and frequency of decisions that the players are going to make. It also determines how much work, and confusion, control will have. But the most important criteria for long-future games is to match the turn length to player agency. By player agency I mean what the role the players are playing in the game could actually accomplish in the real world. Making the players the President of the United States and giving them 10 year turns makes no sense because US Presidents don’t have control over the US for 10 years. It’s 8 at most.141

I also refer to this kind of problem as one of agency-agility-time. Players have to be able to actually affect things in the game. Too long a turn length and they lose the ability to change the course of events (agility). Too short a turn length and they lose agency and agility because they don’t have enough time to accomplish anything. The game has to balance between them.

Operational/tactical142

In operational tactical games we are less concerned with player agency and time than the ability for the systems to interact effectively. If critical processes operate on two wildly different time scales you can get crazy things happening. In wargames this occurs in the

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141 For a more in-depth discussion see (Downes-Martin & Robison 2018) “Challenges of In-Stride Adjudication” by Ed McGrady, p. 23.

142 I define “tactical” games as those where ranged combat matters, typically company level and below.
speed differences between foot infantry, ships, vehicles, aircraft and weapons. From the point of view of aircraft naval and ground forces might as well be standing still. From the point of view of infantry, they are standing still while everything moves around them. Similar effects can be seen in an economic game where the quarterly business cycle is very much shorter than the GDP or national election cycles. Synchronizing things with radically different speeds across time can be a challenge.

To extrapolate these factors into the future you need to account for the type of unit, the technology, and the way the unit interacts.

Operational units typically factor future weapons into abstracted combat values. Units have “strength” values that are compared to resolve combat. Future strength values look a lot like present day strength values as they are both numbers that will be compared. Instead of tank cannons they could be laser cannons and tiny robots, but at the operational level they all boil down to the relative strength ratios between large unit formations.

The operational level designer needs to get the relative abilities of units correct, between friendly and enemy and amongst friendly units.

I define the tactical level as the scale where ranged fire becomes important. At this level the designer has to include rates of fire, targeting, and communications into determining the turn length. This is in addition to movement rates and the ability to observe, communicate, and act (C3).

Future weapons systems typically increase in range, lethality, and decrease in numbers. This means that ISR becomes increasingly important, and the ability to communicate with long-range fires becomes important. At the tactical level this means that the battlespace will expand, not just the map battlespace but all of the systems and capabilities that can be directed onto the map by the tactical unit. This means that the electromagnetic environment will become increasingly important as time goes on, as it facilitates battle management, ISR, autonomous systems, and the ability to access off-map capabilities. Representing these features in games also becomes increasingly important the further into the future you go.

Adjudication

Adjudication of far future games is a challenge because you don’t know the parameters of the systems, either kinetic or non-kinetic. Designers have to project those capabilities into the future in order to determine things like hit/kill rates or success/effect probabilities. This becomes the art of game design, since the designers have to do something and they are not going to get a lot of help from the test range.
The answer is to ground projections in the physics of the system. For non-kinetic systems this means grounding in the social-science and political theory of the effect. From there you have to extrapolate current weapons systems capabilities into the future. This means that you start with underlying principles, but then you begin to layer on problems and issues that you know happen to existing weapons systems. Like the best hypersonic missile in the world will be useless unless you can locate the target.

Another way to do this is to bring in subject matter experts and have them give advice on adjudication. This, while somewhat appealing, is fraught for a couple of reasons. First the Controller has to themselves have a good handle on the physics of the situation so that they can translate the SME’s opinions into actionable game results. Second, the SME’s may be less than “expert” and instead be salespersons or ringers sent in by advocates of particular technologies. Again, the game designers and controllers have to be savvy enough to weed these out.

These general principles apply to all of the levels of warfare, strategic, operational, and tactical, with the focus changing depending on which level you are at.

**Futures processes**

Long-future games can learn a lot from the futures community. Another participant has written a very detailed paper on how futures processes can be helpful in games (Aguilar-Millan 2019) so here I want to focus on incorporating the futures processes into your games.

**Design**

As described in the futures paper there are two broad approaches to the question of understanding the future. One is trend based, where you identify trends and extrapolate them forward. This has the advantage of being both simple and believable. Unfortunately, the future does not follow nice, continuous, curves. It bends and breaks (Aguilar-Millan 2019). A way to account for this is using systems based futuring, where the key systems, political, military, economic, are included in the futures process. Changes in one or more systems is examined in terms of not only that system, but its effects on other systems and the overall future trajectory. Picking which system is dependent on the objectives of the exercise.

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143 For example, if the effect is to dissuade the US from participating in a foreign intervention you can find work that shows how decisions to intervene depend on the United States’ political environment (Drury 2005, Baker 2001).

144 For more information on different types of adjudication as well as some of the pitfalls see [Downes-Martin 2013]. For a contrasting view Graham Longley-Brown commented that “We haven’t found this to be a problem - assuming adjudicators and control staff are carefully selected. We also find people are surprisingly good at Critical Thinking their own side’s capabilities.”
These two futures processes resemble our design problem of continuous vs. singular extrapolation of the future. It also breaks futuring down into PMESII/PEST variables and allows single or multiple variables to be examined.

Other than reflecting how designers might think of scenario development, how does this affect game design?

Running a futures process prior to game development can be used to identify scenarios, variables and possible futures that you want to include in the game. This is a powerful tool to both socialize the scenario with players or sponsors, as well as identify unanticipated relationships between the variables.

And, most importantly, running a futures process with the game sponsor may be helpful in identifying what, exactly, the sponsor is interested in. Not only their objective, but the kind of future that they expect the objective to play out in.

Using a futures process before the game can help clarify objectives, identify scenario elements, and ward against unexpected variable relationships and secondary effects.

**Execution**

Futures processes can also be included as part of game day execution. While doing a futures process inside a game is always possible, it would be kind of strange. Instead I prefer to wrap the futures processes around the game. Using something like the Shell Scenario Planning (Shell 2003) process after a game can give the players a change to expand on their choices in the game and explore alternate paths. The game grounds the players in the subject, gives them the synthetic experience of being the decision-makers, and then the scenario planning event comes along and expands their horizons beyond the single scenario of the game.

Doing the futures process before the game is problematic because it will alert the players to alternative scenarios, relationships between variables, and unanticipated secondary effects that may, or may not, have been included in the game. They can upset the players before they even get to the game, and “poisoning the well” of player goodwill even before they are introduced to the game scenario. Better to do the planning exercise after the game as an expansive exercise than doing it before and having the game become this limiting, contracting, experience.

This process also gives you additional insights into why players made the decisions they made in the game, and how they might have made different decisions in other scenarios or contexts. This expands the data collected from the game and generalizes it.

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145 In this paper I’m talking about scenario planning processes that actually involve a structured approach to identifying key variables and examining the interaction of those variable. There are many other processes that can be used (Lindgren 2003).
What does all this mean?

Far future games are the same as any other type of game, they just have a more speculative scenario. This means that the designers, and sponsors, have to be careful in what they assume and how those assumptions are presented to the players. Their world vision has to be “tight” with secondary and account for unintended consequences.

Designers can use the same techniques they use for designing present day games to determine basic mechanics. It is in assessing the capabilities of units and weapons systems for adjudication that challenges designers. Physics-based “models” of how systems work should go a long way in helping give order of magnitude estimates of hit/kill chances for weapons systems. Systems not based in physics, such as information systems, present their own unique challenges, but those challenges also exist today.

Estimating outcomes from far future weapons systems becomes an art, one that projects current systems results into the future, but also accounts for change in the environment that also impact weapons performance.

Far future games can also benefit, a lot, from techniques from the futures community. Using futures techniques with games has a lot of potential, with the futures techniques used in developing scenarios or game planning, or used in conjunction with games to expand the range of possible game results without replaying the game.

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About the Author

Dr. McGrady is currently the principal in a private media company where he consults and teaches on game design and gaming. He teaches game design for professional games for the Virginia Tech/Military Operations Research Society Certificate on Wargaming course. He also consults on game design and execution. Previously he was a Research Team Leader at CNA where he directed a team devoted to research on games and how they can be used to enhance decision-making. His team developed games and conducted studies on a wide range of topics from cyber warfare and planning to sexual assault and suicide prevention.

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Working Group Discussion

[a] Sebastian Bae: I think this is a really important difference/nuance that is lost on a lot of sponsors and players.

Ed McGrady: It is more often lost on designers of games, who make this mistake and get laughed at by any engineers who happen upon their product...

[b] John Hanley: Recommend that you look at Geoffrey West’s book “Scale: The Universal Laws of Life, Growth, and Death in Organisms, Cities, and Companies”, and data on the acceleration of technology and the rate of technology adoption producing singularities. The power law approach suggests trends that point to topics worthy of closer scrutiny.

Ed McGrady: I’m going to bet that information technologies conform to power law principles while those that rely on thermodynamics don’t. Things like engines seem to follow a more linear scale. But understanding the trajectories is interesting.

[c] Stephen Downes-Martin: We also underestimate what is information. Monsanto considers itself “an information company”. The information that is the core of its business is genetic coding, of plants, insects, bacteria and how those codes interact and can be manipulated. So information includes genetics and biology, both of which may be weaponized for future war. Abstracting information as you are proposing for other tech is an interesting topic worth exploring deeper.

Robert Mosher: Yes; information = knowledge; information = newly acquired news/knowledge; information = product, etc.

Ed McGrady: Yes, and LQG has both time and space being quantized (digitized). But I would see that digression as a distraction here.

[d] Stephen Downes-Martin: I suggest that the attitude and actions of the past Soviet Union and current Russia (e.g. bio and chem warfare) imply that “greatly reduce the scope” only applies to us, not our adversaries. So how do we wargame the future of unrestricted genetic warfare by our opponents with us not being allowed to research, let alone deploy, such weapons? This seems to contradict an earlier point you made that the “ratio of technology advantage between powers is rapidly approaching unity”.

Robert Mosher: I was always amazed that so few of my diplomatic colleagues realized that no arms agreement actually constituted a physical restraint on actions.

Ed McGrady: I will also point out that most of what you see is either chem use in police actions and/or chem/tox/rad assassinations, not full-blown weaponization. Because existing agents don’t really do much on the battlefield (except against civilians as a terror weapon, and I would claim even that is suspect). That’s really why we have the conventions and treaties. (and note I said “existing agents” not “stuff we can think up”).
Stephen Downes-Martin: I always ask myself “what can possibly go wrong?” or “What is wrong with this?” Might “high functioning paranoiac” be a useful characteristic of the wargamer? (There are psychology claims that paranoia is one of the three characteristics of “genius”, the other two being “obsessive” and of course “intelligent”. The latter alone is insufficient.)

Ed McGrady: I assume you are referring to my cynic comment (these comments seem to only refer to the first page of my paper for some reason). I would tend to disagree, paranoia to me says that someone or something is “out to get you”. Instead I say cynicism says that nothing will work out as you plan it, because human nature will always corrupt and pervert everything. (And if human nature doesn’t do it, the universe will stand in.). You’d think that making art was a wonderful chance at self-fulfillment, instead it’s a nasty brutish scramble for the top with everyone trying to make your life miserable in the process. Or, as Sartre said: hell is other people. So, different intent here than either psychotic or paranoia.

Robert Mosher: Don’t omit incompetence.

Ed McGrady: Incompetence by itself is not what I’m talking about either. Rather it is incompetence that enshrines itself within organizational and bureaucratic priorities and systems. It is when incompetence is made powerful that your life begins to degrade ...

Robert Mosher: Good, that’s a useful context for an all too often occurrence.

Stephen Downes-Martin: By paranoiac I am referring (perhaps incorrectly) to the more general belief that “the universe is out to get me”, as in “there is always something I haven’t thought about that will derail my plans”. This leads to the behavior of endlessly questioning whether I have “got it right or considered all the details”. The “high functioning” caveat ensures the avoidance of satisficing (Simon 1956) rather than analysis paralysis.

Stephen Downes-Martin: I suggest these restrictions get ignored when the nation is threatened with the possibility of losing a war to a barbaric enemy. Both the UK and the US committed what in retrospect their wartime leaders suspected were war crimes. Then there is the issue of some states restricting the barbarity of their actions while others happily and with a merry laugh on their lips break every norm known to humanity.

Ed McGrady: Losing -> Threat -> Demonstration -> Battlefield -> Counter force -> Counter value. We have an answer for where we end up when a nuclear nation is threatened by a “barbaric enemy” capable of actually threatening them. The challenge is when we fight over stuff that we won’t escalate over. And also, I believe, our own restrictions on our willingness to escalate which can put us in a reactive mode.

Robert Mosher: Re battlefield behavior - also important to understand that as early as Clausewitz it was recognized that the longer the duration of a conflict (and the longer
individuals experience sustained engagement in combat) these social limits on behavior are eroded away. I also wonder about ROE embedded into weapons’ software directly, in a sense, removing the person from the loop.

**Ed McGrady:** The problem with embedding ROE in a system is that someone has to agree exactly what the ROE is. Probably not hard in an all-out war but in limited war its crazy hard.

**Stephen Downes-Martin:** Things will get really interesting when weapons systems are controlled by AI capable of interpreting ROEs and even showing initiative over when to ignore them.

[g] **Stephen Downes-Martin:** Is this the same as gaming with different ratios of GDP (or other economic measures) among the protagonists? Maybe three different futures get gamed; (1) our economy does better than theirs by a significant amount, (2) the opposite, (3) we do about the same. Of course this requires “significant” to be defined.

**Ed McGrady:** Sure, you could do that, however in most cases people want “realistic” future worlds and hence you need to inflate everyone’s economy at “realistic” rates. Also your suggestion tends to create crazy when you do it with all of the countries in the world as opposed to just two competitors. But in a binary competition, or even a trinary, you could do it. The problem is that, given GDP projections and other economic mumbo-jumbo we kind of know how the trinary system (RU/US/CH) will play out over quite a long time (hint: Russia doesn’t do great.)

**Robert Mosher:** Everyone from financiers to investors to wargame designers desperately need whatever is supposed to replace GDP as an economic measure, it doesn’t capture so much of our newly emerging economic activity.

[h] **Stephen Downes-Martin:** I think this is one of the many interesting areas where our two papers touch. In mine I propose that keeping our political and social values (and persuading other states to embrace them to create a favorable world order) is the game’s victory condition. In yours you propose wargaming within the framework of the favorable world order to examine other problems. The two types of game can run in parallel and inform each other.

**Ed McGrady:** I’m not sure what realistic game we’d ever play where the US would not be trying to persuade everyone to create a world order favorable to itself...however unsuccessfully.

**Stephen Downes-Martin:** The point is not whether we would play a values game over favorable world order (we would), but how we would design and play it with 5 year moves over a ten move game.

[i] **Stephen Downes-Martin:** This opens up the possibility of a “buying game” with players choosing what technologies to invest in (research, develop, acquire). Earlier you argue
that “the ratio of technology advantage between powers is rapidly approaching unity”,
won’t a buying game allow one to explore shifts away from unity?

**Ed McGrady:** I should be more specific between technology ratios which are spread
across systems/capabilities and games designed to get at technology competitions.
Basically what I’m saying is that over time the relative implementation of technologies
between sensible major powers will be unitary. It’s not like if someone discovers
antimatter cannons the other guys won’t have them in a couple of years. However the
operational level decisions as to WHICH antimatter cannons to buy, how to support
them, their ranges, the rate of fire, and all those other things that matter to operators
will depend on budgetary and other decisions. So my assumption is that sensible
governments will implement new technologies in such a way that neither side suddenly
has a devastating overmatch, at the same time you could put your antimatter cannons
on airplanes and I could put them on hamsters and that would affect the way we
operate our forces and what other things we buy (squirrel cages, for example). Also
there is the budgetary decision. Just because the TECHNOLOGY ratio is unitary does not
mean the BUDGETARY ratio is unitary - just look at the US vs. France, for example.
War and Wargames Beyond the Event Horizon

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Introduction

Presented with questions about the future of wargaming, future wargaming, and wargaming the future, I look first, as usual, to the past – to examine what has come before. As the sitcom character George Jefferson once said, “How do you know where I’m at, if you don’t know where I’ve been? Do you get where I’m coming from?”

Modern professional military wargaming is almost 200 years old. Witnessing an 1824 demonstration of “Kriegsspiel”, as developed by two generations of the Reisswitz family, then-Chief of the General Staff Karl Freiherr von Muffling declared, “This is not a game! This is training for war! I must recommend it to the whole army” (Leeson 1988). The rest of that story belongs to Matt Caffrey.

As in our oldest Western game of strategy, Chess, Kriegsspiel presented player-commanders with the opportunity to practice decision-making and tactical to strategic foresight. Unlike Chess, Kriegsspiel presented the player-commander with limited information about his opponent’s forces, their location, their objectives, etc., as well as a more real world playing surface on a terrain table or official military maps. Like Chess, Kriegsspiel offered the opportunity to pause and ponder a situation from multiple points of view at leisure. Kriegsspiel was in its early years so focused upon the decisions to be made by players that it would routinely suspend wargames when the two sides moved into close contact, this was reportedly because the Prussians recognized their limited ability to accurately model this complicated situation on a tabletop. Practice in decision-making in a tactical or an operational context builds mental ‘muscle-memory’ just as tactical battle drills develop a muscle memory that is essential when a battlefield situation changes too quickly and survival, not just victory, will depend upon training and reaction speed. Such attributes support dominance of the OODA\textsuperscript{146} loop identified by John Boyd (Boyd 1986).

Prussia’s adoption and development of Kriegsspiel was one thread in its army’s 19\textsuperscript{th} Century evolution that was widely if not always correctly adopted by other nation’s armies, the British, French, and American among them. By the end of the 19th Century, kriegsspiels had evolved to include elements such as logistics, physical fatigue, morale, communications technology, and field engineering. While the depth and breadth of Kriegsspiel’s impact varied over time and from one army to another, by the end of the 19th Century authors could present books of maps, scenarios, orders of battle, etc., with only minimal discussion of rules sets and without

\textsuperscript{146} O-O-D-A: Observe – Orient – Decide – Act.
the elaborate apparatus of von Reisswitz, Livermore, Totten, or others. Major Wilkinson Shaw, in *Elements of Modern Tactics, Practically Applied to English Formations*, published in 1890, for example, provided a folded map and illustrated instructions on how to make troop markers for infantry, artillery, and cavalry in order to play out the scenarios he presented. When I look back at the history of Kriegsspiel, Chess, Go, I am confident that in the future there will be wargaming, perhaps even beyond some date when there is an end to war. (Some have postulated the possible replacement of war by wargames of various sorts, but I suspect that that would require major alterations in human thinking and behavior.)

**Future Wargames and Wargame Futures**

Before marching boldly into the future, let me emphasize that I agree that wargames prove nothing. What they can do is to help identify the important questions that need to be answered (Perla 1990 p. 9). Future wargames model:

- War-making capabilities and their effects much like current ones,
- Capabilities marginally improved over current ones, or,
- Capabilities radically improved beyond those currently fielded.
- A battlefield environment dramatically altered by climate changes, etc.
- Confrontations between technologically superior and inferior cultures/civilizations (see the history of European actions in Africa and the Western Hemisphere)

The near future is primarily an extension or elaboration of what we already know projected forward. To reach the more fully “unknown unknown”, we need to focus upon the future that emerges two or more evolutions beyond that predictable future to the moment when the unknowns multiply and may even be invisible to us today. History tells us that the most fundamental transformations occur when humanity transitions from one primary major energy source to another – from animal and human muscle power to power based upon chemical interactions (gunpowder, steam, and the internal combustion engine) and now to power derived from our expanding understanding of physics (Dupuy 1990). As each transition moves forward it alters everything about war from material culture to mobility to logistics. With the introduction of nuclear weapons and nuclear power during the Second World War, we are now in such a transition based upon nuclear physics.

To be truly useful, games/simulations of possible futures need to escape the constraints of legacy platforms or concepts and explore what may lay beyond the event horizon.\(^{147}\) Over time, 

\(^{147}\) ‘Event Horizon’ is a term from discussions of general relativity referring to the point at which light could no longer escape from a Black Hole, in subsequent expanded usage, it designates a boundary beyond which an outside observer cannot see or controllably affect events.
the capabilities of one generation’s elite troops have become the standard capabilities of a succeeding generation’s ‘line’ troops. Weapons do not simply vanish as they are replaced by more modern equivalents, but find themselves retained in niche usages or in the hands of marginal forces. Increasing weapons’ ranges and lethality will expand battlefields and increasingly extend then across land, sea, air, and space.

Such an emphasis upon capabilities instead of legacy platforms in future game designs should allow greater exploration of possible RMAs. Thomas Kuhn’s original concept of the revolution in scientific affairs included the recognition that the critical revolutionary step takes place between the ears when someone recognizes and elaborates a truly new application of a new (or even existing) technology or technologies or concept of operations. Revolutionary transformations are almost never generated by the actual inventor or originator of a new technology, weapon, or concept. The real breakthrough on the battlefield comes when someone looks at the new and sees its new capabilities and applications. I would cite as examples:

➢ Britain invented the tank and deployed them in great numbers in 1918, but the Wehrmacht showed early in the Second World War how to integrate tanks, aviation, mechanization, and radio communications and use them on the battlefield (van Creveld 1989 p. 179);

➢ Germany had superior radar technology in 1940, but it was Britain that showed how to make radar technology part of a command and control network that made best use of radar’s capabilities and modern radio communications to fight an aerial battle (Hough & Richards 2008 p. 64).

“What was that?!”

However, wargames must strive to escape the logic trap of assumptions built into the games exploring and testing for RMAs based upon new technology, platforms, and capabilities. The pre-World War Two U.S. army maneuvers in Louisiana and the Carolinas incorporated tank destroyers (cannons mounted on halftracks). Untested in battle, the maneuver umpires were given data, charts, tables, and instructions on how to adjudicate tank destroyers in engagements during these maneuvers (Gabel 1991 p. 48). The results of the use of tank destroyers during these maneuvers were taken as validation of the concept and the weapon system (Gabel 1991 p. 171). Actual battlefield experience in North Africa (with the half-track based TDs) and in Europe (with full tracked lightly armed vehicles) led to a somewhat different conclusion at the end of the war and tank destroyers disappeared from the US Army (US War Dept 1943).

Wargames are about making decisions. Warfare is about rapidly making decisions with inadequate, inaccurate, and incomplete information. So an obvious question is what
information is desirable and how to obtain it. Future wargames need to incorporate the challenge of the cyber world’s accelerated information flow and help explore solutions. One of the biggest challenges at NTC and JRTCs is recreating the flood of information that needs to be assessed and filtered for the commander. It will also need to reflect the ancient truth/reality that some of that information regardless of source or channel will simply be wrong. In his lectures and writings at The Infantry School (1930-1931), then-Captain Adolf von Schell, Reichswehr, drew upon his experiences in the First World War to advocate giving ‘false or exaggerated’ reports in training exercises to accustom officers and troops to this inevitable wartime occurrence (von Schell 1933 pp. 25, 39).

An obvious concern about the future is the things we don’t know what we don’t know - the possibility of one or more “Black Swans”. By definition Black Swans are unpredicted, unexpected variants of the ‘bolt from the blue’ – very rare though very high risk:

“...First, it is an outlier, as it lies outside the realm of regular expectations, because nothing in the past can convincingly point to its possibility. Second, it carries an extreme impact...Third, in spite of its outlier status human nature makes us concoct explanations for its occurrence after the facts, making it explainable and predictable.” (The Black Swan, The Impact of the Highly Improbable – Nassim Taleb)

Bolts from the blue like 9/11 were actually forecast in our intelligence collection (Kean & Hamilton 2004) and Pearl Harbor was examined in maneuvers (Nofi 2010 p. 165), we simply drew false conclusions about the data. War games of the 1920s and ’30s about a war with Japan reportedly left the US surprised in actual combat only by the kamikazes (Perla 1990 p 73, Allen 1989 p. 127).

Dinosaurs inhabited the planet for almost 200 million years but neglected to develop an interest in astronomy and suffered for that lack of curiosity\(^{148}\). Humanity, on the other hand, having dodged similar events in recent memory (Phillips 2009), is now busily cataloging the potential space-based threats and contemplating response options. Humanity has also generated millions of pages of speculative fiction and non-fiction centering on hypothetical ‘Black Swans’. Game designers looking at the future thus have a wealth of material to draw upon (and should) for inspiration re ‘Black Swans’ and what to do about them. Nor are today’s wargamer designers the first to confront the challenge of the Event Horizon. In 1993, RAND game designers inserted the following footnote in a report on a series of their speculative games on future conflict in the Persian Gulf:

“2. To many, an Iraq/Iran coalition might appear extremely unlikely. However, if the Iraqi Shiite majority were to overthrow the existing Iraqi government, it would be much more likely. In any case, gaming should not be limited to “plausible” scenarios since in the real world the implausible (before the fact) scenario seems to occur as frequently. A defense of the implausible scenario is found in an unpublished RAND draft by our colleague James Winnefeld” (Bennett et al 1993 p. v).

Also still beyond the Event Horizon is any ability to truly wage war in space as for the foreseeable future we remain tethered by the limits of our technology and the needs of a human body optimized for life on Earth. Achieving Star Wars/Star Trek forms of war in space clearly require some fundamental alterations in our knowledge of how the universe works and how we apply that knowledge. If we want to embody Space Force now, we should steal a page from author Cixin Liu’s model in Three Body Problem and just suit up about 100 analysts, think-tankers, etc. to just study the challenges and realities of conducting military operations including combat in space for the decades or more required for our technology to catch up. War in space is a dangerous proposition for a species that is still primarily confined to life in a gravity well in a universe full of rocks and which cannot survive in space outside an encapsulated ‘earth’ to live in while traveling through space.

To explore future wars, to include a greater exploration of ‘bolts from the blue’ or ‘Black Swans’ in our games, I come back to the need to include greater free play focused upon capabilities — “What would I like to be able to do?”. We need to see more integration of warfighters into games in control of opposing forces, exposing them to how our combat forces look from the other side, identifying our own vulnerabilities, and doing likewise for potential opposing forces. Scenarios and orders of battle should move away from deployments of the standard TO&E, almost no unit ever goes into battle with everything ‘the book’ says it should have. It was at an NTC exercise that a uniformed colleague confirmed my impression that ‘the Army has a plan so that we know what we are deviating from’.

NSDM’s games encourage free play. Empowered to do so, players will generate ‘Black swans’. Let the players break the game, at which point you capture the data and do a reset to a key moment and move on. NSDM staff do try to avoid injecting ‘Black Swans’ or ‘bolts from the blue’ that are beyond the capabilities of players to act upon within the available time of play. (Nevertheless, both NATO and NSDM games often introduce radioactive mushroom clouds as a way of announcing ‘ENDEX’.) Controllers in Future Wargames will need to be even more prepared to pause their games, collect data, and then consider resetting the game and resuming play.
“I know nothing..!”

I have shared here some of my thoughts excavated from the mental aggregate deposited by some 60 years of playing, studying, critiquing, designing, directing, etc. wargames in multiple formats. One of the original benefits of the NTC model was the opportunity for warfighters to fail and learn from their failures. Without that element, a great deal of the benefit of synthetic combat is wasted. Winning or losing a wargame does not predict losing or winning a battle. One of my high school wargame experiences was winning a Tactics II game played against an Army Lieutenant Colonel. Even as I recognized that I was winning the game, I knew that my advantage was in knowing the game – not that I was a better battlefield commander. Game designers and Exercise control staff will need to continue to distinguish between better gamers and better tacticians or strategists.

Wargames are not going away, though they will continue to change and adopt new forms and formats, even as old ones remain viable. The idea of the wargame embodies the designer’s capability to create whole worlds (and their battlefields), populate them, set the capabilities of that population, etc. Wargames can show us multiple futures. Our challenge will be to identify and then achieve the future we most prefer based upon this and other insights. But this will only happen if we remain flexible, agile, imaginative, and persistent in thinking about both warfare and simulating that warfare, recognizing the universality of war even as we examine its future changes.

“Play up! Play up! and play the game!”

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**About the Author**

Robert A. Mosher is a thirty year veteran of the US Foreign Service whose career included two years in the Office of the Secretary of Defense and three tours as an Intelligence Analyst/Watch Officer. Trained as an Armored Scout/Observer at Fort Knox, he also completed the Command and Staff Course at the Navy War College. A lifetime playing, designing, and working with wargames began with AH Gettysburg (hex) in 1962. Professionally, he has worked in Continuity of Government, NATO, and Embassy Emergency Action Plan exercises and as a Subject Matter Expert/Role Player in US Army, Navy, and Marine training exercises at several JRTCs and the National Training Center (NTC). In addition to the National Security Decision Making Game (NSDM) as Game Director, Game Controller, Scenario Control, and Facilitator, he has lectured with NSDM at the Origins War College and the GenCon Writers’ Symposium. His principal interest and focus has been upon the evolution of war and warfare across history, pursued academically and experientially via conflict studies, living history, staff rides and battlefield walks on three continents across multiple conflicts.

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How To Think About The Future

© Kristan Wheaton
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(This paper is included in the “Wargaming the Future” Working Group Report with Professor Wheaton’s permission. The contents are from his Blog “Sources and Methods: Thinking about the future, and, more importantly, how to think about the future”149. This is a work in progress and Professor Wheaton will be adding additional sections on his blog.)

Part 1 - Questions About Questions

We don’t think about the future; we worry about it.

Whether it’s killer robots or social media or zero-day exploits, we love to rub our preferred, future-infused worry stone between our thumb and finger until it is either a thing of shining beauty or the death of us all (and sometimes both).

This is not a useful approach.

Worry is the antithesis of thinking. Worry is all about jumping to the first and usually the worst possible conclusion. It induces stress. It narrows your focus. It shuts down the very faculties you need to think through a problem. Worry starts with answers; thinking begins with questions.

What Are Your Questions?

“A prudent question is one-half of wisdom.” – Francis Bacon

“The art of proposing a question must be held of higher value than solving it.” – Georg Cantor

“If you do not know how to ask the right question, you discover nothing.” – W. Edwards Deming

Given the importance of questions and of asking the “right” ones (Brooks & John 2018), you would think that there would be more literature on the subject. In fact, the question of questions is, in my experience, one of the great understudied areas. A few years ago, Brian

149 https://sourcesandmethods.blogspot.com/
Manning and I took a stab at it (Manning, B. & Wheaton K. J. 2013) and only managed to uncover how little we really know about how to think about, create, and evaluate questions.

For purposes of thinking about the future, however, I start with two broad categories to consider: Speculative questions and meaningful questions.

There is nothing wrong with a speculative question. Wondering about the nature of things, musing on the interconnectedness of life, and even just staring off into space for a bit are time-honored ways to come up with new ideas and new answers. We should question our assumptions, utilize methods like the Nominal Group Technique to leverage the wisdom of our collective conscious, and explore all of the other divergent thinking tools in our mental toolkits.

Speculation does not come without risks, however. For example, how many terrorist groups would like to strike inside the US? Let’s say 10. How are they planning to do it? Bombs, guns, drones, viruses, nukes? Let’s say we can come up with 10 ways they can attack. Where will they strike? One of the ten largest cities in the US? Do the math—you already have 1000 possible combinations of who, what, and where.

How do we start to narrow this down? Without some additional thinking strategies, we likely give in to cognitive biases like vividness (PON 2010) and recency to narrow our focus. Other aspects of the way our minds work—like working memory limitations (Miller 1956) --also get in the way. Pretty soon, our minds, which like to be fast and certain even when they should

151 https://psychology.iresearchnet.com/social-psychology/decision-making/recency-effect/
be neither, have turned our 1 in 1000 possibility into a nice, shiny, new worry stone for us to fret over (and, of course, share on Facebook).

Meaningful questions are questions that are important to you--important to your plans, to your (or your organization’s) success or failure. Note that there are two criteria here. First, meaningful questions are important. Second, they are yours. The answers to meaningful questions almost, by definition, have consequences. The answers to these questions tend to compel decisions or, at least, further study.

It is entirely possible, however, to spend a lot of time on questions which are both of dubious relevance to you and are not particularly important. The Brits have a lovely word for this, *bikeshedding* (Kishfy 2015). It captures our willingness to argue for hours about what color to paint the bikeshed while ignoring much harder and more consequential questions. Bikeshedding, in short, allows us to distract ourselves from our speculations and our worries and feel like we are still getting something done.
The great Stoic philosopher Epictetus wrote, "Work therefore to be able to say to every harsh appearance, ‘You are but an appearance, and not absolutely the thing you appear to be.’ And then examine it by those rules which you have, and first, and chiefly, by this: whether it concerns the things which are in our own control, or those which are not; and, if it concerns anything not in our control, be prepared to say that it is nothing to you." (Italics mine)

There are good reasons to focus on questions about things you control. Things you control you can understand or, at least, the data required to understand them is much easier to get. Things you control you can also change (or change more easily). Finally, you only get credit for the things you do with the things you control. Few people get credit for just watching.

Whole disciplines have been built around improving what you do with what you control. MBA and Operations Research programs are both good examples of fields of study that focus mostly on improving decisions about how you use the resources under your control. Indeed, focusing on the things you control is at the center of effectual reasoning\(^\text{152}\), an exciting new

\(^{152}\) https://www.effectuation.org/?page_id=207
take on entrepreneurship and innovation (for example, the entire crowdfunding/startup Quickstarter Project\textsuperscript{153} was built on the effectuation principles and are the reason it was as successful as it was).

On the other hand, another great thinker from the ancient world once wrote,

“If you know the enemy and know yourself, you need not fear the result of a hundred battles.” Sun Tzu, The Art Of War\textsuperscript{154}

Sun Tzu went on to outline the exact impact of not thinking about things you don’t control:

“If you know yourself but not the enemy, for every victory gained you will also suffer a defeat.”

Things outside of your control are much more squishy than things under your control. The data is often incomplete, and what is there is often unclear. It is pretty normal for the info to be, as Clausewitz\textsuperscript{155} would say, “of doubtful character,” and it is rarely structured in nice neat rows with data points helpfully organized with labelled columns. Finally, in an adversarial environment at least, you have to assume that at least some of the info you do have is deceptive--that it has been put there intentionally by your enemy or competitor to put you off the track.

People frequently run from questions about things that are outside of their control. The nature of the info available can often make these kinds of questions seem unresolvable, that no amount of thinking can lead to any greater clarity.

This is a mistake.

Inevitably, in order to move forward with the things you do control, you have to come to some conclusions about the things you do not control. A country’s military looks very different if it expects the enemy to attack by sea vs. by land. A company’s marketing plan looks very different if it thinks its competitor will be first to market with a new type of product or if it will not. Your negotiating strategy with a potential buyer of your house depends very much on whether you think the market in your area is hot or not.

The US military has a saying: “Intelligence leads operations.” This is a shorthand way of driving home the point that your understanding of your environment, of what is happening around you, of the things outside of your control, determines what you do with the things under your control. Whether you do this analysis in a structured, formal way or just go with

\textsuperscript{153} https://www.mercyhurst.edu/news/mercyhurst-turns-over-quickstarter-idea-fund-erie
\textsuperscript{154} http://classics.mit.edu/Tzu/artwar.html
\textsuperscript{155} http://www.clausewitz.com/readings/OnWar1873/BK1ch06.html
your gut instinct, you always come to conclusions about your environment, about the things outside your control, before you act.

Since you are going to do it anyway, wouldn’t it be nice if there were some skills and tools you could learn to do it better? It turns out that there are. The last 20-30 years has seen an explosion in research about how to better understand the future for those things outside of our control.

More importantly, learning these skills and tools can probably help you understand things under your control better as well. Things under your control often come with the same kinds of squishy data normally associated with things outside your control. The opposite is much less likely to be true.

Much of the rest of this series will focus on these tools and thinking skills, but first, we need to dig more deeply into the nature of the questions we ask about things outside our control and precisely why those questions are so difficult to answer.

Part 3 - Why Are Questions About Things Outside Your Control So Difficult?

Former Director of the CIA, Mike Hayden, likes to tell this story:

“Some months ago, I met with a small group of investment bankers and one of them asked me, ‘On a scale of 1 to 10, how good is our intelligence today?’” recalled Hayden. “I said the first thing to understand is that anything above 7 isn’t on our scale. If we’re at 8, 9, or 10, we’re not in the realm of intelligence—no one is asking us the questions that can yield such confidence. We only get the hard sliders on the corner of the plate. Our profession deals with subjects that are inherently ambiguous, and often deliberately hidden. Even when we’re at the top of our game, we can offer policymakers insight, we can provide context, and we can give them a clearer picture of the issue at hand, but we cannot claim certainty for our judgments.” (Italics mine)

I think it is important to note that the main reason Director Hayden cited for the Agency’s “batting average” was not politics or funding or even a hostile operating environment. No. The #1 reason was the difficulty of the questions.

Understanding why some questions are more difficult than others is incredibly important. Difficult questions typically demand more resources—and have more consequences. What makes it particularly interesting is that we all have an innate sense of when a question is difficult and when it is not, but we don’t really understand why. I have written about this
elsewhere (here and here and here, for example), and may have become a bit like the man in the “What makes soup, soup?” video.¹⁵⁶

No one, however, to my knowledge, has solved the problem of reliably categorizing questions by difficulty.

I have a hypothesis, however.

I think that the AI guys might have taken a big step towards cracking the code. When I first heard about how AI researchers categorize AI tasks by difficulty¹⁵⁷, I thought there might be some useful thinking there. That was way back in 2011, though. As I went looking for updates for this series of posts, I got really excited. There has been a ton of good work done in this area (no surprise there), and I think that Russel and Norvig in their book, Artificial Intelligence: A Modern Approach (Russell & Norvig 2009), may have gotten even closer to what is, essentially, a working definition of question difficulty.

Let me be clear here. The AI community did not set out to figure out why some questions are more difficult than others. They were looking to categorize AI tasks by difficulty. My sense, however, is that, in so doing, they have inadvertently shown a light on the more general question of question difficulty. Here is the list of eight criteria they use to categorize task environments (the interpretation of their thinking in terms of questions is mine):

➢ Fully observable vs. partially observable -- Questions about things that are hidden (or partially hidden) are more difficult than questions about things that are not.

➢ Single agent vs. multi-agent -- Questions about things involving multiple people or organizations are more difficult than questions about a single person or organization.

➢ Competitive vs. cooperative -- If someone is trying to stop you from getting an answer or is going to take the time to try to lead you to the wrong answer, it is a more difficult question. Questions about enemies are inherently harder to answer than questions about allies.

➢ Deterministic vs. stochastic -- Is it a question about something with fairly well-defined rules (like many engineering questions) or is it a question with a large degree of uncertainty in it (like questions about the feelings of a particular audience)? How much randomness is in the environment?

➢ Episodic vs. sequential -- Questions about things that happen over time are more difficult than questions about things that happen once.

¹⁵⁶ https://youtu.be/Y1HVTNw7w
➢ Static vs. dynamic -- It is easier to answer questions about places where nothing moves than it is to answer questions about places where everything is moving.

➢ Discrete vs. continuous -- Spaces that have boundaries, even notional or technical ones, make for easier questions than unbounded, “open world,” spaces.

➢ Known vs. unknown -- Questions where you don’t know how anything works are much more difficult than questions where you have a pretty good sense of how things work.

Why is this important to questions about the future? Two reasons. First, it is worth noting that most questions about the future, particularly those about things that are outside our control, fall at the harder rather than easier end of each of these criteria. Second, understanding the specific reasons why these questions are hard also gives clues as to how to make them easier to answer.

There is one more important reason why questions can be difficult. It doesn’t come from AI research. It comes from the person (or organization) asking the question. All too often, people either don’t ask the “real” question they want answered or are incredibly unclear in the way they phrase their questions. If you want some solutions to these problems, I suggest you look here\textsuperscript{158}.

I was a big kid who grew up in a small town. I only played Little League ball one year, but I had a .700 batting average. Even when I was at my best physical condition as an adult, however, I doubt that I could hit a foul tip off a major league pitcher. Hayden is right. Meaningful questions about things outside your control are Major League questions, hard sliders on the corner of the plate. Understanding that, and understanding what makes these questions so challenging, is a necessary precondition to taking the next step--answering them.

References


About the Author

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Disclaimer: All ideas and opinions expressed in this article are of the author alone and do not reflect the opinions of any other institution or organization.
# Working Group Discussions

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Implausible and Possible Futures

Stephen Aguilar-Millan

Futurists like to think in terms of various categories of the future. We like to distinguish between implausible futures and possible futures. An implausible future is one which could happen, but which we feel is quite unlikely to happen, something beyond the bounds of possibility. Within the boundaries of possible futures are probable futures - those futures which we think are quite reasonably likely to happen - and preferable futures - those futures which we would very much like to happen. From the previous conversations, it seems to me that we are starting to limit ourselves possible futures and want to stay within the bounds of possibility. That’s OK, but we ought to be aware of what we are missing if we do so.

Futurists study implausible futures - silly sci-fi scenarios - because that’s where the wild cards lie. I think that I could best describe wild card scenarios to this group as along the lines of Donald Rumsfeld’s ‘Unknown, Ununknowns’. In our community we do have a pretty good example of what we mean. In the mid-1990s, an intelligence futurist called Marvin Cetron alerted his masters to the possibility of recently fuelled aircraft being flown into tall buildings in the US. His thinking on these lines was taken out of threat briefings on the grounds that they were too much like science fiction. You probably all know what happened next.

My point is that if we are to concern ourselves solely on possible futures, then we are restricting our view to the ‘Known, Knowns’ and the ‘Known, Unknowns’. I have to say that I feel a bit uneasy about that because I see this as an incomplete story. I am drawn to the ‘Unknown, Knowns’ and the ‘Unknown, Unknowns’ by habit. However, we can’t study everything. I just feel that, as we layer assumptions into the study, we ought to be aware of what we are putting in, and what we are leaving out. If we make an informed choice to do this, then that’s fine. However, we ought to be aware of our limitations.

Ed McGrady

Interestingly the Future of Wargaming working group is planning to use a futures process to understand how wargaming will evolve over the coming years. Right now we’re just planning to use a Shell kind of scenario process, though we could be persuaded to do something else/better. The goal is to get people to think concretely about the future (of wargaming), as opposed to just sit around and speculate.

I was also going to reply to the other thread that McCue seems to have started with a bit about plausible and implausible futures. Clearly we are living in an implausible future, and it will just get more so as time goes on (apparently). I don’t think choosing an implausible future in a game is ever a good idea, unless the game objective specifically specifies it (e.g. “what will we do if aliens arrive” or “what will we do if a giant extra-solar thing is headed straight for us (and
we detect it before it hits”)}. This doesn’t have to be scifi: unless a game is designed to specifically account for typhoons or nuclear detonations it will create a huge diversion for a game to incorporate them. In addition to plausibility there is also the question of myopia - we tend to extrapolate based on what is happening now as opposed to the complex, integrated, changes that will occur in the future (flying cars because all of the big innovation up to that point had been in mechanical efficiency and energetics instead of information so that’s what people knew). On the other hand, sometimes we get specifically asked about long time periods or implausible situations. Knowing a little bit about how to deal with them (as you discuss) would be a good idea.

For me gaming the long future is all about variables and drivers. What will be the big drivers in the future (climate change, perhaps?) and how do we want them to behave as variables in the game (fixed, variable, ignored, etc.)? The choice of variables and drivers goes to the overall objective of the game. In a game on climate change you’ll darn sure need the climate to be a variable, because that is the focus. Military technology in a climate game can probably be a fixed variable. And so on.

My approach to all this is quite practical. Sometimes there are issues (like climate change) where the game variables change over very long periods of time (deforestation, land use, genetic drift, animal populations, AI, mineral resources, economic development, etc. all probably fall into this category). So someone with funding comes to you and wants to design a game in a long future. My focus is on what do you actually do? One answer is “it’s hard and you won’t learn anything.” I find that more of an indication that it’s an interesting challenge that we can think interesting thoughts about.

And Stephen Downes-Martin is correct - in a professional game the key questions should revolve around the “so what” of what are we going to do differently - now - if we learn something from the game - not just explore the future for the future’s sake.

**Stephen Downes-Martin**

Stephen Aguilar-Millan’s point about wildcards in implausible futures is relevant to us for two reasons. (1) The wildcards surfaced by an implausible future might themselves be plausible (and might not be surfaced by a plausible future), and (2) if those wildcards are damaging to us (even if we don’t believe they are plausible) then we can expect smart enemy strategists to be working to author a future in which those wildcards are at best plausible and worse are present. We must think about how to use a combination of futurism and wargaming to explore and author futures that benefit our respective national securities based on decisions we make today, with a process (or processes) for how we develop gaming as the future unfolds.
Perhaps it’s not the plausibility of the scenario or wildcard that matters (analogy to divergent thinking?), it’s how we or an enemy can author a future to make a salient wildcard plausible that matters (analogy to convergent thinking?)
Consistent Terminology for Futurism and Gaming?

Anne Johnson

Since most of us are touching upon similar bodies of analytic and wargaming work; it’s not surprising that the group is showing how many perspectives and fields of study, and use of these tools and data, are biting away at dealing with complexity and uncertainty. My interest is in trying to understand environment uncertainty in the context of “what will the future be like”, not “what is a possible situation we may face”.

I have started using the term “Alternative Security Environments” as a means to convey how “The Future”, or at least components of it, could fall outside traditional assumptions or limits of understanding. Ideas that I incorporate include levels of uncertainty, types of surprises, a range of time horizons, and the direction of creating the future.

In my experience, people are using terms in different ways, so I offer up how I’ve been using some futuring terms. (Note the following terms are taken from literature and are not necessarily ‘military’, rather ‘academic’ or ‘business’.):

- **Trend**: historical, what has happened in the past
- **Projection**: extrapolation (usually of a trend) into the future
- **Prediction**: a statement meant to be accurate

**Four Levels of Uncertainty**

- **Clear Enough**: a single view is sufficient to make decisions
- **Alternative Futures**: a limited set of possible outcomes
- **Range of Futures**: the future is expected to fall within this range (could be the traditional “cone of plausibility”)
- **True Ambiguity**: not enough information to even know all the variables or parameters

**Different types of surprises**

It’s not black and white. A way to think about different types of surprise is:

**Unknown Unknowns**

- **Black Swan**: completely blindsided
- **Wild Cards**: “known (but possibly ignored, not considered) to be feasibly out there and usable”

**Known Unknowns**

- **Black Elephant**: Things we know about but are ignoring (for whatever reason)

**Unknown Knowns**

- **Black Jellyfish**: Incorrect assumptions, things we think we’re right about, but aren’t
Furthermore, these surprises could be technologically-based or use- or policy-based; and due to varying speeds and accelerations of advancement, could/will come to fruition over a range of time horizons.

**Speed/Velocity of (Technological) Emergence**

*Suddenly* from nothing to something very rapidly (e.g. graphene)

*Sleeping Beauty* ongoing work is finally enabled (e.g. artificial intelligence)

*Leap Across Fields* mature in one area shifts to another area (e.g. genetic algorithms)

**Direction of Creating “The Future”**

Either/Both can be used to ensure a future vision is achieved through leading, adapting, or following:

*Push* Often, a view of the future is based in the here and now – what we know and ‘where’ we are. Perhaps a bit more comfortable for most, and tends to be more “fact-based”, using tools trends and to predict for accuracy.

*Pull* Includes Futuring tradecraft tools to determine what “future” we want to create. I think most folks think they’re good at this, but unfortunately, they’re really just using qualitative methods to support their “gut feelings” and move pet-projects/ideas forward. (Designing a future where their solution would be successful.)

**Timeframes** (somewhat acquisition-focused)

*Near-term* what can be accomplished now; perhaps out to 5 years

*Mid-term* what we’re planning for; perhaps out to 15/20 years; programs of record

*Far-term* what we don’t know what to plan for; beyond programs of record

By using Alternative Security Environments, it is not necessary to define or describe the details of how surprises come about – rather their impact to the environment (for example by challenging underlying assumptions). From that point, a scenario for a wargame can be developed. Since so much can and will change between now and (name your future timeframe), coordinating and incorporating the above can be used in games (and other work) to enable decision makers to think differently and more critically; to better understand signposts and indicators, vice understanding how to plan for defined scenarios.

Some thoughts on modeling tools: systems thinking, system dynamics, and causal loops. These are not equivalent terms, though I think many use them interchangeably (not implying anyone in this group – but in my own experience). I think most folks don’t realize that system dynamics is about modeling a problem from a systems perspective and instead think that they
are trying to model & simulate an actual system (system of systems, ecosystem, ...). Also, causal loops do not provide behavior dynamics (neither do archetypes) and therefore counterintuitive behaviors and unintended consequences can be missed unless you build and run a simulate-able model.

**Stephen Downes-Martin**

It seems to me that the levels of uncertainty described by Anne are outputs, i.e. uncertainty leads to different qualitative orderings of the number of possible futures (single, limited number, wider range, wide open). Inputs might be described by John Hanley’s levels of indeterminacy in (Hanley 1991, 2017).

See John’s Table on page 35 of the Working Group 2 report, partially reproduced here for convenience (apologies for any weird screen size of image!):

<table>
<thead>
<tr>
<th>Deterministic</th>
<th>Statistical Indeterminacy</th>
<th>Stochastic Indeterminacy</th>
<th>Strategic Indeterminacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. State space clearly defined</td>
<td>1. State space clearly defined</td>
<td>1. State space clearly defined</td>
<td>1. Conflicting interests</td>
</tr>
<tr>
<td>2. Persistent data</td>
<td>2. Persistent data</td>
<td>2. Persistent data</td>
<td>2. Players specified</td>
</tr>
<tr>
<td>3. Units of measure understood</td>
<td>3. Units of measure understood</td>
<td>3. Units of measure understood</td>
<td>3. Information conditions specified</td>
</tr>
<tr>
<td>5. Initial state known</td>
<td>5. Probability distributions known, and are Markovian</td>
<td>5. Initial state known</td>
<td>5. Player tastes and beliefs known</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. State transition probabilities &amp; rates known, and are Markovian</td>
<td>6. Players consistent and logical (rational)</td>
</tr>
</tbody>
</table>

Trying to link inputs to outputs drives us to decide what we should be focusing on in designing a game, or games, or games plus other methods. Stephen AM’s paper for this working group is worth a read on that topic.

**Ed McGrady**

This discussion raises an interesting issue for me on this overall topic: how much thought/discussion/learning do we need about futurist thinking (coming up with the scenario)? Compared to how much do we need to focus on issues related to mechanics and other game-specific concepts? I think we need both but it’s interesting to recognize that the group will need to balance between futurism and gaming. Because they are not exactly the same things.
Stephen Downes-Martín

I draw attention to Doug Lenat’s experience in the 80’s winning the Traveller Trillion Credit Squadron game using highly unbalanced fleets. The strategy he used was to be as close to unbalanced as it was possible to be, but not quite, for any set of rules imposed by the tournament organizers who kept changing the rules to exclude his unbalanced fleets not realising that it was the rules themselves that defined “balance”, and that unbalanced is what allowed him to win. For this, and other examples of how and when unbalanced might beat balanced see (Gladwell 2009). I believe Ed’s question and past experience with balance leads to the more general question of when and how does balance and unbalance deepen knowledge.

Ed McGrady

Balance here: you are right, each individual will need to figure out how they approach the problem. I was just pointing out there were two different things we were talking about and that how those balance out will affect the overall trajectory of the group. And now you are pointing out that the trajectory will result in different learnings (if that’s a word).

Balance in games: the problem of “balance” is more of a hobby game concept, in my opinion. In professional games the situation (scenario) is the situation. In those games the much more complicated problem of “fairness” becomes an issue and takes in how you treat players and the subject matter. You can game a highly imbalanced situation as long as everyone thinks they are being treated fairly.

Phillip Pournelle

The issue of balance or unbalanced in DoD games is the decision space of Red. Too often we force Red to play like Goliath and for some reason Blue always wins. On the other hand, if Red is allowed to play in accordance with Red Doctrine (which often is like the Press in the article) Blue starts to lose, badly. After repeated exposure to this problem, Blue players can begin to learn the lesson and adjust their strategy accordingly. This gives me hope, I just hope this approach is used often. If the new Joint Publication 5-0, the best practices call for a level playing field for Red, in the form of equal decision space, etc.
Scenario versus game mechanics balance?

Stephen Downes-Martin

In professional national security games designed to explore novel approaches to novel future situations, I argue that balance, or rather the deliberate lack of balance, is a professional game concept in possibly two ways. First, we would like to see how a seriously weaker adversary could defeat us so that we can avoid that, and how if we were seriously weaker we could defeat a superior adversary. Perhaps we can do that with novel unbalanced force mixes that our adversary would not think of and thus would have difficulty planning around? Second, if the scenario is sufficiently far into the future we would like an R&D and Buying strategy that placed us in one of those advantageous situations in which we have an unbalanced force mix with novel COAs that the adversary has difficulty planning around.

And then of course any serious adversary will be thinking the same way.

As Ed rightly points out, balance applies not just to force mix in the scenario, but also to the process of designing games and the process of thinking about wargaming the future. The concepts of “balance” are different between these activities but thinking about them together might trigger some innovative thoughts.

Ed McGrady

For me, balance and harmony are an element of design, and therefore have a very big place in game design. However when I think of harmony in game design I mean are all of the various components in the scenario, mechanics, players, and venue all synchronized and working toward achieving the same goal and presenting the same consistent world to the players. This is very different from the concept of balance in victory conditions that we think of in terms of traditional war-games. And I think it’s different than what Stephen means. He means that we may learn different things from different types and strengths of challenges to the target players (i.e. Blue faces a strong Red, Blue faces a weak Red, etc.). I always push for Blue facing and accurate Red and balance be damned. But I can see his point, getting ourselves off balance - whatever that means - in games can take us interesting places. I’d do it by messing with all the tools, from venue to players to scenario, others may choose to focus on the scenario because it’s too weird (or risky) to do it with mechanics.

So we now have several different concepts of “balance”:

1. Traditional hobby wargame concept
2. Re-imagined in professional games as “fairness” because not all situations are, or should be, “balanced”
3. Variable balance used as a way of stimulating thought in a game.
4. Harmony and balance in the design of games.

I’m sure we could add more!

But the idea of throwing any of these concepts “off balance” as a way of increasing learning in a game is actually an interesting thought. (Except fairness, fairness for me has to be a bedrock value in games or you will unbalance yourself by having no players).
Common Pitfalls of Wargaming Emerging Technologies

Sebastian J. Bae

*The Fallacy of Familiar Concepts of Operations*: Many future wargames assume that units will operate in familiar frameworks and remain fundamentally unchanged – with technology replacing legacy systems. This often stems from the approach of utilizing gap analysis to creating technological solutions for present-day challenges. However, historically, significant shifts in technology in terms of warfare have been accompanied by radical organizational change. Rarely, if ever, do wargames ever wargame fundamentally different/radical organization structures and concepts that could be coupled with new emerging technologies.

*The Myth of the Silver Bullet*: One of the most common pitfalls I see is that wargames/sponsors create a suite of technologies that are unrealistically capable and tailored made to solve present problems. This is worsened by the fact that wargames rarely incorporate or examine the technical or operational demands of new capabilities. For instance, for energy-based weapons, where do you get the energy from?

*Balancing Realism and Radical Innovation*: The core fundamental tension in wargaming the future is the tension between feasibility (aka realism) and fostering out of the box thinking simultaneously. This is inherent to most wargames, but it is particularly acute for wargaming the future given the unknown qualities of the future technologies and not being trapped by past thinking. Commonly, the majority of wargame either are too conservative in their predictions of the future or so wildly speculative to be nothing more than science fiction. The difficulty is finding the balance.

*Recommendation*: There is no single solution to any of these challenges in wargaming the future. However, one of the best approaches is to conduct iterative wargames as part of a series, with different wargames aimed at examining or eliciting different aspects of the problem. For instance, the first wargame can be a matrix style game designed to elicit creative, out of the box thinking. This can be followed by more rigorous analytical games that incorporate realistic limitations and capabilities for future technologies.

Stephen Downes-Martin

Your situation assessment appears to have some connection to the wargame pathology known as the “(technology) victory machine”, wherein the game technologies are given to Blue that guarantee a Blue win -- Blue gets matter transporters and photon torpedoes, Red gets rotary dial field telephones and scud missiles, gosh we need matter transporters and photon torpedoes. There are analogous “logic victory machines” -- “If blue can pre-empt red decision making and overwhelm red forces, then blue can win” (honest, word for word a game research question proposed by a game sponsor some years back).
Is it the case that some pitfalls you mention have their roots in current game pathologies? And that you can identify new pitfalls generated by the uncertainties inherent in gaming the future?

Sebastian Bae

I see that the technology victory machine is a very fundamental one -- often showing up in future based wargaming in the DoD. I believe it is only amplified in future games -- hence the silver bullet.

In using familiar concepts of the past to the future, I believe this is a pathology more rooted in wider military thinking than in gaming. It is the pervasive belief that we just need to think faster, shoot farther, and see more -- while avoiding any significant changes in how we think or plan or execute in conjunction with new concepts.

Ed McGrady

Just a thought because it relates to my topic as well (McGrady 2019), you may wish to consider the time horizon in terms of the types of pitfalls. Within the FYDP, “beyond the FYDP” (10ish years) or within the JCOFA (20 years?) all make a difference in terms of the types of pathologies you will encounter. The interaction with threat technologies also matters - we can’t just predict what we’ll be doing, but also what the threat will be doing.

(My goal in my paper is to examine how to game topics that go beyond the normal set of scenario tools we have (FYDP, JCOFA, etc.) and think about the forces that should be included in the games, and what different techniques can tell us about the future. At least that’s the goal of my paper. Obviously technology is important, but the social and other factors are also important.)

Sebastian Bae

I can see how our papers are related. Mine is more focused on the pitfalls and pathologies that arise when wargames interact with new technologies like lasers and hypersonic weapons and autonomous weapon systems.

I identify that we often:

1. Script victory via technology hence the victory machine Stephen mentioned
2. Fail to imagine radical organizational changes in conjunction with new technologies
3. Try to wargame too many variables all at once such as 30 new technologies which muddles what is useful and not
4. The sinkhole of science of fiction. Where we game technologies so far into the future that we don’t really know how to quantify their effects on the battlefield
Ed McGrady

In terms of pathologies I believe you have hit on quite a few of them.

1. In my paper I’m going to probably talk about how we think about projected capabilities and their interaction so as to avoid this sort of crushing victory machine behavior. In most cases new weapons systems don’t actually completely crush the opposition, the opposition finds something to mitigate the effects. There are other ways to handle this as well.

2. But if you look at “radical organizational changes” in the US military it was not technology that was the driver. For the joint process it was the cluster of Grenada that finally pushed us into the joint paradigm (OK, not a historian, stand ready to be corrected here, but it was something like that). Technology has certainly increased information flows between organizations, but it has not redesigned organizations, that has mostly been at the hand of social and political forces (e.g. the COCOM boundary shifts of late). Again, in my paper I’m going to talk about the social and economic drivers that have to be taken into account if you’re actually going to game in the out-years.

3. One of the key things you have to do with long-term wargames is to fix at least some variables. In one of my games I fixed the ratio of technology effectiveness - future “warships” were roughly the same in capability and expense between us and “them” as they are now. The key thing of course is ISR and aerospace dominance. With a move to fast, small, and many that may take us in a weird direction - those are the kinds of things I want to talk about in my paper. But even in a game that occurs within the FYDP trying to change too many things - even if they are small and idiotic - will produce gaming chaos. So you are absolutely correct.

4. I’m not sure what to think about SF. It’s not immediately apparent to me that it’s a sinkhole - whatever that means. Chris Weuve has done some very interesting stuff at the intersection of professional gaming and SF (Peck 2012, 2013).

I think what really matters here is the line between professional and silly. The further out you go the more tempting it is to fall into the trap of silly. By silly I guess I mean both actually silly and stuff that does not directly address the objectives for the game. Sure, the US could become a monarchy and be ruled by a giant biologically engineered reptile - let’s call him King Ralph. But what does that do with understanding how the US should think about institutional change to adapt to the world political climate in 2050? If I keep in the reptile king, the answer will be “don’t create giant mutant reptiles and let Ralph become king” - not terribly helpful and rather obvious, on the other hand if I keep most things in government the same then decision makers can easily see how changing boundaries, economic development, access to technology, and other stuff that matters might affect their decisions in the future - and give them some insights for how to shape policy today. I can go all SF in some of these things - mining in the
Antarctic may very well become a lucrative and productive thing to do around 2050. So some SF good, other SF not so good. Which is why I use my silly test.

Other pathologies? The one that immediately comes to mind is not defining the objective in terms of things that the sponsor can affect now. It’s great to play Starsoldier (I’m a big fan SPI games), but what, exactly, does it tell us about decisions we need to make now (in reality, a lot, but then read my paper). Objectives for the game should not simply be speculative “tell me what 2050 looks like” but rather “identify key policy choices that if made today would have positive/negative outcomes in 2050”.

Anyway - look like everyone is going to be going after the future - so we’ll all have a similar subject - but I suspect we will vary a lot in the way we get there (hopefully all of us do get there...).

**Phillip Pournelle**

Ed and I have encountered this in a series of games trying to address new capabilities, etc. I believe we were quite successful because a) the games were iterated in a cycle of research with analysis between games, b) we required those who proposed the systems provide detailed descriptions about how it worked, what support mechanisms were required, etc. c) rewarded teams who thought through the implications and organization to employ them (which then led the other team to up their game), and d) introduced a limited number of variables between games.

One issue we found was the range of potential systems, either program of record or more speculative, was so large the supporting details created a phone book which was difficult to absorb, to say the least. Quite often we could not determine the impact or non-impact on systems because players simply did not know they had them, and therefore could not organize their forces and plan accordingly.

**Sebastian Bae**

So how did you fix the phone book manual problem and the issue of translating effects of systems especially those that are speculative in nature into the games you were running?

**Ed McGrady**

You can’t solve the phone book problem with a phone book. What essentially happens is that the players choose which systems they want to focus on, because they think they need them, and ignore others. Like in the real world. Of course they may be wrong because they don’t understand the systems, but that can also happen in the real world. Military officers spend years understanding their weapon systems and days understanding how to fight wars, in
a game of the future you have hours and minutes to get them up to speed on the future but with everything being different. You simply do the best you can.

If by “translating effects” you mean “adjudicating outcomes” - at least in the timeframe we were working the laws of physics still pertained. You have to know your physics. If you do it is a lot easier to get close to the truth.

Sebastian Bae

In relation to the adjudication of future tech, physics plays a part, but I’m curious how you typically determine the effectiveness of weapon or technology. Like say a laser was shot at a drone or a manned aircraft, what are the probability of success and how do you determine those to help with adjudication.

Games I have worked on typically use combat tables or SME or a combo of both. But creating combat tables to emerging tech is speculative

Phillip Pournelle

In multiple cases, we employed a matrix game technique drawing on the expertise of those participating in the game. The referee worked to come to a consensus of what could occur, and sometimes used dice to make a decision. Like in planning, you have to make an assumption to keep going, so we did that in the game. Just like in planning, after the game was over we looked closer at that assumption and it became the focus of analysis in the post game work. This then formed the basis for drafting new rules to be used in the next game, subject to the experts on the topic. This highlights the importance of iteration in games which examine speculative systems. It also highlighted how little we know of /existing/ systems.

Ed McGrady

As Phil said, expertise in the systems can be very helpful, as can examining your assumptions and iteration. However in order to put all that together you need to understand the basic physics. For missile systems (which is almost inevitably what we are discussing) you have to detect, identify, track, target, engage, have the weapon sensor detect it, and the weapon do its thing. That involves a lot of a) looking at stuff at a variety of frequencies, and b) processing of data. Assumptions can be made of effectiveness based on environmental, target, and weapon characteristics. Tables get you part of the way in terms of Pk, but all of the various conditions ranging from the weather to the aspect will need to be adjudicated by someone who understand sensor and kinetic physics of the engagement. As Phil said, perhaps the best way to do this is in dialog with the weapons system designer who can (or often can’t) answer particular questions - like what the FOV of the sensor is, it’s processing, etc. Of course if no one knows any
of this stuff you need to make some realistic assumptions that the engineers won’t put something together that doesn’t see, fly, or explode.
Low Entropy and Schrödinger’s Tiger

Brian McCue

“The future’s uncertain
And the end is always near.”--Jim Morrison

When considering the uncertainties of future war, especially in the middle-distant future that is a few decades from now, we tend to focus on the uncertainty caused by our inability to predict how technology will develop over that span of time. However, little can be done, other than to wait and see how technology turns out, and it is not clear how wargaming can do much to help. Other forms of uncertainty will remain, and in fact may well predominate, and some of these can perhaps be somewhat mitigated by wargaming, if we are willing to conduct wargames differently from how they are conducted now.

One form of uncertainty that may be addressable by wargaming is what I call Low Entropy. In the decades since the Second World War, conventional weapons (to say nothing of nuclear ones) have become vastly more lethal--almost entirely because of huge increases in the probability of hit--and far fewer in number. The number of possible outcomes has plunged, simply because the arguments in the combinatoric expressions have decreased so much (think of the difference between a raid of however many F-117s, armed with a few smart bombs each, against Baghdad, and a thousand-bomber attack on Berlin), and the M&S people, with their “variance reduction techniques” and bland assurances that “It’ll average out,” get farther and farther from the truth, which will happen only once and will contain big surprises because of the number of possible outcomes is low and co-variation has gone up. Success and failure feed on themselves and luck no longer “evens out.” An early version of this form of uncertainty was visible in WW II carrier battles, in which the numbers of airplanes were small (dozens, vice hundreds in the air war over Europe) but the damage they could do was considerable, because of the delicacy of aircraft carriers. The variation in outcomes was enormous. Even more extreme is the near-asymptotic case of Electronic Warfare. We do not know if Red’s black box EW system can outperform Blue’s or not, and we may be tempted to express our ignorance as a statement that the probability of Red’s box defeating Blue’s is one-half. And as a Bayesian, I say “So be it.” BUT each side’s boxes are all the same, so if in one case, Red defeats Blue, the same result is likely to obtain in all other instances. There may be dozens of encounters, but the EW Die is rolled only once.

And this is the second form of uncertainty: Schrödinger’s Tiger. It is uncertainty caused by our ignorance of ways in which one thing will (or will not) operate upon another, and in future warfare, this uncertainty will be profound. In a measure-countermeasure duel, one side will win, but we have little means of predicting which one, and although the contest may happen many times, the outcome will be the same in nearly all of them. To add the final category to
Secretary Rumsfeld’s famous epistemology of uncertainty, it is an Unknown Known [sic]. This effect is most clear in cyberwarfare, and second-most in electronic warfare, but in fact it probably extends to physical weapons themselves, where the struggle between stealth and sensors, difficult or impossible to replicate in a test, much less an exercise, becomes close to imponderable.

It’s my understanding that in the famous pre-WW II naval wargaming at the Naval War College, the parameters of the Japanese ships were varied. But sources (and I can’t cite any--this whole thing is a recollection from a debate on the old NavWarGames listserv) vary as to how and why. Some say that the variation reflected uncertainty on the part of the intel people. If they weren’t sure of some speed or range or something, they would use different values in different games. OK, makes sense. Others went further and said that the variation was introduced, perhaps even counterfactually, to give the Blue players experience in dealing with uncertainty, or maybe even just bad information, to the point of using information they knew was wrong. There’s an Unknown Known for you. A respected figure in naval analyses (and naval wargaming) had a strong “they would never do that” reaction, but I’m such a contrarian that “They would never do that” usually causes me to increase my suspicion that they had. YMMV. Perhaps those with NWC Wargaming connections and proximity could dig into what remains of the records from the pre-war gaming.

Now consider the union of these two forms of uncertainty (plus any residual technology uncertainty that may remain): the upshot is that we have a sequence of interactions whose entropy, already low because of the small numbers of entities involved, is further reduced by the reduced (perhaps drastically reduced) level of independence among events, caused in large part by their shared correlation with Unknown Knowns.

How can gaming help?

I’ve noticed that quite a number of present-day scenarios boil down to a mobile defense of a high value item in an unfortified battle space. Examples include Theater Anti-Submarine Warfare, Ballistic Missile Defense, and Cyber. In all cases, the peacetime condition is constant vigilance conducted by a small number of detection systems that are turned on all the time. They have to have high sensitivity and low false alarm rates.

(Side-rant: Few, if any, sponsors appreciate how hard that is, and only the ones with experience as console operators (usually available only to enlisted people) can even see anything the matter with the inevitable guidance “Maximize detections while minimizing false alarms.” See also Igloo White, the CAPTOR Mine, TSA passenger screening, etc. EOR.)

Then the attack (or other enemy operation) begins, and the mobile defenses have to get themselves sorted out against the attackers and respond--while themselves being subject to false-alarms and misses, and also to possibly unfavorable combat results. At the simple-game
level, TASW, the defense of Tobruk, and response to a cyber event are all pretty much isomorphic, and could all be represented by the same double-blind game.

Now comes the part about not playing the way we normally play. In this game, the players would not be given the Combat Results Table or other such converter of die-rolls into outcomes, and in fact this table would change every game. It is the Unknown Known. Think double-blind _The Awful Green Things From Outer Space_, except it’s so double-blind that the players don’t get to see the CRT or the die-rolls, and they just have to learn from experience what’s a good weapon and what’s not. (People might want assurance that the game would, regardless of these changes, always be “balanced,” and I’m undecided as to whether or not that’s a good idea. (“Life is unfair.”--JFK))

The simplest game I have ever run, years and years ago, might also have been the most instructive, and certainly the most highly leveraged because it was played by a group of fast-burn Navy Captains and Marine Corps Colonels. Jeff Cares had asked me to spend an afternoon with the CNO’s SSG, up in Newport. He gave me three hours, told me that Rod Stewart always opened with Maggie Mae, rather than save it for an encore, and that I ought similarly to spend the first hour on U-boats. So I did. I spent the second hour on Military Experimentation (my CNA assignment at the time was to the Marine Corps Warfighting Laboratory), and then I devoted the final hour to having the group play their way through the Two-Armed Bandit Problem.

As I explained to them, a Two-Armed Bandit is just like a One-Armed Bandit (i.e., a slot machine), except that it has two levers with presumptively different pay-off distribution. I stipulated that the TAB in my game was also unusual (by Las Vegas standards) in that it was worthwhile to play because at least one of its arms had a positive net payoff. Also, it was memoryless: each arm followed a set distribution regardless of what had transpired before.

I had pre-calculated a long set of payoffs (making them Unknown Knowns) and all the SSG had to do was to tell me “Left” or “Right” and I would tell them how many dollars (if any) they had gotten back for the one they put in.

It worked wonderfully--the SSG started out by thinking that the problem was trivial, and ended up, an hour later, by deciding that it is nearly impossible. The latter view is closer to being correct. The difficulty, of course, lies in deciding when to cease experimenting and start pulling just one arm.

Sebastian Bae

I see some games try to eliminate uncertainty by giving overly favorable outcomes to Blue. Could you elaborate on two points, what did you mean by:
1. “At the simple-game level, TASW, the defense of Tobruk, and response to a cyber event are all pretty much isomorphic, and could all be represented by the same double-blind game”

2. “The difficulty, of course, lies in deciding when to cease experimenting and start pulling just one arm”?

Brian McCue

“Never tell me the odds.” -- Han Solo

Reference: “1. At the simple-game level, TASW, the defense of Tobruk, and response to a cyber event are all pretty much isomorphic, and could all be represented by the same double-blind game.”

About a year ago I was at some workshop and there was a session on cyber. I know zip about cyber, so maybe I went because the session description said there would be a game. After some description of how intrusions work (I still know zip), the game came out. The board was a schematic map of a computer network. It had big blobs with little blobs inside them. Of the big blobs, some were more important and others were more susceptible to covert entry. The attackers had to enter one that they could enter, and then work their way node-by-node to an important place. Connectivity among the big blobs was sparse, and it was made directly to little blobs, so to move around, the attackers had to enter a big blob via an accessible little blob inside of it, move through little blobs until they came to one that connected to a little blob in some other big blob, make the leap, etc..

As the defenders, Hank Donnelly and I could shift our attention from place to place arbitrarily: it was our network. At any blob, we could try to detect intruders. If we found them, we defeated them automatically and they had to start over. But there was a possibility of false contact, so if we thought we’d defeated somebody, we couldn’t necessarily go back to patrolling the entryway, because maybe we only _thought_ we’d defeated somebody, and the real attacker was still on the loose, deep in our system. And one more thing--we knew the various probabilities (and so did the attackers), but they varied from one little blob to another, so there was a drunk-and-lamp-post effect.

Hand and I had done ASW when he was at CNA, so we both thought of ASW as soon as we saw this game. It could have been a perfectly plausible ASW game: searching some places is easier than others, the sub has to work its way through whereas the defenders can go where they want, and, of course, there can be false contact.

Later, I read Agar-Hamilton’s account of the defeat of the Commonwealth troops at Tobruk (1942) by Rommel. Tobruk is called a “fortress,” but it didn’t have tall ramparts with big guns shooting out of loopholes or over the top. It was really just a group of interconnected strong-
points, manned by too few infantry and tanks to hold them all at once. The CONOPS was to have a thin crust that would wait for an attack and then call for reinforcements when the attack came. There was not much of an issue of false contact per se, but there were major command-and-control problems and forces could get sent to the wrong place (or even no place at all) even in the absence of true false alarms. Defending companies and platoons rushed around just like cruisers and destroyers defending a carrier, and the Germans came in just like an attack submarine. And it also seemed to me similar to the cyber game (it could certainly have used the same board, but some different rules), and it also seemed to me like a missile defense problem I had seen, in which one missile could probably defeat one missile, but six missiles could not necessarily defeat six missiles because they had to get themselves allocated right, the later missiles could be confused by debris from earlier hits or they could lock onto outgoing missiles of their own side (false contacts), etc., etc. “The Patriot missed because the SCUD malfunctioned.”—Peter Jennings

Reference “2. The difficulty, of course, lies in deciding when to cease experimenting and start pulling just one arm.”

When you start playing the Two-Armed Bandit, it’s clear that you have to work with both arms for a while, to see which is better. In the endgame, you’ll have decided which arm is best and you’ll just pull that one. But when do you make the transition, and on what basis? Even in a limited TAB problem (and there’s a big literature on this, mostly coming out of RAND—one wonders what they were really working on) in which all the payoffs are $1 and it’s just a question of estimating the probability that a payoff will occur, this problem is non-trivial. In the more general version that I gave the SSG, in which they knew only that at least one arm paid more than $1/pull on the average, but soon found out that the payoffs could be quite large (and rare), it is difficult to decide when you have found the good arm.
False Information as Uncertainty?

Robert Mosher

In the book, Battle Leadership, by then-Captain Adolf von Schell, based upon lectures he gave in 1930 while a foreign student at Fort Benning, von Schell argued that training units in exercises should be given false information in order to prepare them for the reality of the unexpected.

Peter Perla

With the introduction of the Fires Effect rules beginning in 1921, the college added an ever increasing array of factors to the adjudication tables in what appears to be an effort to get results on the floor that were as close as possible to what could be expected “in real life.” This follows a review of the rules that were currently in use (arguably designed for ease of use over ‘realism’) after the Battle of Jutland. Early rules, for example, had no modifier for target aspect with regards to probably of hit, which incidentally was deterministic, not stochastic. Nobody was rolling dice!

Within that context, it seems unlikely that the college would randomly change performance parameters just to introduce uncertainty. Rules were periodically updated to reflect changes in technology, new intel estimates, etc. In hindsight we know that many of the rules came up short – the performance of Japanese torpedoes is the oft cited example.

It bears remembering that the point of interwar-years gaming at the college was by in large educational, not war planning, not analysis, and was driven by the curriculum. It wasn’t until the late 1930s that CAPT Van Auken of the Tactics Department did any trend analysis of games over multiple years. Given the frequency of conflict up through the early decades of the 20th century, the students faced the very real probably of a fight within their period of service, and were focused on gaming battles with the fleet they had today, and less about future conflicts with hypothetical fleet of tomorrow.

That said, it should be noted that the fleet Nimitz played with on the floor of Luce Hall in 1923 was very different than the fleet he went to war with in 1941. And yet when he spoke to the NWC student body in 1960, he extolled the value of war gaming in preparing him to deal with war in the Pacific. It is easy to get wrapped up in focusing on the tech, but in the end, it is humans and the decisions they make, that is the crux of war (and war gaming!)

Peter Perla

I’m often asked how we introduce “fog and friction” into our games. The answer is usually that we don’t; in a game with 300+ participants, there’s plenty of nature fog and friction to go around!
Robert Mosher

This has been our experience with NSDM games often having anywhere from one to as many as four dozen players.

Peter Perla

I also recall a source discussing the issue of whether the effectiveness estimates at Newport were deliberately changed from year to year or even game to game specifically to emphasize the uncertainty and need to learn during the event. But I cannot recall where. I may well even mention this in my book but I’m too bloody lazy to look for it at the moment!

My recent exploration of 1940 has also illustrated the critical importance of human factors interacting with technology, as well as the fact that complex systems often need to be regarded as dynamic systems. French tanks in general had better armor and better guns than German ones. But too often the French tankers were not as familiar with, much less as well trained on, their tanks as the Germans. And the command overload on the French tank commanders, coupled with their limited radio comms, didn’t help. So the Germans seemed to be quicker and better at solving the problems posed by the French tanks than the French were at solving the problems posed by the German panzer divisions. Hence the too often heard overly simplistic explanation that French must have lost despite their technological superiority because their will to fight was poor. Their high command was, of course, outthought and out paced, but the soldiers themselves fought pretty well, at least at the beginning. It strikes me that we are in danger of placing too much emphasis on technology and not enough on how to assess the ability of the contenders to make best use of their technology. Or to use cyber jujitsu to turn the opponent’s fancy AI battlefield control systems into bricks, just like my cellphone in Europe. Not because the technology didn’t work but because operator error (mine own) coupled with lack of sensible support from the tech backbone (the Verizon online sign up system) allowed me to sign up my phone for a service it was not capable of using and not being told there was another service that I could use.

Another favorite topic of mine, which has some relevance here (probably more than my Verizon story!) is similar to Brian’s TAB problem. Back in the day (80s or 90s) Joe Miranda designed a Franco-Prussian War game for S&T. He used a combat system based in drawing chits from a cup for each combat. These chits gave different percentage losses as well as special effects, like increased effectiveness of cavalry or other things. Sadly, however, the RAW always used all the chits in the cup, effectively making the system isomorphic to a standard CRT. Joe had missed the opportunity to create the uncertainty in the minds of players which had been experienced by the real commanders, not quite sure how or whether some weapons systems and tactics might work. Had he randomly removed some of the results before starting the
game, he could have accomplished this easily. Only by observing the results of several combats could the players then learn what was the actual distribution in that particular game.

Ultimately, of course, it comes back to, “So what? “ What do we want the game to do for us? Predict battlefield dynamics fifty years out? Good luck. Teach decisionmakers how to identify and recognize the unknown knowns (not sure I really understand that one, but it sounds good!)? But today’s players aren’t going to be around in fifty years. So I ask my usual question, what do we want such wargames to accomplish? And following the SDM mantra, why do we want it and why don’t we have it?

Stephen Downes-Martin

Reference Peter’s comment “… whether the effectiveness estimates at Newport were deliberately changed from year to year or even game to game specifically to emphasize the uncertainty and need to learn during the event.”

The accepted wisdom / water-cooler rumor at NWC is that the tech was altered year to year so that (a) the students could not pass onto their previous-year’s colleagues the solutions they had come up with, and (b) no one cared or knew what the actual tech would be in the future, they wanted to force the students to get good at solving unfamiliar problems by being mentally agile. Could be post hoc rationalization and wishful thinking about a past golden age of wargaming I suppose ...
Working Group Discussion References


Wargaming the Future Workshop Discussions

Chair: Stephen Downes-Martin

Before the Connections US Conference, participants who registered for the Wargaming the Future Workshop were granted read-only access to the draft working group papers and requested to think about “how would you design a game, a game mechanic, or any part of a game that handles any challenge they choose to the problem of wargaming a future out to 50 years?” as preparation for the workshop.

The workshop started with a brief reminder of the problem and some of the challenges and approaches dealt with in the working group papers. Having already prepared, workshop participants then spent ten minutes individually and silently answering the above question for themselves. They were asked to write down their answers to include the chosen challenge, proposed approach and what might be needed to implement the approach.

A workshop participant was chosen at random and asked to read out the challenge. The group was then asked for a show of hands for anyone else with a similar challenge, and those people were placed in a subgroup, and sent out to a break out area to work. The process continued until all members of the workshop were in subgroups. Some participants selected challenges that were so specific that no one else shared that challenge. The workshop chair allocated such participants to subgroups whose challenge broadly subsumed the over-specific challenge. Each subgroup elected a named leader who was responsible for facilitating their subgroup discussion, documenting the discussion and providing that documentation to the workshop chair. All participants were asked if they would allow their notes to be photographed for analysis.

Participants were asked if they wanted their name and contact details to be excluded from the final report. Some workshop participants chose to be off the record and are not named in this report. Hence some subgroup participant lists are shorter than the actual number who participated. Finally participants were invited to email to the workshop chair by August 30th additional ideas, working papers or other material they would like included in the final Working Group Report.

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Dealing with Indeterminants

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The Challenge

John Hanley presented a quick overview of indeterminacy from the paper that he wrote for the Wargaming the Future working group (Hanley 2019). The group then discussed how to identify the issues (the decisions the inquiry was to support) and the uncertainties related to those issues.

Modeling uncertainty and impact: One person, familiar with at least conversational complexity theory, suggested that the uncertainties were akin to when adding grains of sand to a pile results in cascades of different magnitudes. One cannot predict whether adding one grain will result in a cascade, or what the magnitude of the cascade would be. He suggested that focusing on each grain of sand would not be very productive.

This is worth developing further. It comes down to whether one thinks of probabilities in terms of Markov chains where probabilities are given for moving from one state to the next, or in terms of power laws where one can give the probability of changes of different magnitude occurring over a specified period of time, like earthquakes, but cannot say when the change will happen. Geoffrey West’s book (West 2017) is an excellent example of this form of analysis. We did not have time to discuss this in the group.

The next person suggested that the challenge was creatively imagining the future and coming up with plans for the imagined future. The group then discussed what the structural factors might be. This got into discussions regarding whether nation states or corporations would be the major actors in the future, and related uncertainties. The challenge of how one establishes what the driving factors would be became apparent, but different people had their favorites.

The discussion turned to focusing on change versus retaining perishable skills. A former military officer discussed how reliance on computers had resulted in people losing the ability to do things manually, like navigation. Another person extended the analogy to the seed bank should a crop fail catastrophically. This led to imagining a future where civilizations collapsed requiring people to return to agriculture and a discussion of the need to be able to adapt.
One person with an international relations background discussed the predictability of nation states’ behaviors. He suggested that the universal human desire for individual dignity would emerge in the future to affect state behavior.

**Gaming (and related) Approaches for Addressing the Challenges**

The group began by asserting that the game had to be a model of the projected future. It should have features to reward adaptability, and while a focus on military issues is natural the game must go beyond military.

One person suggested using a game similar to Civilization. The approach was to project alternative futures with different resource allocations for each player, and then allow the players to determine successful strategies addressing the opportunities and challenges. Others endorsed the outlines of this idea.

This led to a discussion of how one would generate the set of futures to be used in the game, and the possible use of games to generate those futures. The group seemed to have a general consensus regarding doing a series of games to generate alternative futures and then games using those futures.

The discussion then turned into focusing on effects using abstractions rather than details. The group again emphasized that adaptability should be a key variable in the game, along with resilience to react to events for which they had not shaped.

**The Impact**

The first idea for creating an impact on organizational policies and plans was to get bosses into the game, plus the hotwash (and a post-game analysis). The objective was to change the way that they think; “an unintentional didactic.”

When pressed about how much change even a Service chief or CEO could make when convinced of the need for change, the group turned to bottom up approaches. Some went so far as to suggest online/video (virtual reality) games could be so compelling as to cause voters to select representatives who pursue wise policies. The discussion of the effect going on beyond democracies due to universal desire for human dignity emerged again.

The group emphasized the need for multiple games for different player preferences in the style of game. One person referred to Bernard Suits: “playing a game is a voluntary attempt to overcome unnecessary obstacles.” The intent was that people would play compelling games voluntarily (Suits 2014).
Efficacy of command and control processes

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The Challenge

How do we wargame the efficacy of command and control processes 50 years in the future?

Our group took as a premise that trying to guess the future was likely to be futile, even ten years out, but that the perennial requirement for a Command function to carry out John Boyd’s OODA loop (see the Boyd Website) was historically going to be both a continuing trend and a constant (to badly plagiarize Wayne Hughes). The group proposed the following characteristics of the future battlespace are important and enduring:

- There will be unknown and unknowable technology at any moment in the timeline.
- There will be a mix of legacy and current state C² systems for all protagonists at any given point on the timeline.
- Connectivity between these C² systems will almost certainly be unstandardized, due to the nature of various system maturities and the probable coalition nature of future conflicts.
- Degradation of reliable C² systems will occur during the fight.
- C² System resiliency will be variable against unknowable threats and defenses.
- Speed of reaction will need to be quicker as weapons get faster.
- Agile, networked C⁴ISR will be required in this OE.
- Pattern recognition and human decisions based on incomplete SA will still be needed.
- Commercial and civil communications will in some way be used or integrated by/into the military system as the military will tap into these systems to attempt to utilize (and possibly hide amongst) the general comms clutter.

Approach -- The wargame must:

- Cater for different opposing C2 structures, processes and capabilities. The pros and cons, strengths and weaknesses of these systems/tech/processes should be represented in the game using, at a highish abstract level, the OODA loop.
➢ The game must cater for at least two opposing sides, and more realistically be able to represent up to eight sides to represent coalitions and alliances interacting. One side may have assets that are better at a certain process than the other, for example where a certain air asset being to outrange (strike radius) another would give one side an enhanced ability to Orient for an ACT strike.

➢ The sides may/could include megacorporations with assets and capabilities coerced/volunteered/sold to Red and Blue.

➢ Both sides will have hidden capabilities that can enhance or degrade the opponents C2 capability. For example a surprise capability to obscure Observation, a means to disrupt Decision capability, a means to disrupt successful enemy Orientation.

➢ The players should not be given a complete intelligence picture of the other sides capability unless they have spent a lot of resources and time on this, to the detriment probably of something else. See point 7 below.

➢ False information, obfuscation of ground truth and generic information operations will be commonplace and may indeed be the main battleground for hearts and minds. This should realistically be represented in the game to the extent needed to remind players of the non kinetic side of life.

➢ No side should have/will have unlimited assets. Both sides will have limited resources to allocate to offensive and defensive activities. The game must represent the hard choices that command teams will have to make in a relatively short timeline.

➢ Time pressure must be felt by the players to make a correct decision faster than the enemy.

➢ AI asset capability could be significant and can be represented under the 4 OODA categories as it matures. This is already being assessed and considered.

➢ The game has to measurable and quantifiable in the speed of circling the OODA loop and also illustrate the effect of being faster or more accurate than the enemy. The way to get command teams thinking about the outcome of the OODA advantage is to have both sides set up and try different tactics and processes, with variable assets and outcomes.

➢ Damage inflicted by the enemy in the game should affect some, or many functions of command (for example the OODA nodes will be damaged or degraded) or should result in the degradation of assets, which in turn will prevent or delay mission accomplishment.
What is Needed

➢ “A real time” game mechanic, we envisage no set move and decision time - the faster OODA circling team should gain an advantage in getting off Actions before the enemy. Navel gazing should be deadly to those looking downwards – this is Boyd’s revelation and he illustrated it with multiple historical examples.

➢ Representation of success is by comparing actual vs optimum. For example how far were the players SA removed from the actual ground truth during the Observe Phase. This needs to be recorded simply to track back missed cues, opportunities and successful enemy deception, amongst many others in the other Phases.

➢ A measure of how long it takes a command team to get between phases is a key measure. Human decision making may be enhanced by AI aids, but we see this as still ultimately being a human decision-making process, even 50 years out.

➢ The game concept can be used for any level of conflict from low level tactical to strategic with suitable phraseology, assets and choices.

➢ OODA loop Act phase can be linked into any other command capacity wargame, for example movement of land, sea or air assets, cyber, space etc. This game will provide the command points for each side. For a potential future scenario involving C2 after a cyber attack see (Swift 2018).

➢ Victory conditions for both sides are measurable – and therefore competitive.

➢ The game can be largely technology agnostic or very detailed as required. It can also be set at any security level, as the actual assets/capabilities of each side can be suitably masked, or can be very detailed as engendered by the players clearance. For example it could be stated to Blue that they could (given the cost in resource allocation and time) attack the enemy Observation capability with “Secret Weapon X” without knowing any of the details of it.

➢ A Red team that is knowledgeable about enemy capabilities, or future capabilities will make the game much more challenging for Blue. If Blue wins more than half the time then the balance/assumptions/capabilities may need to be looked at very hard indeed.
What Technologies will Affect Warfare in 50 Years?

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The Challenge (1)

How do we predict what technologies will develop and affect warfare in 50 years?

Approaches

1. Take a current system and iteratively upgrade/modernize the technology into the future to make a tree of future technology possibilities.
2. Let the players create their own future scenarios and design the game themselves
3. Choose a future technology of interest – set up two games, one with the technology and one without – and compare the outcomes from the two games.
4. Build a game framework that has pull-down menus of technologies to include and combine, at the players’ discretion.
5. Map out the kill chain/OODA loop of the technology of interest, with expected and unexpected pros and cons. CONOPS will develop with iteration of play.
6. Create a technology “arms race”. Players make investments in selected technologies to see what pays off. Players have an objective and decide how to get there themselves.
7. Game mechanics should include major external influences like climate change, natural disasters, and social changes affecting the military, for example.
8. Include some way of accounting for risk. High risk/high payoff vs. lower risk/lower payoff.
9. Gaming TO the future – play six turns between 2020 and 2070.
10. Use probability scorecards to determine probability of success.
11. Look at historical examples of military technologies that failed, and examine why they failed. Apply to game as appropriate.
12. Look across domains (land, air, sea, space, cyber) and include social domain.
13. Once individual players have designed their “future”, they should be able to play each other and see which is more successful.
What is Needed

1. Subject matter experts on technologies of interest.
2. Futurists who can inject concepts into the game that most people are not aware of.
3. The imagination to generate the next ideas when projecting into the future.
4. Ability to prune the tree of possible futures.
5. Technology to store and automatically manipulate huge numbers of possible futures.
6. Live/VR immersion to create realistic scenarios.

Engage with the Sponsor and Players

Thorsten Kodalle suggested the following process for wargaming the future:

1. Identify Purpose
   - training (building future scenarios),
   - analysis (e.g. capability gap identification),
   - education

2. Identify target group
   - required and actual level of expertise
     (beginner, intermediate, expert)

For example: learning to build future scenarios with beginners to prepare them for future analysis when they become SMEs in specific topics.

3. Decide on the level of seriousness or level of gamification (Pain 0 ←→ 10 Fun) and match it with your target group.

4. Create a Results Only Working Environment (ROWE) that provided a way for autonomy, mastery and purpose for the players.

5. Mix media for different levels and types of visual sophistication
   (3D printer, Virtual Reality, Augmented Reality) using Artificial Intelligence / Machine Learning.

There is no one game design to fit all solutions. Use the framework:

beginner ↔ intermediate ↔ expert

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The Challenge (2)

Bruce Wyman raised the challenge of examining a specific future technology -- quantum communication -- to obtain and sustain a pervasive common operating picture that is secure without encryption.

Discussion

If one can use quantum communication without depending on remote coupling of particles (quantum entanglement?) then one might achieve secure data flows without the need for encryption. If true, then a Common Operating Picture based on such techniques would be secure without encryption. This would also reduce data flow delays and complexity and thereby significantly speed our OODA loops and allow decisions inside our adversaries’ decision cycles at national, theater and AOR levels.

Approach

The first question to address is how useful would a Common Operating Picture with the above characteristics be to different levels of command, and at what point does the added usefulness become worth the investment. Wargaming can assist with this question by wargaming multiple scenarios. Each scenario is wargamed twice, first with a baseline “current capability” COP, then with a perfect COP enabled by proposed quantum communication capabilities. Such games would inform us of the value of using quantum communication, how best to use such COPs, and the possible weaknesses they contain that our adversaries could exploit.
Resilient, Adaptable, Extensible, Flexible System of Systems

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The Challenge

How do you build a system of systems that is resilient, adaptable, extensible and flexible for the alliance in 30-50 years? Objective is to develop plausible 2070 scenarios we can then wargame. How do we structure scenarios so they can be wargamed? It may be easier to generate an answer for a more specific challenge since games with long lists of research questions often struggle to answer more than a few of them. Note that not all scenarios are interesting (for example peace and unity) even if they are what we are attempting to achieve.

Approach

So how do we design a series of wargames to design an “architecture” that can meet the challenges 50 years into the future? Use Acquisition games (Path games with 5 year moves) and Crisis games (month to 1 year moves) embedded in Perla’s Cycle of research. Path games can be used to create a crisis scenario for crisis gaming, and can identify new technologies or other topics to be explored in the crisis game. A Key objective of path games is to get to a desired future force without a period of massive vulnerability en route, while a key objective of crisis games is to test the optimisation of the force.

Two background topics are useful to consider:

- **Useful versus Plausible versus Probable.** Low probability/high impact events need to be explored. “Useful” may be better than “plausible.” A useful scenario could be the most stressful scenario, one that pushes the envelope. Exploring extremes/black swans can really test your force.

- **Forbidden Topics.** A critical question is what are we usually not allowed to investigate? For example, Is the current alliance structure (FVEY/NATO) a constant (and thus will persist into the future) or is it a critical uncertainty? Individual states can be flipped but there is a limit to how many state relationships you can test in one game. Alliance systems can be growing or declining. Rephrase forbidden topics to be open ended, for example use “health of the alliance” rather than “alliance has ended”.

Three techniques are useful when designing path and crisis games that address the deep future:

- **Future Projection.** Identify two dominant critical uncertainties. Then create a 2x2 matrix. This creates four scenarios. Then mash your force design into each scenario and
address the three questions: “Which force is the most resilient?”, “Where am I most reducing risk?”, and “Where are the relevant commonalities?” (Analogy: future projections as a shotgun versus a flying duck, constantly turning to track.)

➢ **Epoch Analysis.** Characterise a series of epochs through the lifespan of a platform. Consider Constants (such as Geography and Demography) and Trends (which are rooted in the present). Note that it is dangerous to assume trends are continuous. Compare constants and trends and ask two questions: “Which are dominant?” and “Which create relative advantages and to whom?” Use large chunking and use the full range of PMESII (plus any other relevant topics).

➢ **Backcasting.** Ground in 2070 and work backwards to avoid present day assumptions using a hybrid phased approach. Use a structured exercise to identify three or four plausible futures and a “what if?” exercise to show how you get there. Then identify trends and constants common across those future pathways. Finally explore the revealed underlying structure by wargaming. Trends lead to path games, which lead to crisis games. In a path game all sides have agency for force development. Define different force structures and test them in the crisis game. Then for the “best when tested (or gamed)” force structure examine how we can actually get to it. One must be careful when designing and implementing the hybrid approach not to be creating a self-fulfilling prophecy.

*Path → Crisis Games.* Design an acquisition game with five year moves dealing with Order-of-Battle (OOB), Prototypes and Research & Development (R&D). Players spend resources to move R&D to Prototypes and Prototypes into OOB. Adversary makes similar type moves, all sides take others’ moves into account, and the White Cell can introduce kinetic surprises which might trigger kinetic war before some or all sides are ready for war. Different sides can have different play speeds, for example faster acquisition for some or all capabilities. Note that speed can come from smaller platforms, elements on platforms (weapons, subsystems, etc.), supporting system of systems, and CONOPS. An example is that of Battleships in WWII, they lose capital ship role but gain key role in shore bombardment. The addition of radar, proximity fuzes on 5” guns, plus CV, creates a task force almost impermeable to air attack. Is a “base” another type of platform? It has a fixed location, involves major investment and is a big target (and there is a resiliency issue if one has too few bases).

**Parametric approach.** Explore extremes and opposites, left and right of arc boundaries:
1. 3-4 scenarios
2. Path game each scenario
3. Run the Crisis games. Which force was resilient, etc. in this scenario?
4. Revisit initial assumptions and repeat process.
5. When to cut off further data collection/analysis and write the report.
Avoid Vulnerabilities

I.a Build A/B force structures. Play each Epoch game x4 (8 games total). Analyse resilience in each scenario quadrant.
I.b Path games to get to A/B
I.c Crisis games branch out of I.b

Force structure is always transitional. Readiness (for example German concerns about Russian railway development c. 1914) and desire to strike with advantage now is of concern:

II.a Reverse approach, start with the Path games.
II.b Reach force structure.
II.c Test force structure in the four quadrants.

Approach II as a good test of an existing plan. Use results to persuade the sponsor to try approach I.

What is Needed

As is true of any project, we need time, patience, capabilities and resources, and sponsor knowledgeable interest in the game with a good, gameable question. In addition, specific to wargaming the deep future we need to know whether we need or are able to scale to entire alliances or to single states. As with any wargame we need good game design, skilled (trained) facilitators and adjudicators, access to relevant subject matter expertise and a strong game director. All of which influence the timeliness of game execution and quality of the results.

We can do a Path game in one day with up front research and player selection, so could do multiple games quickly. Standard Crises games take three days to execute, plus prep time, plus post-game analysis of the game and of the issues identified in the game. When embedded in Perla’s cycle of research this leads to a two year effort cycle, which means we need continuity of project leadership over those two years.

It is hard to get senior leader participation in long games. If the lack of senior leader participation damages the credibility of gaming, what is the trade-off between senior leader participation in shorter games and the potential loss of game result quality due to the game being too short? Without senior leader participation then perhaps we should wargame one level lower with subordinates. Junior officers might be more innovative but also might be more concerned with short term issues concerning the platforms and systems they will live to operate. Fifty years is beyond the career horizon (or even lifespan!) of most senior leaders, who tend to be focused on shorter term budget, programs, planning and election timetables. We need senior leaders who take the long term future of national security seriously.

Whatever process is used to wargame the future, it must be transparent, understandable, open about and challenge assumptions, and it must go beyond the purely military in order to generate freedom of action based on different mixes of DIME and PMESII relationships.
Construct an Interdisciplinary Futures Game Group

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The Challenge

How do you bring together an interdisciplinary group of futurists, gamers, and public private sector subject matter experts to begin experimenting with ways to develop games that explore the future? Additionally, how do you use these games to help prepare and develop future leaders?

Background

Several organizations currently develop games that currently look into the future. However, due to compartmentalization, these games are often subject to groupthink and their results cannot be broadly shared.

Senior leaders and career government officials may struggle to view possible scenarios outside of the traditional lenses they developed a career contemplating. (Hard to let go of ingrained cultural ideas, like aircraft carriers).

Crowdsourcing is an important approach to innovation that should be considered when developing games to explore the future.

Developers of future games must be innovative in their approach to game design, as well as innovative in imaging a plausible future (see the discussions on practical vs. plausible vs. preferable elsewhere in this Working Group report).

Recommendation

Cultivate an interdisciplinary futures gaming group that will use experimental methods to develop and conduct games that explore plausible futures out to 50 years.

A futures gaming group should be public, and discussion unclassified. This is to enable crowdsourcing diverse ideas, and the dissemination of scenarios, game concepts, and lessons learned.

➢ Senior leaders could use the game designs and scenarios created by the futures gaming group to create their own internal games.

➢ Interagency decision makers can utilize the lessons gathered from the games.

➢ Private sector and academic partners can gain insight into potential future military requirements.

➢ The dissemination of data will help publicly promote the method of gaming.
Future leaders will be able to participate, and or learn from the group’s outputs. Game outputs may lead to new concepts, studies, policies, and prototypes.

Initially focus on developing games that explore a narrowly focused concept or domain in the future in order to ensure they can be completed by the group and played in several iterations.

Four-step futuring process based on history, present, plausible futures and aspirational perspectives.

**Basic Steps to Establishing a Futures Gaming Group**

- Establish goals of the group
- Identify a sponsor organization
- Identify potential participants, solicit initial interest of desired participants
- Draft a group charter that lays out the processes, procedures, policies, information sharing guidelines
- Identify potential resource requirements ($), gain access to a venue
- Gain and maintain voluntary interest by members (could rely on graduate and PhD students). Establish incentives to motivate participants
- Ensure decision makers are groomed for the future
  - Select a specific topic to conduct a game about
  - Begin developing scenario and concept of the future (refer to other white papers for the processes)
  - Develop, test, and conduct a public game. Seek to conduct multiple iterations of gameplay
  - Document lessons from both the group’s wargame development process, and player outputs from the game
  - Publish results
  - Repeat cycle
Futures Game Concept Diagram
The Character of Future Warfare

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The Challenge
What is the character of future Warfare?

Approach
The approach is a series of events designed to identify common threads across alternate futures:

- **Event I: Alternate Futures.** This event serves as the foundation of the series. Established parameters, based on objectives for the series (who/what is informed), “focus/ground” free thinking ideas to develop alternate futures. Four varying futures are selected for comparison throughout the remaining events. Attendees range from Sci-Fi, Academics, Economists, Futurists, Military, etc., to help inform the alternate futures.

- **Events II-IV: Aspects of Future Warfare.** These events examine each alternate future using one aspect of Future Warfare to identify common trends/threads. Aspects include: The Future OE, The role of the military/politics (how warfare is used), Interoperability, etc. These events can range from seminars exploring the topic to wargames where participants compete against one another.

  (i.e. Role of Military/Politics. One future may be like today where Nation States control most armies while another future may have corporations with armed forces. Participants with National Armies may look differently when war is an extension of politics than the group that may not want to use a corporate army because it cuts into profit, etc. The common trends are collected for analysis.)

- **Event V: Backcasting.** This event looks at the common trends from across the alternate futures to identify likely unknown unknowns on a “road to war” or timeline. This can inform the sponsor based on their objectives.

What is Needed?
- Sponsor (Objectives)
- Wargaming Staff (Event Designers, Facilitators, etc.)
- Resources (Facility, Funding, Equipment, etc.)
- SMEs (Futurists, Economists, Academics, Military, etc.)
- Tools: Digital vs Analog, Processes, etc.
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Wargaming the Far Future


