The Future of Wargaming, Working Group 2, Connections 2019

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What was the question?

We wanted to understand what wargaming might look like in 2030 or 2040. Would technology dominate? If so, what technology? How would we think about games? How would they be integrated, or not integrated into our decisions? Would we see the same old challenges, or would new ones arise?

The answers were:

- Yes, technology certainly dominates our thoughts about the future. Visualization, processing, and algorithms are the subject of a lot of interest and discussion whenever we think about the future of gaming. In this group they were seen as applying not only to visualization and adjudication, standard areas for technology, but also the whole game. Technology just might replace the whole game, both players and controllers.
- Immersion may be an important component of future games. As technologies allow game experiences to be increasingly immersive they raise a whole host of questions. They also open up a whole new series of possibilities for how to game non-kinetic subjects.
- Another challenge is how to build games and simulations, particularly for training, that address the key skills and issues, without adding costly requirements that do not increase effectiveness.

How did we go about answering our questions?

We took a three-pronged approach. First, we held a more or less open call for fictional stories describing wargaming in the unspecified future. These stories ranged from corporal level stories of games as training tools, to games used to run the whole war. Some were gritty, and some were dystopian. They are collected in a separate document that is attached to this one. In this document we draw the stories together to see what we can discern from the fictional worlds that were created.

Second, we invited speakers to help baseline us on new technologies and concepts. A representative from VT-MAK discussed simulation, while Prof. Lucien B. Parsons from the

[1] Working group team moderators were: Dr. Jeremy Sepinsky, Dr. Justin Peachey, Mr. Nate Fritz and Mr. Paul Bussard

University of Maryland's MAVRIC (Mixed/Augmented/Virtual Reality Innovation Center) program gave a wide-ranging presentation on new technologies and their impact on gaming. In this document we briefly summarize the implications of those presentations.

After the presentations, participants took up the third part of our effort: a scenario planning exercise. The primary purpose of this document is to explain what we did, and describe the results.

In the end what we discovered is that thinking about the future tells us more about what we are worried about now than what the future will actually look like. Seen through that lens, this becomes a fascinating way of understanding what the community is interested in, and what forces they see as driving us forward.

Stories of Future Gaming

Attached to this document is a companion piece containing fictional stories describing future games. Taken together what can we discern from these stories?

The first observation is that the stories closely track with the author's personal point of view. These include:

- How games can be used for training at the tactical unit level? We had two stories that focused on the tactical unit level of operations. They tried to show that gaming could be used profitably as a training and motivation tool for the line infantryman. The authors saw a deficiency: current gaming practice seems to focus on either digital media for training or face-to-face gaming for policy and operations.
- The role of technology in games, particularly virtual and augmented reality (VR/AR). Several stories focused on the role that technology might play, with VR/AR dominating one and artificial intelligence (AI) dominating the other. The ability to incorporate both player interaction as well as digital display and recording were seen as important advantages throughout the working group discussions.
- The interaction between technology, constraints, and bureaucracy. One story focused on the dystopian potential for large-scale social deployment of AI, including augmented command decision-making and individual AI's that augment personnel. Another story focused on biological augmentation and the potential for instrumenting the biological element in games. Those stories suggested it's important to remember the challenges that technology brings, along with the advantages.
- On a happier note two stories focused on the redemptive power of games when used by leaders to shape social and political landscapes. Whether they are used to identify exceptional decision-makers (players) or to shape political movements through digital game products, the focus was on how games could shape and affect the real world. This was also a theme seen in one of the working groups (Group 2).

The stories show the range of topics and points of view that you can arrive at when considering the future of gaming. The role of technology, including AI, is something that is of obvious concern to many who have to execute games on a daily basis. But the bigger picture, that the potential of games has not yet been fully tapped by the national security establishment, suggests that games have a long way to go before they maximize their potential.

Describing the future

We had two baseline presentations. The first presentation from VT-MAK[2] was Peter Swan with an example of current wargaming technology. His focus was constructive simulation as used in military training. VT MAK builds and deploys a suite of rapid scenario development, combat simulation, and data collection tools. These tools can interface with and drive standard DoD command and control systems or be used in a networked, stand-alone mode to support command node training wargames. VR-Forces is their primary ground and air combat simulation tool. This computerized tool accommodates high fidelity combat from the tactical to the joint level of resolution.

The second presentation, by Lucien Parsons from the University of Maryland's MAVRIC program, gave an in-depth look at industry trends in immersive technology. Immersive technology consists of augmented or mixed reality (AR/MR) where digital media are superimposed on the real world (think Pokémon Go[3]) and virtual reality (VR) where the real world is replaced by the digital. MAVRIC works on applications and technologies in the AR and VR spaces for both serious and gaming applications.

From the perspective of someone inside the virtual media and gaming environment the scale, scope, interactivity, and variety of tools are all growing rapidly. For example, from 2004 to 2019 the number of players has gone up an order of magnitude from 300 million to 3 billion. The diversity has increased and the scope of games has expanded beyond the dozen or so genres available in 2004.

But the potential for technology to shape the gaming experience has grown as well and will likely continue to grow. Specific systems he discussed include:

- AR contacts. Contacts would allow players to dispense with glasses and have a much more integrated AR/MR experience. This would have significant implications for games, as well as society at large.
- Holograms. The implementation of true holographic displays and the ability to project holograms outside of the displays (as in Princess Lea in Star Wars: A New Hope) would allow for virtual gaming pieces and boards that did not depend on physical objects.
- Location based AR/MR. Examples include the Jeff Koons balloon dog in Central Park[4] and team AR games like Ingress Prime.[5]
- Augmented/Mixed mapping where location information is overlaid with mapping information to provide real time navigation.
- Tele-everything where telepresence and real-time virtual presence becomes common.
- New interaction mechanics including:
    - Natural language processing

[2] https://www.mak.com/
[3] https://www.pokemongo.com/en-us/
[4] https://www.nytimes.com/2017/10/10/arts/design/augmented-reality-jeff-koons.html
[5] https://www.ingress.com/

    - Hand, arm, and gesture following
    - Tagging of apparel and other items to allow for in-game interactions
    - Next generation glasses and goggles that are less intrusive and have augmented sensors (motion, sound, etc.)
- New ways to build games including image and motion capture, graphics and software production, and data management tools.
- New players. As games and the digital space diversify different players and participants will bring varying expectations and understandings.
- New types of outputs. With 3D printing and robotics, the interaction between the game world and the real world may become increasingly blurred.
    - The ultimate example of that in wargames is Ender's Game[6], something that was also examined in working group 2.

The presentation painted a picture of a technology future where smaller, more integrated technologies will enable enhanced visualization during wargames. Smart tools for development and graphics production may also streamline the development process for integrating those tools into games.

[6] https://en.wikipedia.org/wiki/Ender%27s_Game

Planning the future

After the discussion we broke into four groups for a brief facilitated scenario planning event. The goal was to identify two variables that the group thought was going to drive gaming into the future, and then conduct a short scenario planning exercise to identify how those variables might interact to give us different futures. Figure 1 shows the process we used.

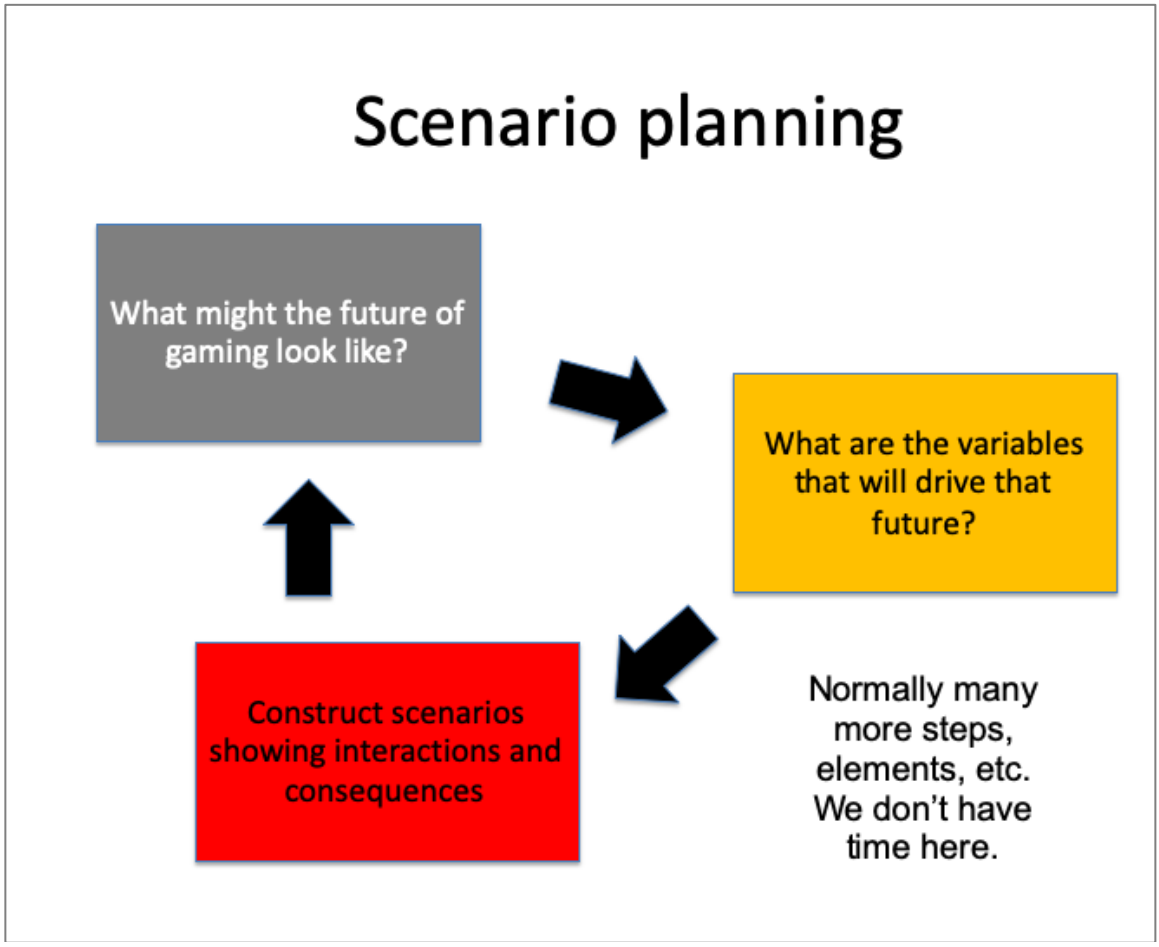


Figure 1 – Scenario planning process

How did it work?

What do we mean by "variables"? They are anything that can have a significant impact on future gaming. This could include technology, or attitudes, or funding. For some variables we will want to be a bit more specific. For example, we may want to define which type of technology we are discussing. Digital construction tools (software development) are different than visualization or artificial intelligence. Our variables should not lock us into a particular future, rather they should set up the next event with a rich set of possibilities for discussion. In Appendix 1 we give a list of variables that were given to the participants as a starting point.

After identifying the variables participants were asked to examine how the two variables might interact in the future. Using these interactions, they were to create simple futures by extrapolating those variables into the future. Figure 2 illustrates this process for one set of variables.

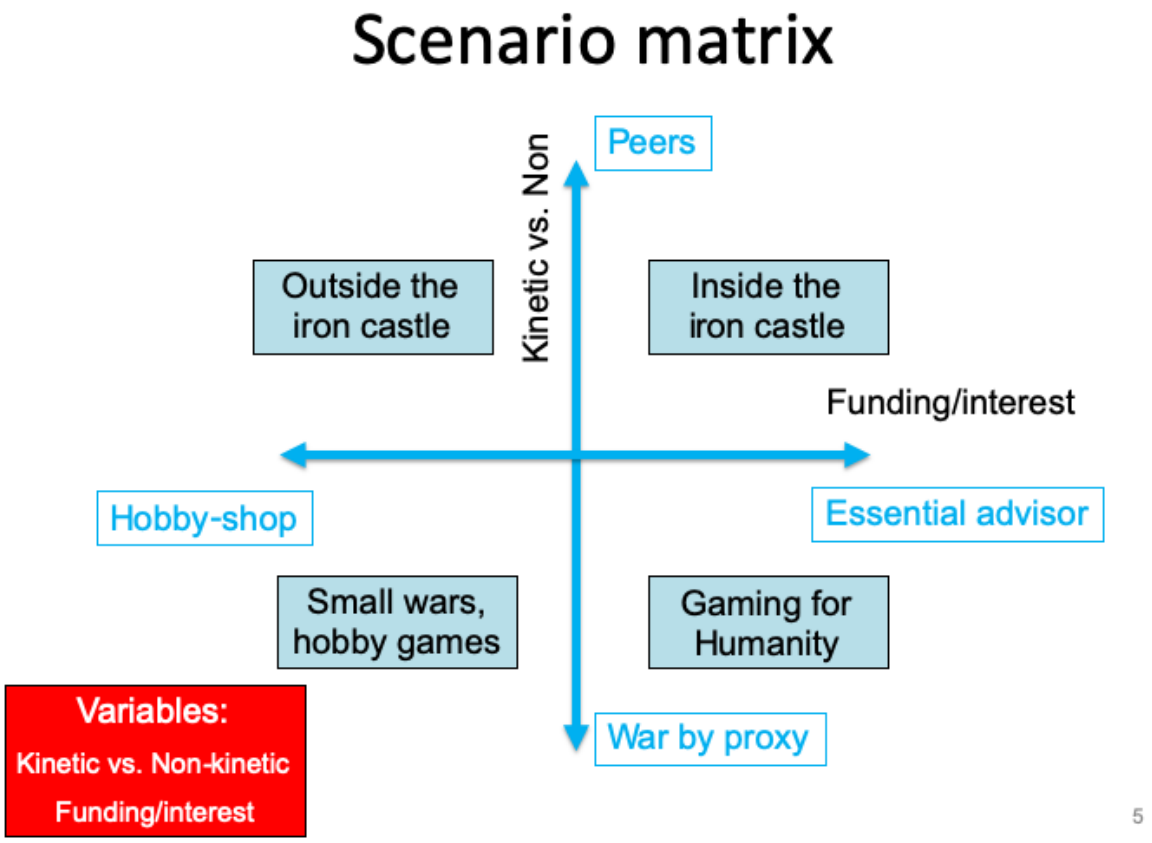


Figure 2 – Scenario process

As can be seen in the figure the two variables are Funding/Interest in gaming, and Kinetic vs. Non-kinetic emphasis in warfighting. The latter variable roughly compared to peer competitor conflicts vs. small-scale contingencies (SSC), Afghanistan/Iraq, and humanitarian assistance/disaster response (HA/DR) operations. If funding/interest is "high" then gaming becomes an essential advisor. If the emphasis is on "peer conflict" then gaming will be an essential advisor inside of the warfighting decision-making logic. Likewise, if the emphasis is on less intense conflicts and HA/DR then gaming may be seen as a way to relieve suffering and better deliver services to those in need. At the other end of the spectrum, if gaming is simply a backwater "hobby shop" with little influence it will be left outside the decision-making process,

or end up focused elsewhere, such as hobby games. This, of course, is just an example that we used to explain the process to the participants[7].

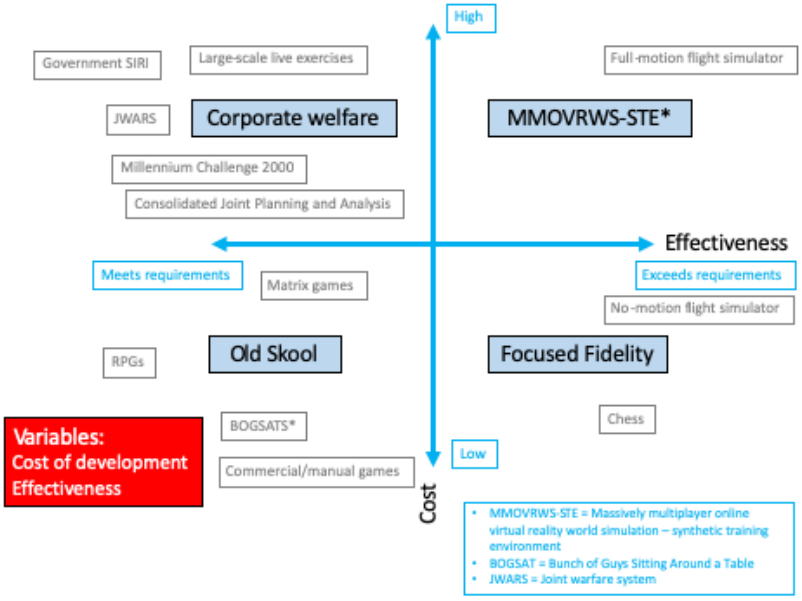
As mentioned previously participants broke into four groups. Each group developed its own character and point of view, to include whether the participants stood up or sat down, and how the participants interacted with the facilitator. Most groups used some sort of voting process to decide which variables they wanted to use. Groups had approximately 10-15 people in each group, with only small variances.

The following sections describe the results for each discussion group.

Group 1: A cost effective world

This group chose cost and effectiveness as their two variables. Other variables considered by this group are given in Appendix 2. They were suggesting that in the future the funding, or cost, of the wargames would drive what kind of games were developed, and the types of games could influence the effectiveness of the game.

Figure 3 shows this variable graph.



As can be seen in the figure, the group was primarily interested in finding cost effective ways to have the most effective game. High cost options, such as MMORGs, flight simulators, or other

[7] Comparing the sample matrix variables to those that were chosen, and the choosing process, suggests the sample variables and the matrix in particular had an influence on participants as to which variables they would consider. The kinetic vs. non-kinetic variable was popular, but interpreted in several different ways.

digital type training aids were thought to be generally effective, but the requirement to digitize them at high levels of fidelity made the cost high.

The bottom, right, quadrant was the most important quadrant, with systems that had a high degree of effectiveness but at a reasonable cost. An example would be a driving simulator that used only VR goggles and simple input controls to provide training. If studies showed that such minimalistic approaches worked, and some do, then significant cost could be avoided. The term used here "focused fidelity" sums up the intent. For this group what is needed in the future are games and digital simulations that have their focus on the right set of parameters to achieve the objectives.

Currently that area is occupied by traditional manual games. Without the need for digital development, manual games are low cost, but they don't exceed the requirements for the analysis or training. By adding some low cost features, such as VR, training games in particular can still be low cost, but also have higher degrees of success.

Finally, the high cost/meets requirements quadrant was characterized as "Corporate Welfare" by the participants, still meets requirements but can lack focus, lack high fidelity, while still incurring high costs due to the cost of digital development. Examples included simulations like JWARs (Joint Warfare System) and large-scale exercises. While large-scale exercises meet requirements, they can also be extremely expensive and may not be necessary if there are lower fidelity, but sufficient, ways to use wargames to replace many of their training elements.

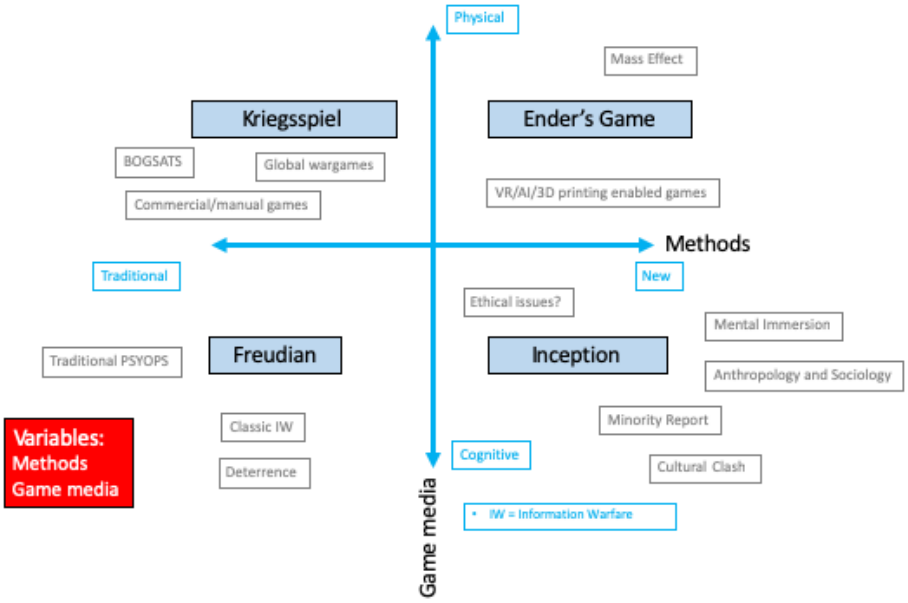
For this group the way games move forward in the future is to work the cost/effectiveness curve. By introducing the right technology into traditional, manual, gaming techniques the training and analytic value may increase substantially, while at the same time avoiding the cost pitfalls with extensive, high fidelity, complex digital products.

Group 2 – The matrix

Group 2 created a very different world than group 1. For this group is was all about the way in which games interacted with players and organizations, and the complex, intermingled, results.

This group chose wargaming methods and the nature of war as their variables. In one potential future, war remained mostly a physical pursuit. The winning side in wars could provide greater force to achieve their objectives. At the opposite end of the spectrum, future wars are won by targeting the adversary's "hearts and minds," i.e., in this future one could win the physical realm and lose the war. Other variables considered by this group are given in Appendix 2.

Figure 4 shows this matrix.



This group had perhaps the most conceptual view of the future. They were trying to understand how current games involving information and force on force would evolve as methods of gaming changed. While the methods were not specified, the force on force games become increasingly digitally driven as time goes on, while new methods for dealing with information increasingly draw on social sciences, and social media, techniques. This really divides the worlds into two paths, one where conventional force-on-force combat dominates, and the other where information operations dominate. Both could be seen as running in parallel tracks, related, but independent in the methods used to include them in games.

For the force-on-force track, the scenarios range from what we do today, the traditional quadrant, to new methods and techniques. This evolves gaming from where we are today, with global wargames and manual games into an increasingly digitally mediated form of gaming.

The methods to incorporate information in games, from information warfare to cyber to PSYOPS, are not something that is widely or well understood today. This means we are moving from a place where our understanding is incomplete and rely on outdated theories (Freudian) to a place where new techniques have been created to better address the problem. In the new (Inception) world created in the future games may find ways to more completely immerse the players in the game experience. In that case the players will literally lose themselves in the game, raising a number of ethical and analytical issues. Is it ethical to subject players to an immersive artificial reality in order to analytically understand a problem? And if we do it, how

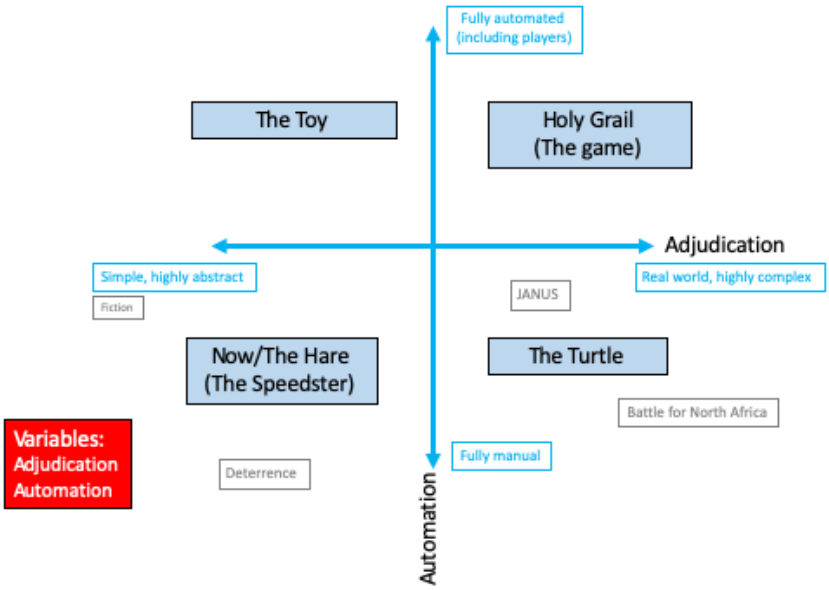
will be conduct analysis on the outcome? Will fields like anthropology, psychiatry, and sociology be more applicable than traditional analytical techniques?

In this set of variables technology allows for games to evolve in two different ways. One simply moves the traditional force-on-force techniques into the digital realm, while the other revolutionizes the experience of games through immersion. The role that immersion and player perception have in games, and what technology as well as new gaming techniques, will do for that in the future is both an important, and interesting, topic.

Group 3: Automation and Adjudication

This group chose to examine how automation would interplay with adjudication. The other variables they considered are given in appendix 2.

Figure 5 shows this matrix.



Automation was the driver in these discussions. Just how automated could you get in a game? Could even the players and controllers be automated, and could that be done within the context of a highly complex, real world adjudication process? This group considered full automation to be the "holy grail" scenario where automation combined with highly realistic and accurate models to give an environment where replication and variable space mapping could occur.

On the other hand, without high-speed automation the play bogs down the more detailed and complex the adjudication. In this world, the ability to adjudicate outstrips the ability to automate the game (including interfaces and visualization) resulting in the Turtle world. An

obvious example of a turtle style manual game is Campaign for North Africa[8] arguably one of the most complicated and detailed games ever produced. JANUS is an example of a simulation that has a tremendous amount of detail. The challenge with complex, detailed simulations is that the can take a long time to run, and are often dependent on a large number of input variables describing the systems and scenario.

Typically, professional game designers put on a much less complicated or detailed game than Campaign for North Africa. While sticking to manual adjudication, the games increase playability to nearly tolerable levels through the use of various forms of abstraction including having the facilitator internalize many or most of the key adjudications and outcomes. This is the "Now" world or the speedster, sacrificing complexity and detail for playability in manual games.

If you automate the abstract games you get into the "toy" world. Here the simplifications clash with the automation to structure the game like commercial computer games. Fully automated toy games would be able to address certain, abstract, research problems in information, cognition, and communications but would be less believable (by observers and consumers) on complex subjects such as a major theater war.

The group also considered the elements of what could be automated:

- Participants. The group asked if humans are fully necessary for every game.
- Information. This is a challenge in human/computer games. How do you manage display, content, and input from players and controllers while not bogging a complex game down with endless data entry?
- Structure. How to players function and interact with the game? Participants suggested that different player roles might have different game interfaces.
- Data capture. Automation greatly enhances data capture.

The relationship between automation and the complexity of wargames was identified as an important consideration for how games will evolve in the future. This, ultimately, is a trade-off between playability and human factors in the games (keeping them short and making interactions easy) with the desire for complexity as a marker for realism. The more complicated the models and game requirements, the more likely they will be automated, with the concurrent loss of playability. During this working group we saw some technologies that may address some of the playability issues, such as VR and AR, as well as technologies like AI development environments which may address issues of cost and time to implement advanced interfaces.

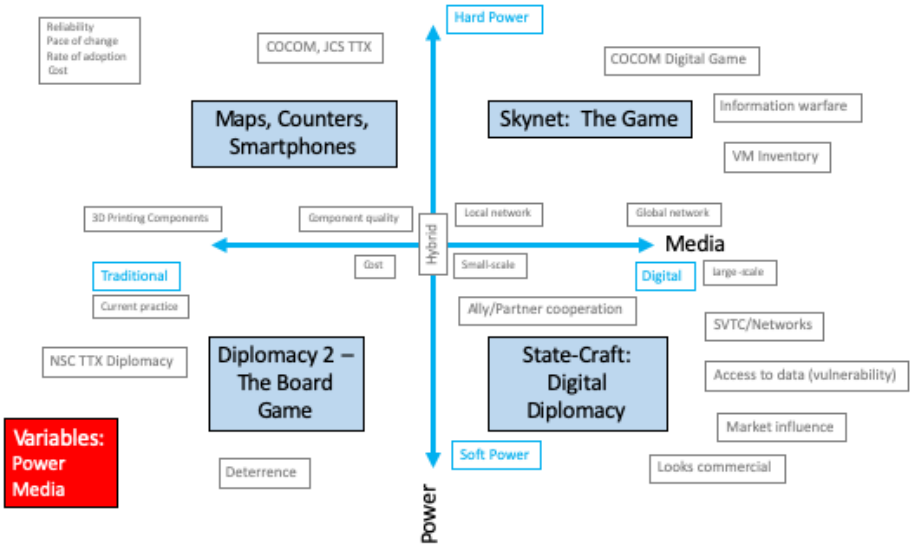
Group 4: Hard power, soft ware

This group chose Power and Media type as their two variables. By "power" they meant hard (kinetic) vs. soft (non-kinetic) power. In that sense they had the same variable as the example,

[8] https://boardgamegeek.com/boardgame/4815/campaign-north-africa

and as Group 2 (who called it "media"). By "media" they meant digital vs. "traditional" or manual gaming. This, again, was the same as Group 3 (automation), and similar to Group 2's "methods" (new vs. traditional).

Figure 6 shows this matrix.



In the case where digital predominates and the challenges are mainly hard power, this gave rise to the Skynet of Games scenario. Here a globally integrated information environment (GIG) allows for COCOMs to continuously game scenarios, including soft power issues like information warfare. The scenario is predicated on large-scale availability of fast networks, and the infrastructure to support the gaming.

If the focus is instead soft power, then "Digital Diplomacy" becomes the focus of the games. With the kinetic de-emphasized the challenge becomes developing digital tools (models and simulations) that address some of the issues associated with soft power. One way to deal with that is to use people to represent the soft power base in a game, but that may require access to high speed networks and integration of video teleconferencing, including classified teleconferencing, into games.

Traditional games deal with soft power through mechanics that allow players to either experience or emulate the effects of soft power. In this scenario, labeled "Diplomacy 2 – the Board Game" players interact with the game through traditional mechanics and materials. This is little different than the type of deterrence and diplomatic games we conduct now.

Moving to hard power we arrive at “Maps, Counters, and Smartphones”. This is the current state of hard power gaming, where players are presented with a map and pieces and then must figure out what they want to do. Technology may have a role, such as using smart phones to capture player actions and map configuration during an unclassified game.

A unique consideration for this group was the inclusion of a “hybrid” approach to the games, a place where technology, traditional techniques, and the challenges of incorporating soft power into hard power games all met. The use of conventional, small-scale, games with some digital enhancement currently provides a low-cost way to deal with both the conventional hard power game, along with the incorporation of soft power into play. This hybrid approach has a lot of advantages, but can be overlooked when digital is considered as a variable in game design.

Discussion

In this section we discuss the overall course of the working group, with particular emphasis on the scenario planning exercise. What can we learn from all four groups? Did any broader themes emerge? What do our discussions imply for the future?

What variables were chosen?

If you look at the variables that the teams chose you see some of the trends and issues that concern game developers today:

- Cost/Effectiveness
- Game media (kinetic vs. non-kinetic)/Methods (Traditional vs. digital)
- Adjudication/Automation (manual vs. automation)
- Power (kinetic vs. non-kinetic)/Media (traditional vs. digital)

Clearly the role that the "media" the game is expressed in seems to matter as we think about the future of gaming. The incorporation of digital tools and techniques was a dominant theme in the conversation about the future of gaming, in the stories, the briefings, and in the participant discussions. The adaptation of digital into professional games will need to account for several limiting and accelerating factors:

- Cost. Digital simply costs more.
- Fragility. Digital techniques and hardware has a fixed shelf life. Maintenance costs can often dominate the overall cost profile for digital.
- Pace of change. Digital is changing fast. New hardware, software, and development environments are coming on line. These, as we saw in the MAVRIC presentation, have the potential to revolutionize how players interact with the game.
- Real world intrusions. One place where digital is accelerating is the intermingling of digital with the real world. Whether through AR or 3D manufacturing techniques, digital is increasingly able to reach out and touch the real world in ways it has not been able to in the past.
- Distribution. The ability to conduct games over networks was raised by several groups, but is not something routinely considered in the discussion of future gaming.

Equally important to the groups was the distinction between hard and soft power, also expressed as kinetic and non-kinetic warfighting options. For the past decade US forces have been involved in counter-terrorism and counter-insurgency operations which rely heavily on non-kinetic means for resolving conflict. With the emergence of Russia and China as near peer competitors focus as changed to higher-end, kinetic warfighting. Non-kinetic has not gone away, just shifted to become a component of the high-end warfight as seen in the Russian involvement in Ukraine and Crimea. Because these are current concerns, and frequently addressed in today's wargames, they are also topics of concern to the participants. The fact that kinetic and non-kinetic operations were used in the example matric may have also influenced participants choices.

Cost and effectiveness were a very specific pair of variable choices that were designed to get at the problem of how to develop games that were both effective, and low cost. This is a counter to the traditional concept of digital as being both all encompassing, covering every aspect of the problem being simulated, as well as costly to build and maintain. Examples of low cost, but highly effective, digital implementations mean that more consideration may need to be given to alternative ways of building games and simulations. Examples given include no-motion flight simulators, or truck driving training using over VR goggles as opposed to a full-scale truck simulator with motion. Here it appears that expectations of the contracting agency as much as the designers or implementers understanding will need to be managed. Convincing the sponsoring organization that a less capable or advanced system is just as effective as a complex, full-scale, simulation may take time, and may not be in the interest of those who build such systems.

Scenarios

The interaction of the variables built different scenarios. In turn, the scenarios can themselves spark discussion about some of the more interesting insights gained from the exercise. Here we discuss several interesting outcomes that we, as the overall moderators for the working group, would like to highlight.

Ender's Game and Inception.

While kinetic vs. non-kinetic operations were raised in several groups, group 2 extended the meaning of non-kinetic beyond what we would traditionally think of in terms of non-kinetic operations. They called out one of their variables as "game media." In the previous section I described that as simply "kinetic vs. non-kinetic". However, the intent behind that variable was much subtler and more complex. While it was interpreted by the participants as "kinetic vs. non-kinetic" in some cases in others they interpreted it as "a way in which players and the game system interact." This led to their "Ender's Game" and "Inception" futures.

In this interpretation, new methods (their other variable) draw players into the game in ways that they currently don't. This could include VR/AR but also techniques and procedures that immerse players in the game more fully than what is currently available. In our interpretation of this set of future methods, designers use stories and visuals to completely immerse players in the game, with the consequential emotional and mental effects. As players become more and more entwined in the game the "soft" aspects of what they bring to the game (emotional, agendas, politics, points of view, etc.) come more and more to the forefront of game play. As they do in the real world.

This can have implications for the players and designers. For example, what are the ethics of immersing players so fully in the game? Or, how do you collect data and information from such a wholly immersive world? While digital enables collection about action, immersive digital will give you all the same problems you have in the real world about understanding intentions,

decisions, and understanding. In this case digital does not enable collection any better than what you would have in a non-digitized, real world, environment of an operation or exercise.

Moving up the scale of cognitive to physical you get to the other scenario: "Ender's Game". As you will recall, in the story Ender's Game by Orson Scott Card, students gifted in game play and decisions were recruited as trainees for commanding fleets against an alien race. What they were not told was that their training exercises eventually became real, as they "played" with real fleets in real engagements.[9]

The role of games in planning for, and possibly executing, operations in the real world were not only explored here, but also in the fiction stories "The Last Peace Fighter" and "A Nice Game of Chess" (both by Matt Caffrey) in the "Stories of Future Gaming" piece associated with this working group. The idea of gaming moving out of the "laboratory" of analysis and decision support and into a practical tool to shape real world decisions, is something that is clearly on the minds of some participants in the working group.

Why might this work? How would it work? One clue is in Ender's Game, where participants in the game did not know they were actually controlling real forces. Therefore ,they felt freer to take risks, and adopt strategies, that they might not if they knew the situation was "real." At the same time if the game is produced without constraints and limitations imposed by real world considerations, of course the strategies may be more effective but at a higher cost in other areas. In the case of Ender's Game much of the human fleet was sacrificed, and the war was won through a genocidal elimination of the enemy. Without incorporation of limiting values and expectations into games, any game, the results can be biased in ways that are impossible to execute in the real world.

While immersion and integration, whether simply cognitive or with the real world, is an interesting possibility for gaming, the implementation of such integrative games will most likely need to consider limitations and constraints that are not commonly implemented in other, more limited, games today.

Focused fidelity

In Group 1 "focused fidelity" was the clear preference for how digital could be economically introduced into gaming. The concept was to identify that which is essential for the gamed action to succeed, and then remove all of the other considerations from the implementation. This is clear for training games where data can be used to assess which elements of the activity need to be incorporated into training, and which don't. If the goal is to exercise coordinated fighter and shot tactics then aircraft movement may be irrelevant in a simulator. If, however, muscle memory for emergencies or maneuvers is the objective, aircraft movement may need to be simulated. Defining the objectives for the training elements can produce significant cost savings in some cases.

[9] Card, Orson Scott. 1985. Ender's Game. Tor Books.

The case for focused fidelity becomes more complex when analytical or exploratory games are considered. Here the goal is concept development, creating a new way of fighting or testing a war plan. The question of what to leave out and what to include in the game is a question of game design. Given the number of design options open to the designer, which combination of design elements can be brought together to minimize overall cost and effort in the game while still allowing players to explore the question. This becomes less a cost/effectiveness question and more of a design/effectiveness question, though in some cases cost issues may occur.

Diplomacy and State Craft

By "Diplomacy 2" in their scenario name group 4 was referring to the Avalon Hill game *Diplomacy*[10]. The larger issue was how to include "soft power" or "non-kinetic" actions in games. This was also raised in the "Freudian" scenario of group 2[11]. Given the requirements of the past 10 years to explore counter-insurgency and nation-building operations these issues have been required to be incorporated into games for a long time. However, game designers still struggle with how to quantitatively, or even qualitatively, incorporate soft power issues into games. Participants clearly saw that as an issue that would continue in the future. Even if hard power/kinetic operations are the primary focus, operations like Ukraine, Hong Kong, or the recent interference in Western country elections, suggests that soft power will still be an element of power use by great powers.

Reading between the lines in the working groups there were two thoughts to incorporating soft power into games. One was to rely on players, whether real or automated, to generate actual data on how soft power elements will be processed by the targets. For example, political parties can be played in games, with players representing the various agendas and factions in the population.

Or soft power can be simulated. In this case programs are designed to replicate population behaviors and attitude's and players must act against those programs with their soft power maneuvering. This simulationist approach has all of the same problem as any simulationist approach to gaming: data set up, interfaces, and model validation all present difficult and costly challenges.

The Turtle and the Grail

How far can we go with automation? Is it possible to have a game with no players? Can all adjudication be turned over to a simulation, with players playing against the simulation?

[10] https://boardgamegeek.com/boardgame/483/diplomacy

[11] The "Inception" scenario of group 2 was focused on a different set of cognitive questions than the "Freudian" scenario.

Group 3 asked these and other questions as they considered the boundaries of complexity and simulation in games and in particular game adjudication.

Taken to the extreme, a highly complex adjudication problems, perhaps involving hundreds of aircraft, thousands of missiles, and hundreds of different types of targets is virtually impossible to adjudicate manually[12]. Some sort of simulation would be needed in order to manage the outcome in any sort of detail. However, the process of building the database, inputting the initial conditions and other interface factors may make even a fast running simulation impractical.

At the other extreme a rigid-Kriegsspiel board wargame is simply an algorithm that is being manually adjudicated by the players. If a program had all of the inputs then managing a manual wargame would be relatively straightforward for a computer[13].

So, abstraction of the game elements may also help with the input problem, and alleviate some of the difficulty in interfacing between the game board and the players.

But automation does not have to stop with automating the adjudication process. As group 3 discussed, you could also automate just about every feature of the game, including players. For example, an agent-based program, with each agent representing a decision-maker on the battlefield, could be placed in the same synthetic environment you are placing the players in. If the agents were artificially aware, then their play would be parallel to what you could expect from a human player. In fact, the AI could be "trained" on the game in question through repeated play throughs, in ways that human players could not.

The key challenge in such systems today, and apparently for the foreseeable future[14], is building an AI system that does not introduce some sort of systematic bias in the results. If the game is considered as a very large, complex, variable space, then the training process for AI's using deep learning is essentially exploring that complex variable space, looking for local minima and maxima in whatever value condition you impose on the AI. Examples of value conditions might be number of units lost or geographical gains. In training the AI you will be assuming that the variable space has been explored to some extent. Any areas that have not been explored, and thus are not part of the AI's cognitive landscape, will be difficult to explore once the AI is move from training to game execution.

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[12] Here we make a distinction based on what players are willing to put up with. Hobby players are often willing to put up with extremely long and complex adjudication or other mechanics, while professional players tend to be put off by such shenanigans.

[13] In miniatures gaming there is a system for computerized game management and adjudication, however it requires a systematic set of player and controller actions to make sure the table and the computer are kept synchronized. http://www.carnageandgloryii.com/index.htm

[14] Strong AI is almost always predicted to be at least 20-30 years in the future, no matter what year the prediction is made.

Using traditional agent-based or expert-based programming also has the potential to introduce biases in the play of the agents. This could be from programmer bias, or bias from how the experts used play the game.

As is usually the case, it depends on the purpose of the game. If the purpose is not to explore a set variable space, but open up the problem to new concepts and ideas, AI's playing the game will not be able to do that, at least at the current state of technology. Only players will be able to add new variables and conditions to the mix, invading Belgium even though it's a neutral country, to get around perceived operational or tactical limitations.

Appendix 1 – Suggested variables

This list of variables and descriptions was provided to participants prior to their arrival at the conference. Participants were free to use these variables, or develop their own.

Construction tools. Currently there is a lot of overhead in digital game development. Despite engines like Unreal and Unity designers and developers still have to assemble teams with specialized knowledge, hire graphic artists, and build for specific platforms or systems. This could easily change in the future with automation, artificial intelligence, and other developments that ease conversion of designs into digital formats. A key issue for this variable is how to overcome the overhead imposed by graphics (for example, outsourcing as opposed to digitization). For an overview of these types of technologies see:

https://www.bbvaopenmind.com/en/technology/artificial-intelligence/how-ai-powered-tools-are-bringing-revolution-to-software-development/

http://news.mit.edu/2013/writing-programs-using-ordinary-language-0711

https://thenewstack.io/ai-automates-video-game-design-with-conceptual-expansion/

https://www.fiverr.com/categories/graphics-design/digital-illustration

Interaction tools. This technology goes hand in hand with digitization. How will we interact with games in the future? This includes how we get information from games, and how we place information into games. Visualization technology is clearly one of the most interesting facets of this variable right now with the advent of virtual and alternate realities. But information can flow through many different mechanisms. Sound, voice, touch, reading, movement, and non-verbal expression are all ways we communicate. For some imagination cueing examples see:

https://arxiv.org/pdf/1801.07481

https://pdfs.semanticscholar.org/0004/f72a00096fa410b179ad12aa3a0d10fc853c.pdf

Digital vs. manual. I actually don't think this is a valid variable because the medium is not necessarily independent of the design requirements. For an organizational game looking at how different groups work together a digital game might be exactly the wrong way to approach the game. For a training game digital might be absolutely required. However, this is a variable, just one I don't think works for our discussion.

Integration. How integrated is gaming into the day to day enterprise of the Government? Does DoD use it the same way it uses simulations to examine future systems? Does it integrate gaming into all kinds of planning and decision-making? Or are games special, one off, events that occur only occasionally?

Funding and interest. Is there a high level of funding and interest available for gaming? Do creative gaming styles continue to be sought after and used in DoD gaming?

Creativity in design. Do we continue to innovate game designs and ways to conduct games? This is beyond simply slapping digital skins of existing types of games, rather it involves re-thinking the fundamentals of the game mechanics. The advent of matrix games is one example of this kind of innovation, but there are likely to be others coming in the future. How creative are we going to be in the future with our games, scenarios, and game mechanics?

Automation. You would think this is wrapped up in digitization, but here I mean automation of tasks that are currently done by people in games: players and controllers. Can we use various kinds of AI to automate certain functions that are currently done in games by people?

Topics. Right now, we can probably think of the mix of topics covered by games for the US Government, with "operations" dominating, followed by "intelligence development" and "interagency" or "intragovernmental" planning. There are also the occasional organizational or topical games. Is this a variable? And if so where is it coming from and where is it going? You could envision gaming being used for direct decision support in real time, or in systems testing and acceptance. What does it mean to move beyond the "standard" topics of interest to sponsors and into a new set of tasks and ideas that need to be gamed?

Kinetic vs. non-kinetic. Prior to the emergence of the peer competitors much of DoD's and the interjacencies focus was on operations short of war: counterinsurgency, counter-terrorism, and HA/DR. What is the implication for games if one or the other trend amplifies? Will we be stuck doing the same kinetic games over and over till we can do them in our sleep? Or will emerging mission requirements challenge our ability to do the same games in ways that we have always done them? It's the difference between a world of nothing but Blitzkrieg and a world of the COIN series.

Appendix 2 – Working group variables

Some groups used voting systems to develop their variable sets. Here we present lists of variables considered by groups 1, 2 and 3.

Group 1 – A cost effective world

This group associated its variables in pairs, and then voted on the pairs. Here we present them groups as pairs of variables. Ultimately the group chose Cheap/Expensive and Effectiveness as their variable pair. Because some variables were paired with more than one other variable we list some variables twice. Because Cheap/Expensive was paired with so many other variables we do not list that first anywhere. The last two variables were not paired with any other. The pair that was used won the voting by an overwhelming majority of votes (7, all other pairs got 2 each)

Imaginative – Analytical (Solutions)
Government – Civilian (Users)

Digital – Real (Interface)
Cheap – Expensive (Equipment/Facilities)

Minimally Effective – Maximally Effective (Effectiveness)
Cheap – Expensive (Equipment/Facilities)

Tactical – Strategic (Scale)
Abstract – Faithful (Fidelity)

Simple – Complex (Design Elements)
Cheap – Expensive (Equipment/Facilities)

Manual – Automated (Adjudication). (Not paired)

Fun – Control (Gamification/Purpose) (Not paired)

Group 2 – Inception

This group did not pair up variables, and used the two highest vote-getters.

Cognitive warfare – Physical warfare (4 votes)

Manual adjudication – Automated adjudication (1 vote)

Traditional – New Paradigm (3 votes)

Bio-enhanced – “Normies” (2 votes)

Physical currency – Digital currency

Highly regulated – Unregulated (1 vote)

Tailored – Untailored (1 vote)

Individually created – Enterprise created (1 vote)

Group 3 – Automation and adjudication

This group had a relatively small number of variables. But they elaborated on automation.

Adjudication

- Could enable replication
- Increase both playability and rigor

Automation (of everything?)

Visualization

Funding/Interest

- If you could build it, would they come?

Peer/near peer, or not?