Wargaming to Support Strategic Planning

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Abstract— **The Canadian Armed Forces (CAF) capability based planning process uses a set of force planning scenarios to assess different options for the capability requirements of future forces. A good understanding of the key drivers of the scenario is important so that the subject matter experts can more fully understand and identify the capabilities required for success in it. A project is underway to investigate whether this capability identification can be enhanced through the use of various wargaming techniques. The Matrix game methodology is one that has been chosen for this research and was used in a recent series of research games. An ISIS conflict scenario was used as an explorative tool in all the games which were played out using several combinations of player types. Each iteration of the game was analysed using a set of metrics to help determine the utility of the games for the force planning application. The results are provided in this paper.**

Keywords: wargaming, strategic planning, capability based planning

I. INTRODUCTION

The Canadian Armed Forces (CAF) currently uses a capability based planning (CBP) process to support its long range (15-year) strategic planning. Part of this process involves identifying future capability requirements through the structured analysis of the scenarios in the Force Development Scenario Set (FDSS). This set of scenarios is designed to be representative of the projected defence and security environment of roughly 2029 and also to cover the full spectrum of military operations from normal peacetime missions to full-scale armed conflict between state actors.

The process of assessing these scenarios for capability requirements continues to evolve and be improved. An evaluation conducted of the previous cycle of CBP highlighted that there were concerns raised about the credibility and robustness of the existing method for extracting capability requirements from the FDSS. The method is structured but subjective and depends on the knowledge, experience and judgement of subject matter experts (SMEs). The concern was that this approach may not be fully exploring the richness of the scenarios and fails to account for all the key drivers of activity in them. These key drivers – whether they be related to dimensions such as (but not limited to) military, economic or humanitarian – are what the capability requirements are derived from.

Wargaming techniques might provide a remedy for the perceived limitations of the current capability requirements generation process. Consequently, a project was established within DRDC-CORA's Strategic Planning Operational Research Team (SPORT) to investigate two types of wargames whose features were thought to be suitable for improving CBP process. In doing this, SPORT leveraged collaborative agreements with both Dr. Rex Brynan from McGill University in Montreal, Canada and Cranfield University in the UK.

Cranfield University has agreed to build a wargame for CORA based on its Rapid Campaign Assessment Tool (RCAT) methodology. This will be built around a scenario from the CAF FDSS set and should be ready for play in September/October 2015.

The focus of this paper, however, is on the "Matrix" wargaming methodology [1, 2]. There is an extensive literature around Matrix games but the features of interest for this application are that they:

1. Use a system of argument and counter-argument to identify and explore the drivers of the scenario.
2. Can leverage the expertise of a group of people whether SMEs or not.
3. Use relatively few rules making the games easier to set up and run and allow inexperienced players to play immediately with little or no training.

SPORT recently ran a series of four iterations of a Matrix game using the Islamic State of Iraq and Syria (ISIS) crisis as the scenario. We refer to this series as the MAtrix Games for the Improvement of CBP (MAGIC) series. The primary purpose was to test the idea of using the Matrix game methodology for our CBP purpose but also to allow the authors to gain some experience in running and analysing games like this.

The following sections of this paper provide more detail about the MAGIC game series and the results to date. We begin with an overview in Section II of the Matrix game methodology as it was implemented for these games. This includes a review of our hypothesis and a discussion of the game design and implementation. Section III provides more on Matrix games, how they can be played and the rules used in our game series. Section IV discusses the ISIS scenario used including the start state, the factions played, special game rules and a sample narrative of how one of the iterations played out. Section V discusses the results and we present our conclusions in Section VI.

II. METHODOLOGY

The MAGIC series of games was meant to begin the testing of wargaming methods that might meet SPORT's goal of enhancing the scenario assessment process within the CAF CBP process. Matrix games represent one type of game whose characteristics might achieve that. The MAGIC series was meant to test the following hypothesis:

> Wargaming techniques can overcome the observed limitations in the CBP process related to the scenario development and validation phase and the JCPT [1] capability assessment phase. Specifically:
> - Wargaming techniques better inform the JCPT process compared to the Operational Planning Process (OPP) method by better informing the process with broader and differing perspectives on the key drivers of how a scenario plays out.
> - Wargaming techniques improve the awareness by players of the key drivers affecting how a scenario plays out thus diminishing the possibility that players will focus on a single driver or dimension of the scenario.

We define "better" to mean that the wargames would more easily uncover the key drivers of the scenario because players can let the events and actions play themselves out so that those key drivers become self-evident. Better also means that the key drivers will show up more naturally because the players play the game and devise their strategies based on the goals and motivations of the faction they are playing.

Our plan to test the hypothesis has two main steps. The first was to run a wargame and vary the composition of the player population to see what affects that would have on the gameplay and outcomes. This step was started with the MAGIC series of games. Other series of games (including RCAT) with different scenarios may be run in the future. The second step will be to assess the outputs of the wargaming and compare it with what the JCPT process currently does to determine if wargaming offers worthwhile benefits that might enhance the CBP process.

A set of metrics was devised to provide the framework for data collection and testing of the hypothesis. We chose the PMESII[2] framework as a convenient way to categorize game moves[3] but added "culture" as an additional dimension and hence PMESII-C. The metrics framework was:

1. Overall suitability of the game for CBP Purposes.
    a. Suitability for the validation of the FDSS in Phase 1 of CBP.
    b. Suitability for the capability assessment phase (Phase 2).
2. Effects of the style of gameplay.
    a. Facilitates examination of all dimensions of the scenario (PMESII-C).
    b. Leverages the contributions of all players.
3. Impact of player population choice on game play and outcomes.
    a. Impact of level of player expertise on game play and outcomes.
4. Game planning, execution, data collection, analysis.
    a. Lessons about / observations concerning planning.
    b. Lessons about / observations concerning game execution.
    c. Lessons about / observations concerning data collection.
    d. Lessons about / observations concerning analysis of the data collected.

We chose to begin with a Matrix game that had already been built by McGill University for their purposes based on the ISIS crisis. . We were given full access to the game materials thus eliminating the problem of having to design and build a game from scratch. This allowed us to focus our game preparation efforts on other things such as the selection of players, data collection metrics and planning for introductory briefing sessions.

In early February 2015, CORA staff were invited to participate in and observe an iteration of the ISIS game hosted by McGill staff and run at the University of Ottawa. We refer to this game as MAGIC 1. The players were a combination of graduate students, University of Ottawa staff, Middle East experts from the Government of Canada and CORA scientists. The game's white cell was comprised of staff from CORA and McGill.

With MAGIC 1 concluded, the authors planned a series of additional iterations to test the hypothesis above. We decided to look at the impact of the choice of players on the game outcomes and outputs while holding the rest of the game design essentially constant.

The players for the games were drawn from a pool of twelve volunteers made up of defence scientists from CORA. The members of the pool had no particular expertise in Middle East issues and politics beyond what people would normally have from watching news reports.[4]An option to use military personnel as players in an iteration was deferred to a future game because our judgement after playing some iterations was

[1] Joint Capability Planning Team. Tasked with deriving capability requirements from the FDSS scenarios.
[2] Political, Military, Economic, Social, Information, Infrastructure.
[3] In this paper, the term game "move" is the same as "turn".

[4] In our context, an SME means someone with knowledge and understanding of ISIS and Middle East issues that goes beyond what one would normally have from public news sources.

that they would not play the game in a markedly different way.

The ISIS game was designed so that there were six factions to be played (see Section IV). We randomly selected six players from our pool to play in our first game (called MAGIC 2) and the remaining six were asked to play in our second game which was called MAGIC 3. At the conclusion of MAGIC 2, the players expressed interest in playing the game a second time. As that provided us with an additional data point, we agreed. That game became known as MAGIC 2aand we randomly re-assigned the player roles so that each player played a different faction than in MAGIC 2. As well, one of the MAGIC 2 players was unable to attend 2a and so one of the authors played one of the factions. Apart from these differences, we ran MAGIC 2a in the same way as MAGIC 2.

On the day MAGIC 2a and 3 were run, several players were unable to attend and so the authors had to step in and play one role in MAGIC 2a and two roles in MAGIC 3. Although the authors played as objectively and "normally" as possible, data related to their participation was excluded from the analysis.

MAGIC 1 and 2a were each played over one afternoon and focused only on playing the game. Our MAGIC 2 and 3 games were played over a full day where the morning was allocated to introductory briefings on Matrix games and the factions in the game. The morning also had time for the players to learn about their factions through briefing materials and then prepare strategies for how they would play. Strategy development also included players holding private discussions with other players to establish agreements and alliances. The afternoon was then dedicated to the game play and a final hour was used for player surveys and a "hotwash" (sometimes also called a "hot wash up" in the wargaming literature [2, 3]), around-the-table discussion. The game itself does not have a specific end-state or stop condition as there are no real winners and losers. Therefore, we chose to run the gameplay for a set time of 3 hours.

The white cell for MAGIC 2, 2a and 3 was comprised of the authors but as mentioned earlier, two of us had to play in MAGIC 3. Two of us worked together to provide the Game Master (GM) and adjudicator functions while the other two served as observers to record observational data on our metrics and the details of the game play (in particular, details of the player moves). When one of us played a faction at MAGIC 2a, we simply used one observer / data collector. All white cell members contributed observations to the final data set.

It was apparent from MAGIC 1 that the GM and/or the adjudicator had to be an SME (in this case about ISIS) in order to properly and fairly consider the arguments and actions of the players and to keep the game moving off on a tangent that was inconsistent with the goals of the game.

III. MATRIX GAMES

A Matrix game is a game or table-top exercise [1, 2] based on arguments and debates and a minimal set of rules. In contrast, traditional wargames tend to be based on sets of complex rules and rely heavily on probabilities [3]. The objective of a Matrix game is to be highly flexible and allow the creation of a structured and logical narrative.

The participants of a Matrix game are either players or members of the white cell. The players each act as a faction within the scenario and attempt to reach their objectives through strategies consistent with the nature of the faction (social, political, religious) and its level of resources. The white cell manages the game and is made of one or more individuals, acting as GM or adjudicator. The white cell is responsible for adjudicating the moves made by the players.

During the game, each player states in turn the action they would like to pursue and provides up to three arguments as to why this action will succeed. The other players then make up to three counter-arguments as to why they think the action will fail. The white cell then decides which arguments and counter-arguments are valid and a dice roll modifier is obtained. For each valid argument in favour of the action, the player gets a +1 modifier. For each valid argument against the proposed action, the player gets a -1 modifier.

The final outcome of a turn is decided by a dice roll based on two six-sided dice. The positive and negative dice roll modifiers are combined and added to the result of the dice throw. If the combined outcome is seven or more, the action is successful, otherwise the action failed. To model secondary effects and introduce added uncertainty, the white cell might modify the intended effects of the turn in the cases of a very low roll (significant failure) or a very high roll (resounding success).

IV. THE ISIS CRISIS SCENARIO

The Matrix game used for this study was based on the current conflict in the Middle East involving the expansion of the ISIS [4]. The game was assumed to begin at the end of August or early September 2014 for all iterations and the existing conditions on the ground at that time were used as the starting state of the game. The game map was primarily focused on Iraq as shown in Figure 1. Counters were used on the map to represent the contested areas and the areas under the control of each faction. The counters were also used to represent the type and the rough order of magnitude of the quantity of resources of each faction. These resources were varied, from foreign advisors to Regular Force units, and from militias to air support. A picture of the room setup for MAGIC 2, 2a and 3 is shown in Figure 2.

Fig. 1. The ISIS Matrix game developed by PAXsims [4].

Fig. 2. The ISIS Matrix game room setup.

A. *Players*

Six factions were represented in the ISIS crisis scenario. These six factions were:

ISIS: It proclaimed a Caliphate over the territory it controlled in Syria and Iraq in June 2014 and does not recognize international borders. It wants to expand its territory and to apply true Islamic rule as it understands it.

The Iraqi Government: It has lost control of significant portions of the Iraqi territory populated by Sunnis to ISIS. It also has limited authority over the Kurdish Regional Government (KRG). The Iraqi armed forces are poorly led and motivated and large portions of the Sunni population are either alienated from the Iraqi government or in open revolt.

The Sunni Opposition: The Sunni community has been marginalized by the Shia-dominated government of Iraq. The community is now divided. Some work with the Iraqi government, some rallied to ISIS as the only true defender of Sunnis in Syria and Iraq.

The Kurdish Regional Government: The Kurdish regions of Syria and Iraq are on the frontlines of the conflict with ISIS. The Kurds in Iraq have their own government and their own militias (the Peshmerga). The long-term Kurdish objective is to get as much self-rule as possible for the Kurds, ideally in an independent Kurdistan, more realistically in a decentralized Iraq.

The Islamic Republic of Iran: Iran wants to protect the Iraqi Shias and to maintain its influence over the Iraqi government. ISIS is seen as a threat to the Shia branch of Islam. An overt and large-scale intervention in Iraq, however, would risk creating a conflict with Saudi Arabia and the Gulf monarchies as well as with the United States.

The United States (US) of America: The US Administration does not want to get into a new large-scale ground intervention in the Middle East. While having significant resources at its disposal, the US has to balance a number of interests including: stopping IS, promoting Iraqi national unity, and dealing with Iran and Arab regional powers.

In addition to these six players, if the narrative required it, the white cell could also intervene on behalf of other entities not represented directly in the game, such as the governments of Syria or Turkey for instance.

B. *Special Rules*

To increase the realism of the ISIS scenario and to better represent the starting conditions, additional rules were introduced by the game designers [4] in addition to the basic argument-based dice roll modifiers described in Section III.

These special rules were meant to represent some of the relative strengths and weaknesses of the factions so as to make it easier or harder for some actions to succeed.

For example, to model the momentum of ISIS at the beginning of the scenario, every time any player rolled a double, ISIS was immediately awarded another move.

Similarly, to model the fact that the public opinion in the US is against a new military involvement in Iraq, any actions by the United States involving direct use of military force was given a -1 penalty.

Each of the six factions had similar sorts of special rules and dice roll modifications.It is important to note that as Matrix games are meant to be flexible, the game allowed players to propose rule changes at any time, as long as the requested changes were supported by strong arguments (including that they were consistent with the research goals of the game) and validated by a successful dice roll.

C. *Example of Narrative*

As discussed in Section II, two iterations of the ISIS game were played by scientists from CORA. The narrative created during the first of these iterations unfolded as follows.

At first, each faction carefully observed the moves made by the other factions and focused mainly on reinforcing their troops on the ground. ISIS began by moving troops closer to the frontline on the eastern border of their territory. The Sunnis focused on raising a new militia in Ramadi to prepare for a potential takeover of the city by ISIS.

The Iraqi and Kurdish governments both decided to accelerate the training of their troops to increase their readiness. The Kurdish government successfully converted a militia unit into a Regular Force unit. Meanwhile, the Iraqi government tried to improve the training of its air force pilots, but the process failed for a number of reasons.

Iran decided to increase the presence of advisors in Kurdistan and succeeded despite objections from the US government. The US then decided to focus their attention on providing humanitarian relief to the refugees in Kurdistan.

Having reinforced its eastern flank, ISIS conducted a public relations campaign in Syria to promote itself and reduce the legitimacy of the Syrian government. This campaign was very successful and this was represented in the game by giving ISIS a +1 modifier for any action conducted in Syria. With limited resources to work with, the Sunni opposition then approached the Arab states of the Gulf and asked for money. This request for additional resources was granted and it translated into a +1 game modifier to be used later in the game.

The governments of Iran and Iraq were both concerned by the recent propaganda success of ISIS in Syria and decided to act to reduce ISIS' influence. Iran successfully increased aid to Syrian government and this move was so successful that ISIS lost the +1 modifier it had just obtained from its public relations campaign. Iraq decided to be more forceful and got the US to conduct a successful air strike against an oil refinery controlled by ISIS. This airstrike came with a double roll which gave ISIS an immediate counter-move. In response, ISIS decided to raise a militia unit in Ramadi using the impact of the US strikes on Iraqi oil installations as a recruitment factor.

While ISIS was under attack in Syria, the KRG tried to take the initiative and launched a wide-scale ground offensive to retake Mosul. This offensive failed and degenerated into a stalemate. Staying away from any kinetic actions, the US government then tried to organize a unity conference bringing together the Iraqi government, the Sunnis and the Kurds. This move was successful as all parties agreed to attend this conference.

Under attack on both its western and eastern flanks, ISIS then decided to construct a makeshift chemical weapon and smuggle it into Mosul for later use. This succeeded, but the Kurdish government was made aware of the situation and with the help of the US conducted a successful raid.

Iran then kept pressuring the Syrian government and convinced it to conduct airstrikes targeting the ISIS leadership in the city of Al-Raqqah. This strike succeeded, but a double roll gave ISIS an immediate opportunity to fight back. ISIS decided to conduct a surprise raid into Damascus and this raid caught the Syrian government by surprise causing significant casualties.

This iteration of the ISIS scenario concluded with Iraq launching an offensive to retake Fallujah. Despite receiving air support from the US and being advised both by the US and Iran, the limitations of the Iraqi army were once more made obvious when the offensive collapsed.

V. DISCUSSION

This section of the paper presents the results of the analysis of the data collected over the four iterations of the ISIS game. The data set consisted of the survey data from the players, the issues presented at the hotwashes and the observations taken by the white cell. Note that there is no survey or hotwash data for MAGIC 1. The results are discussed grouped according to the metrics framework.

A. Metric 1

The question that this research effort is exploring is: Can the use of wargaming augment or improve Canada`s CBP process? Currently, the process involves three major phases and wargaming has potential application to the first two of them: as part of the validation effort of the development of the Force Development Scenarios of Phase 1 and as part of the capability assessment effort that is undertaken by the JCPTs over the course of Phase 2. Each of these is discussed below.

Suitability for the validation of the FDSS in Phase 1

General observations contributed by either the players themselves or the authors include:

a. There may be a practical limit to the number of players that can play a Matrix game, or the number of turns that can be realised in a normal period of game play. MAGIC 2, 2A and 3 all involved 6 players, were played over a three to four hour time period and averaged approximately 5 minutes a move per player [Table I]. Most players agreed that this game pace was adequate (see Figure 3).

b. Some players indicated the scenario background information that was provided was helpful but that more background information might have helped them to better understand the motivations and dynamics of their particular role.

c. There was also concerns expressed by some players that the resources available to their respective factions were not well understood or perhaps were too generalised and vague.

TABLE I. DISTRIBUTION OF THE AVERAGE TIME TAKEN PER TURN FOR FOUR ITERATIONS OF THE GAME

Turns	MAGIC-1	MAGIC-2	MAGIC-2a	MAGIC-3

Turn 1	5:34	7:30	5:25	6:45
Turn 2	6:50	8:37	5:05	6:23
Turn 3	7:24	5:03	6:00	6:43
Turn 4	4:17	N/A	N/A	N/A
Turn 5	4:12	N/A	N/A	N/A
Overall Average	**5:35**	**7:03**	**5:34**	**6:37**

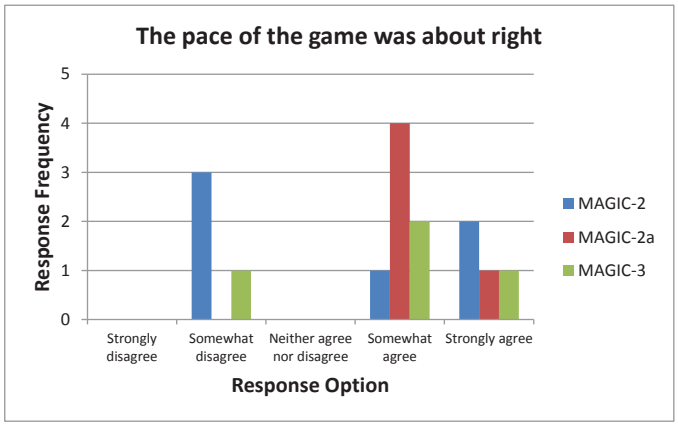

Fig. 3. The pace of the game was about right.

These general observations, while providing some insight to broad issues concerning the conduct of Matrix games, do not offer clear indications one way or another as to the suitability of Matrix wargaming as a supporting method to enhanced the validation of proposed Force Development Scenarios in Phase 1 of Canada's CBP process. The conjecture that bringing many different experts together and using a Matrix wargame to validate a Force Development Scenario still has intuitive appeal but, due to the broad political and military nature of the ISIS game used in the experiments reported upon in this paper, this conjecture remains unconfirmed.

Suitability for the capability assessment effort in Phase 2

In general this game was able to touch on some of the key PMESII-C drivers, but, again, due to the pol/mil nature of this ISIS game (as seen in the results presented in Table II), the drivers were heavily skewed to the political and military. It is also observed that the ISIS game is played at such a level that it is not really designed to bring out capability issues. Although this was known going in, it was instructive to experiment with this scenario to see whether the different player groups would highlight capability issues in their discussions. This generally did not happen. Thus, these experiments can neither prove nor disprove the potential utility of Matrix gaming methods to augment the capability assessment effort of Phase 2 of Canada's CBP process.

TABLE II. DISTRIBUTION OF PMESII-C DOMAIN OF PLAYER TURNS OVER FOUR ITERATIONS OF THE GAME

PMESII-C	MAGIC-1	MAGIC-2	MAGIC-2a	MAGIC-3
Political	9	4.5	5	8.5
Military	16	13	15	9
Economic	0	1.5	0	1
Social	3	0.5	1	1.5
Information	0	0.5	2	0
Infrastructure	0	0	0	0
Cultural	0	0	0	0
Unknown	7	0	1	0
Total Moves	**35**	**20**	**24**	**20**

B. *Metric 2*

Effects of the style of gameplay

For all iterations of the ISIS game, the style of gameplay was competitive and based on six players, or six teams in the case of MAGIC 1, playing against each other. Other styles of gameplay could also have been considered for this Matrix game such as a more communal approach. However, it was observed that the use of a competitive style was very successful at leveraging the contributions of all players. As each player had to play during a turn, every participant contributed to the narrative. Also, the competitive element motivated the players to develop counter-arguments against the other players allowing for a more refined discussion and narrative building exercise.

As stated in Section II, one of the objectives of this ISIS game experimentation was to determine if Matrix games can be used to identify the key drivers of a scenario. These key drivers were categorized into the seven PMESII-C categories. The gameplay did not specifically attempt to focus players on any particular PMESII-C scenario driver. The game design simply allowed the players freedom to play as they saw fit and use whichever PMESII-C elements they thought were necessary.

Upon completion of each iteration of the ISIS game (except for MAGIC-1), the players were asked if the game allowed them to know more about the PMESII-C dimensions of the scenario. The results of these surveys are summarized in Figures 4 to 10. Overall, the results indicate that the use of Matrix games can increase the knowledge of some of the key drivers of a scenario depending on the game design. These figures indicate that the players felt they learned mostly about the political, military, social and cultural dimensions of the scenario. The results for the other PMESII-C categories are mixed. These results are in line with the distribution of moves based on the PMESII-C dimensions summarized in Table II. It appears that the design of the ISIS game led the players to focus mostly on political and military moves during all four

iterations of the game. The social and cultural dimensions were mostly explored through the arguments supporting the moves and were especially present during the moves dealing with the interactions between the Shia and Sunni communities.

While nothing prevented the players from choosing to explore any PMESII-C driver, some elements of the game design created constraints and focused the gameplay towards political and military moves. The game design was based on a starting point where ISIS was aggressively advancing and taking territory. This created a significant bias towards military and political drivers. Furthermore, the limited number of moves conducted in each iteration of the game restricted the exploration of the key drivers and made it difficult to change the main direction of the game once a specific kinetic scenario was unfolding.

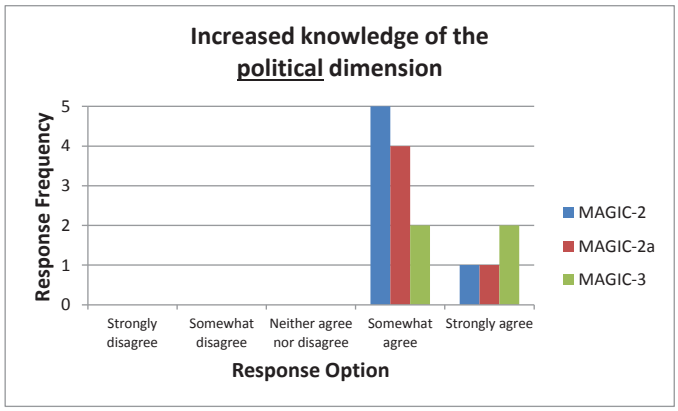

Fig. 4. After playing the game, I now know more about the political dimension of the scenario.

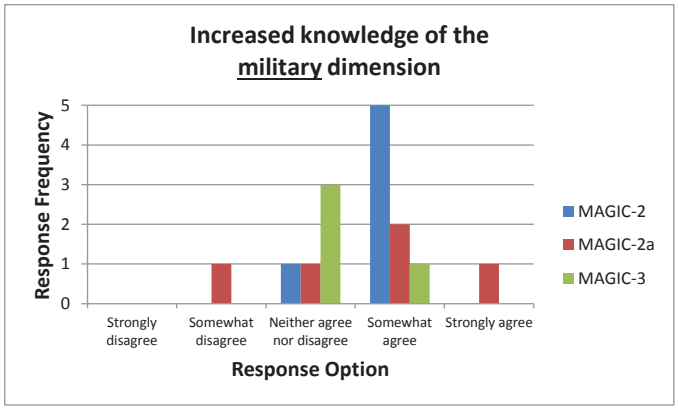

Fig. 5. After playing the game, I now know more about the military dimension of the scenario.

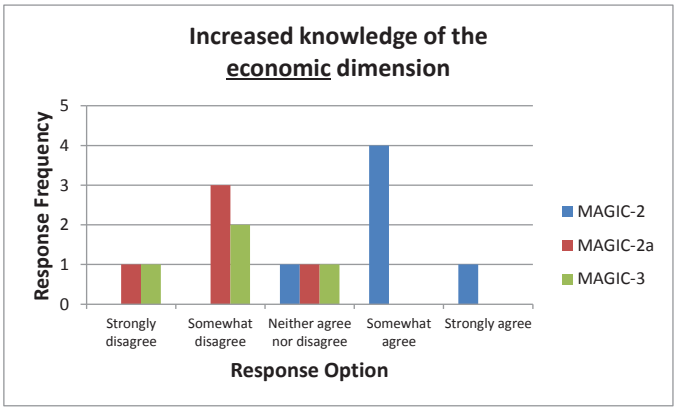

Fig. 6. After playing the game, I now know more about the economic dimension of the scenario.

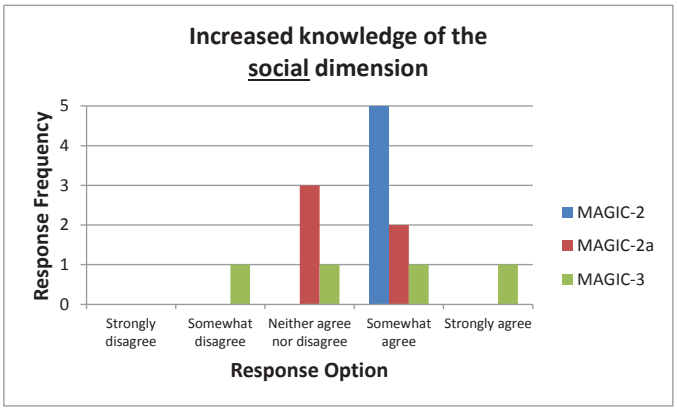

Fig. 7. After playing the game, I now know more about the social dimension of the scenario.

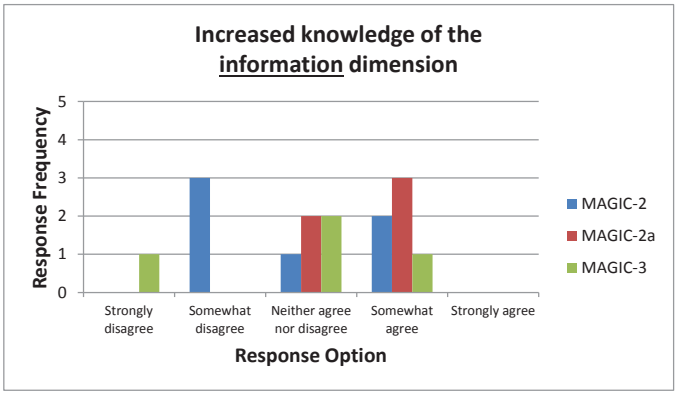

Fig. 8. After playing the game, I now know more about the information dimension of the scenario.

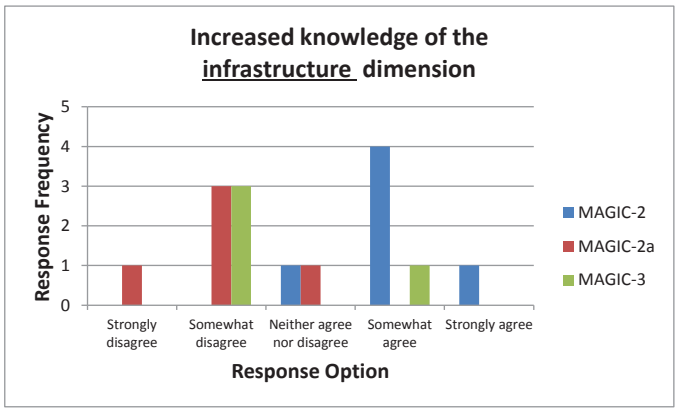

Fig. 9. After playing the game, I now know more about the infrastructure dimension of the scenario.

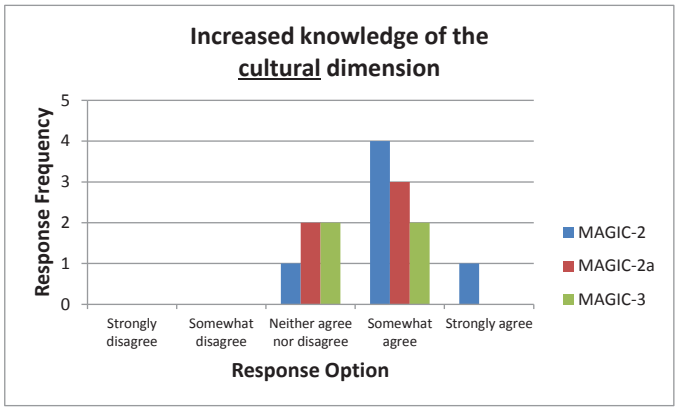

Fig. 10. After playing the game, I now know more about the cultural dimension of the scenario.

C. *Metric 3*

Impact of player population choice on game play and outcomes.

We analysed the player population data along two main axes: (1) whether a player was an SME and (2) experience with wargaming. We wanted to see if these factors had any impact on the game play or the sort of outcomes and insights the game produced.

The impact of the players being SMEs or not can be seen looking at the data in Table II. The data shows that the general distribution of move types is about the same across all four game iterations. Regardless of whether players were SMEs or not, most moves in the four games were of a political or military nature. As well, game moves in the other dimensions were uniformly infrequent across the games. Recall that MAGIC 1 featured mostly SME players whereas the other three games did not. We conclude that the game outcomes, as gauged by the types of moves and strategies employed by the players, were not affected by players' expertise with Middle East affairs.

The impact of the players' level of wargaming experience is measured by the data portrayed in Figures 11, 12 and 13, and also by the results shown in Table II. Again, Table II indicates that the players played the games in a similar way across all four iterations and utilized the same types of moves focused in the political and military domains indicating that any wargaming experience differences did not have a significant impact.

In fact, MAGIC 2, 2a and 3 participants who had extensive wargaming experience still commented that they found devising moves and executing strategies was quite difficult in this game. That was also mentioned by the inexperienced players. Figure 12 indicates that some players found it difficult to devise moves and others found it easier. The players who played in MAGIC 2 and then 2a indicated that it got easier to devise moves with that extra experience.

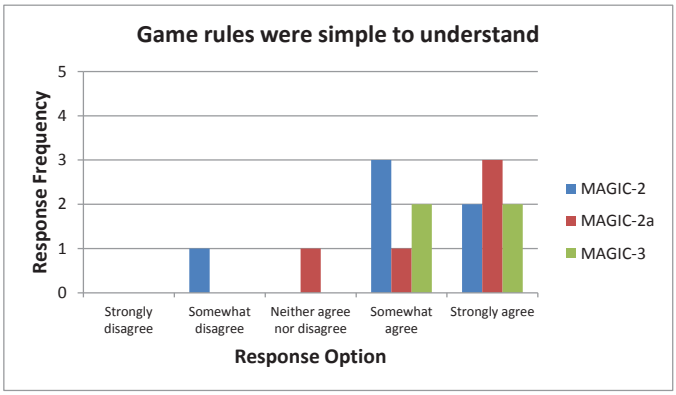

Fig. 11. The game rules were simple to understand.

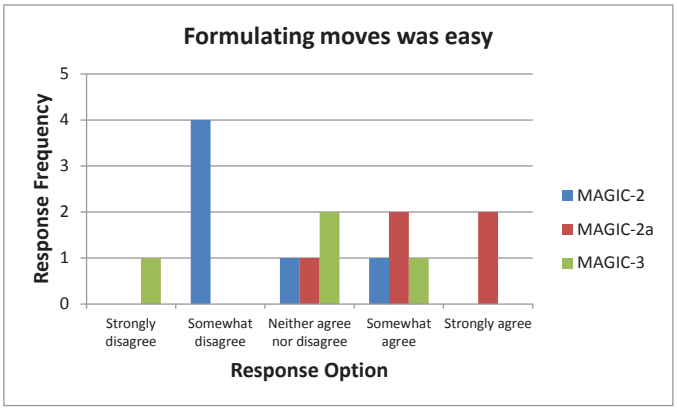

Fig. 12. Formulating moves was easy.

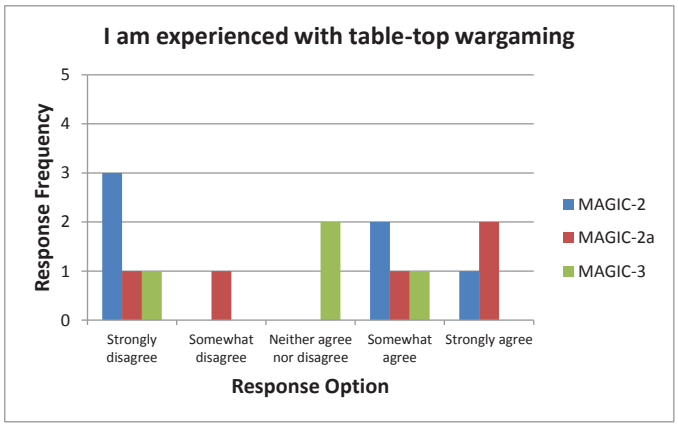

Fig. 13. I am experienced with table-top wargaming.

Figure 11 tells us that in general, the players found the Matrix game rules to be easy to understand. This was a strength in that it allowed experienced and inexperienced game players to quickly play at the same level. On the other hand this lack of rules structure may actually have may it harder for players to devise moves since they could do pretty much anything they could think of. Some reasons reported for the difficulty with formulating moves was because of the uncertainty in the outcome of their own move as well as not knowing what situation they would face until it was their turn.

Since the players were the same at MAGIC 2 and 2a, we expected to see some sort of learning effect that might generate gameplay and outcomes that were different. In the end, the data shows some evidence of a learning effect but overall, this did not alter the gameplay or outcomes. The players played the game in the same way (by making the sorts of moves) as shown in Table II. One would not necessarily expect the players to increase their knowledge across the PMESII-C dimensions by very much by playing a second time. That expectation is generally supported by the data in Figures 4 thru 10 where we see the distributions shift from MAGIC 2 to 2a in a direction indicating no real increase in knowledge by the players after 2a. That's what one would expect if the game were being played and it's overall outcomes were the same.

There is a noticeable learning effect depicted in the data distributions in Figures 11 and 12. There is a shift toward the rules being easier to understand and the moves being easier to formulate from MAGIC 2 to 2a.

D. Metric 4

Game Planning, Execution, Data Collection and Analysis

A variety of observations were collected on the planning and execution of the MAGIC series of wargames as well as on the data collection and analysis. With regard to planning, MAGIC-1 did not include a "hot wash" The hot wash is a common practice in professional wargaming [5] and its absence during MAGIC-1 impacted the amount and quality of evidence that could be drawn from this first instance of the MAGIC series. Hot washes were included in the subsequent MAGIC wargames and generated key evidence presented in this paper. This was the main finding for the game planning phase as the participants did not report any significant issue with regard to game planning that affected them and a majority of them felt that the background information provided to them (as part of the game planning) was useful (see Figure 14).

Observations dealing with game execution were more numerous. The following are the ones that have the most value from the perspective of general applicability to professional wargaming:

- The role of the umpire/adjudicator can be influential. An assertive umpire can steer a Matrix game toward a specific purpose or influence its unfolding and therefore the findings it generates. In MAGIC-1 some evidence supports the notion that the adjudicator over-influenced the unfolding of the wargame by his decisions and interventions in the game. In subsequent MAGIC games, the role of adjudicating the game was generally shared by more than one person who tried "to stay above the game" in order to let the game dynamics express themselves to the greatest extent possible. This arm's-length approach to umpiring and adjudication was judged more appropriate to the context and purpose of the MAGIC wargames. A more assertive umpiring style, in contrast, might be more appropriate when Matrix games are used for teaching or instructional purposes.

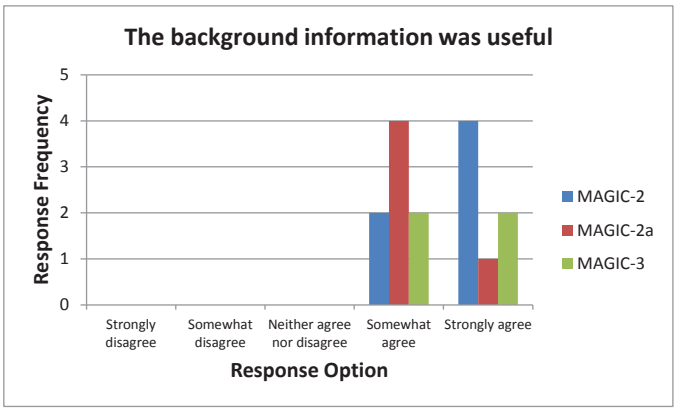

Fig. 14. The background information provided was useful.

- The ISIS-themed Matrix game we used was designed for six players, just like many of the Matrix games presented by Curry and Price [2]. We found that this number is about a maximum. Having more than six players would compound the problem we had with the time available which constrained the total number of moves that could realistically be done in a wargaming session of about half a day. Adding more

players would likely result in fewer turns for each player, which in turn would affect their ability to implement a strategy. The alternative of expanding the number of players while keeping the number of factions to six, thus creating teams to play each faction, is interesting as some factions would benefit from a collective play that would reflect their own internal divisions and debates. But playing each faction with a team would in all likelihood lengthen the time each move would take as the team members would have to discuss and agree on their moves. The end result would therefore be fewer moves in total in a given length of playing time.

- As alluded in the above observation, players were somewhat constrained by the time available to play the games. Most players in MAGIC-2,-2a, and -3 averaged 3 moves per game—with the ISIS player generally having a few more moves due to the rule that gave the ISIS player a free move when a double dice roll occurred. Many players expressed the difficulty they had in implementing any kind of strategy or long-term plan when they would discover as the game unfolded that they would be limited to only a few specific moves during a game. Having said that, the results of the survey (see Figure 15) indicate that players had enough time to plan their moves. In summary, given the time available the players did not have enough moves to implement a strategy, but the planning of each of these few moves benefited from sufficient time.

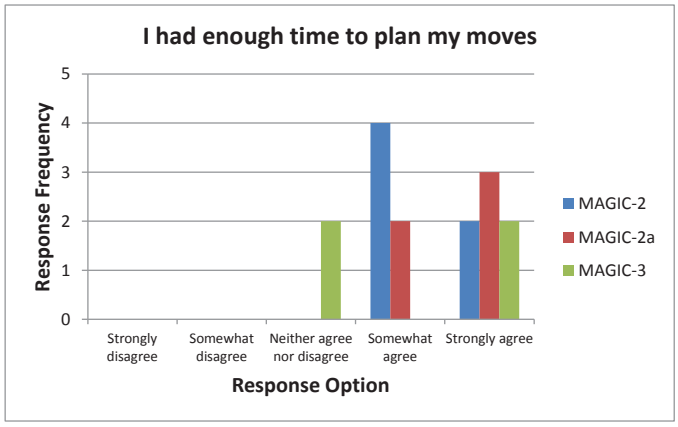

Fig. 15. I had enough time to plan my moves.

- Interestingly, while players found that the rules were simple to understand (see Figure 11) and that formulating a move was relatively easy (see Figure 12), they also reported during the hot washes that the development of a strategy was made difficult by the open nature of the Matrix game. Matrix games are not structured with an end state or clear objective that determines a winning side or the relative progress of a player. As a result, a player has to both determine his/her own objective, what would constitute success for his/her faction, and then develops a strategy to achieve it. The nature of the ISIS crisis, where domestic Iraqi politics, military, sectarian, and international dimensions are in play makes for a complex situation that renders strategy development also more complex. A player has to situate his/her play in relation to potentially multiple dimensions; which would not be the case in a wargame with a more conventional-war theme where two forces confront themselves foremost in the military dimension. Furthermore, a number of players would have liked to see a game where each player could pursue moves in different dimensions within a same game turn as if a game turn would have sub-options or phases designed for political, military, resource-building, and propaganda actions. Such design possibilities exist in more complicated commercial wargames focused on political-military conflicts such as the game designs of Volko Ruhnke [6, 7, 8]; however such an elaborate game design would go against the principle of simplicity of Matrix games and would also require more preparation and play time.
- Some observations from the players and authors also point at the possibility that game execution was influenced by the nature of the game components. The ISIS-themed game used a map with defined zones, each controlled by one faction, sometimes two when it involved some of the Sunni areas in Iraq where both the Sunni opposition and ISIS could be present at the same time. On that map, players had counters representing some of their resources and some of the entities present such as refugees or oil installations. For some players, the game components became the focus of their play and as a result dimensions of the conflict not represented in the game components may have not attracted as much attention as those represented physically. On a minor note, some players complained that the map was cluttered with counters near Baghdad; this situation could be corrected in the future by using smaller counters in relation to the size of a given map.
- With six players or factions and the light set of rules involved in a Matrix game, the authors found that such a game can be easily managed by a team of four peoples of which two are observers and the remaining two adjudicate and supervise the wargame itself. In one instance (MAGIC-3), the authors managed to run a game with only two peoples acting as adjudicator and observer while the two other game organizers had to substitute for missing players.

As in any activity designed to support analysis, the data collection and analysis plan can exercise an influence on the requirements for personnel or automated data collection instruments to support the wargame and its

subsequent analysis. In the context of the MAGIC series, the data collection requirements were minimal and included: description of moves and their outcomes, timings of moves and game turns, responses from surveys, and the feedback collected during the hot washes. Despite these relatively, minimal requirements, both the authors and some of the participants thought that this amount of data could have more effectively been collected had we had access to an electronic meeting system (EMS) or group decision support system (GDSS), that is, electronic tools that allow a group of people to share, discuss and categorize or vote on submitted information. With an EMS/GDSS tool, more data could have been collected more easily, and in particular more information on the rationale behind the moves made by the players or the reasons for their answers to the survey.

VI. CONCLUSIONS

In Canada's Department of National Defence the table top Matrix wargames to support strategic planning have not been used. In an effort to better understand the potentialities of Matrix wargames as a research tool and to explore the hypothesis that wargaming can support the department's CBP processes, SPORT has experimented with the ISIS table top game developed by Dr. Rex Brynen of McGill University. In all, SPORT conducted four separate iterations of this game with different sets of players in three of the four games.

As a result of these experiments a number of useful observations were obtained concerning the intricacies of organising and conducting a wargame; the value of participating in a wargame from the players' perspective; and the potential applicability of augmenting Canada's capability assessment efforts with one or more wargames. In terms of conducting a wargame, valuable experience in understanding the importance of the rules and structure of the game; of the principles and limits of keeping players involved in the game; and of the nature and key role that the GM or adjudicator plays in the conduct of a successful game. From the players' perspective new players gained a greater understanding of the Matrix wargaming methodology, and more experienced gamers gained a greater appreciation of the many layers of complexity and dynamics that characterise this regional conflict. Finally, in terms of the relevance of Matrix wargaming methods to supporting Canada's capability assessment effort, this experiment was limited by the nature of the game itself. The ISIS Matrix game is a replication of a complex, multiplayer, geo political situation. As such, it was observed to be a useful platform for introducing some of the region's complexities to the assembled players. This would seem to have similar promise if this methodology were to be applied to one or more of Canada's defence planning scenarios, but this clearly resides in the realm of future work.

In the coming months, SPORT plans to advance the use of the Matrix gaming methods by creating a Matrix game based on one of Canada's Force Development Scenarios. At the same time, it will explore RCAT as another alternative wargaming augmentation to the CBP process.

ACKNOWLEDGMENT

The authors would like to thank all the scientists from DRDC CORA who participated in this study. The authors would also like to thank Dr. Rex Brynen and his research group at McGill University.

REFERENCES

[1] A. Zegers, "Matrix game methodology development and employment for Vancouver 2010 Olympics marine security planning," Proceedings of the 27th International Symposium on Military Operations Research, pp. 1–13, September 2010.

[2] J. Curry and T. Price, Matrix Games for Modern Wargaming, 1st ed., vol. 2. History of Wargaming Project, 2014, pp. 7-11.

[3] J. F. Dunnigan, Wargame Handbook - How to Play and Design Commercial and Professional Wargames, 3rd ed. Lincoln, NE: Iuniverse, 2000, pp. 34-106.

[4] PAXsims, ISIS Crisis, McGill University, Montreal, Canada, 2015. https://paxsims.wordpress.com/tag/isis-crisis/

[5] J. Curry (ed.), Peter Perla's The Art of Wargaming. A Guide for Professionals and Hobbyists, History of Wargaming Project, 2011, p. 231.

[6] V. Ruhnke, Labyrinth. The War on Terror, Hanford, CA, GMT Games, 2010.

[7] V. Ruhnke, Andean Abyss. Insurgency and Counterinsurgency in Colombia, Hanford, CA, GMT Games, 2012.

[8] V. Ruhnke and B. Train, A Distant Plain. Insurgency in Afghanistan, Hanford, CA, GMT Games, 2013.