LIBRA AD BELLUM NOVUM: A POLITICAL AND MILITARY ESCALATION IN THE NEAR EAST AS SCENARIO FOR SUPPORT ADVANCED STRATEGIC DECISION MAKING

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ABSTRACT

The paper proposes a mission environment to be used to test simulation frameworks to be used to assess strategic engineering methodologies in decision making. The idea is to use this fictional, but realistic scenario, in order to be used in educational and training environment; indeed, the proposed scenario could be very useful to educate people in mastering strategic engineering methodologies based on combined use of simulation and data analytics. The paper defines the scenario and requirements for such a system and proposes an architecture and implementation solutions based on new MS2G (Modeling, interoperable Simulation and Serious Games) paradigm.

Keywords: Strategic Engineering, Hybrid Warfare, M&S, Education & Training, PMSEII-PT

1 INTRODUCTION

It emerged along last years the opportunity to adopt scientific approaches in supporting decisions related to complex scenarios including political, economical, diplomatic and military aspects (Gerasimov 2013). It is evident that simulation represents the crucial element to proceed in this way and it should be stated that these elements have been considered in the past to address these problems. Therefore we should also recognize that traditionally use of Simulation on these problems has been limited by several issues including among the others the difficulty to model the real case complexity, the problems to prepare quickly the scenarios, the lack of intelligence to automate the execution and virtual experimentation as well as the shortfall in processing capability of the huge amount of data obtained by the simulation runs.

All these elements are critical, but there is also a major additional aspect that is related to the lack of individual and team skills available among human actors in using new scientific opportunities and simulators (Bruzzone and Massei 2017b). This paper proposes the idea to define a scenario that could be stimulating the decision makers and their staff to test and experiment new simulation solutions and to become confident with their capabilities, limits as well as with methodologies to be applied to get a competitive advantage by their use. The scenario identified is related to case where multiple layers interact as it usually happen when it is required to adopt a comprehensive approach in analyzing a complex PMESII (Political, Military, Economic, Social, Infrastructure, Information) and PE (Physical Environment) Scenario (Lowrance and Murdock 2009).This aspect is fundamental to address strategic decision making once as well as nowadays (Clymer 1993; Blackmore 2006; Jalali 2019). In this paper it is proposed an analysis of critical elements that enable the development of such E&T (Education and Training) solution to be adopted by decision makers as well as the specific features and characteristics to be provided.

2 SHORTFALLS AND CRITICAL ISSUES

Before to proceed with the solution it is necessary to identify the gaps in adopting simulation to address complex PMSEII-PE and to evaluate if they could be faced and if we have valid proposition to overcome them. From this point of view there are several major elements that limit the growth in this sector, in the following some of them are identified and analyzed.

2.1 Technological Limitation

- Complexity of the real environment: often the real case deals with some many different aspects regulated by complex and unknown rules that strongly interact and make it very hard to create models. For instance modeling the complexity resulting from interactions between power grid, financial world, cyber attacks, population reactions and political/diplomatic actions; usually population is a pretty critical element (Huang et al.2005).
- Scenario Setting and Preparation: the huge amount of variables and objects as well as the definition of the scenario are so big and require so much conceptual and operative workload that a scenario preparation requires often months to be finalized.

2.1.1 Simulation Execution

- High Resolution Simulations: sometime just to execute a single run, it is required a lot of people; they operate the virtual entities, supervise operations and assign/execute orders/actions; so there is a big issue in terms of human resources to be involved that limits the number of executions to be carried out (often 1 or 2) and the duration (~few weeks).
- Low Resolution Simulation: often in this case the simplifications are so hard that the validity of the model is pretty low (e.g. enable or disable the CIMIC within the theater operations).
- VV&A (Verification, Validation and Accreditation): due to system complexity it results pretty hard to have certified data and valid tailored procedure to finalize the process and properly involve the users (e.g. Validation and Verification on human factors); in this area a crucial element is not to miss the accreditation phase (Balci 2000).

2.2 Cultural Background

- Expertise in Simulation Use: depending on the specific individual experience and training/educational path (usually related to his own country and profile), the use of simulation, especially for supporting comprehensive scenario analysis and decision making, could be something completely new.

- Expertise in Analysis Methodologies: depending on the specific individual experience and training/educational path (usually related to his own country and profile), the use of innovative data analytics techniques as well as data farming results often a gap.

2.3 Mind Set

- Attitude versus Scientific Simulation: several experienced people, especially from older generations, have concerns respect use of Simulation as support, often even due to the bad experiences resulting from wrong approaches or related to past capabilities of these solutions.
- Limited Time assigned to these activities, due to mind set, but also to real priorities of personnel usually engaged in many operational issues and overloaded by contingencies.
- Self Confidence on your own expertise: many decision makers have very good and very valuable experiences, therefore sometime there is a risk to desire to apply past solution based on experience to completely new different scenarios without using any advices including simulation (e.g. risk to plan approaches used in Afghanistan within North Africa).
- Lack of Confidence and Trustiness: due to an improper approach in applying VV&A the users see simulation as a Black Box providing results affected by unknown reliability and obviously they could move to don't trust them and don't use them.

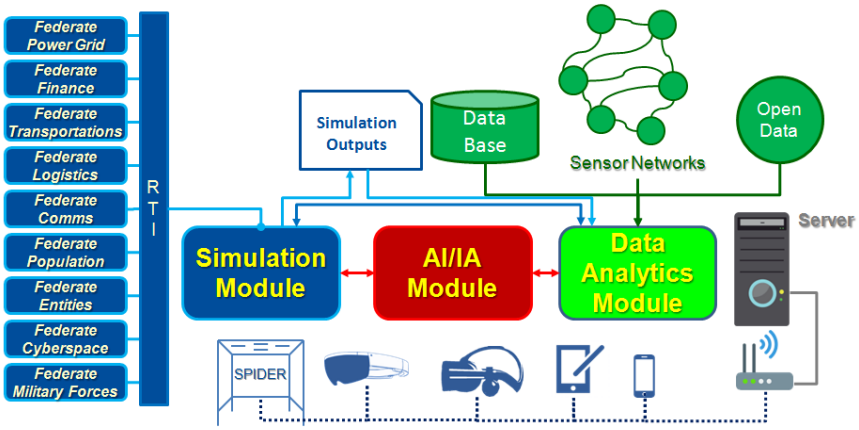

Figure 1: General Architecture.

First, we should state that all these consideration and gap are valid and that, it is a duty fir simulation developers to face them and make it works for user needs by engaging them (Amico et al. 2000). These problems exists since very long time, therefore new advances could allow us to overpass part of them (McLeod and Suzette 1977; Clymer 1980; McLeod 1999; Elfrey 2006) We should also state that the scenarios evolving along last half century demonstrated that there are significant margins to improve the capabilities in dealing with PMSEII (Summers 2009; Goodson 2011; Campbell 2013); so the idea to use new technologies in scientific way it is a real need to maintain a competitive advantage.

3 NEW APPROACHES TO ADDRESS CRITICAL ISSUES

From this point of view it is proposed a set of fundamental elements to consider and to include in new simulation solutions to address these criticalities.

3.1 Technological Enablers

- MS2G (Modeling, interoperable Simulation and Serious Games) allows to adopt multi layer and multi resolution solutions based on modern interoperable simulation as well as to use SG (Serious

Game) methods to maximize the engagement of users (Bruzzone et al. 2014a). This should be achieved not only in terms of 3D graphics, but using storytelling, emotional engagement, intuitive environments; from this point of view modern XR (eXtended Reality) technologies allow to create very immersive, interactive and intuitive environments that could be operated individually and collectively over a wide spectrum of platforms from Smartphones to tablets, Headsets, Hololens and even CAVE (Longo et al. 2018).

- Interoperability & Multi Layers Approach to address Complexity: it is crucial to adopt am interoperable modeling approach, not only technologically, but even conceptually; in this way multiple models, corresponding to multiple layers could interact (Kuhl et al. 2000).
- Automated Scenario: Use of Artificial Intelligence (AI) techniques and Intelligent Agents (IA) should be used extensively to create automatically scenarios, ready to be played just based on data fusion on multiple data sources, including open data (Sanchez 2004; Bruzzone 2018).
- Improved Computing Capabilities: new Computing capabilities could enable cloud to be effective in processing very hard scenarios (Cayirci 2013).
- Automated Execution Capabilities: IA-CGF (Intelligent Agents Computer Generated Forces) should be used to drive the objects and automate execution in order to create self driven simulation that don't requires huge human efforts nor weak assumptions and too low details; for instance in SIMCJOH it was created a set of units, population and authorities driven by Agents (Bruzzone and Massei 2017).

3.2 User Engagement

- Tailored New Solutions: It is fundamental to tailor new technological solutions in order to make them compliant with user needs expectations; this should be used, from other side, to familiarize users with these technologies and to drive them step by step in adopting even more advanced solutions. It is recommended to begin with low invasive, very intuitive and interactive platforms (e.g. SPIDER, tablet, smartphones) that hardly improve possibility to engage users and improve VV&A as well as their engagements (Bruzzone 2018).
- Autonomous Interactive Exercise: Development of Exercise to be played on highly automated MS2G with self evaluation features allows to support continuous and/or mobile education as well introduction of users into the use of these technological solutions as well as in using methodologies. In this way it could be possible to have AI providing an automated assessment of the performance achieved both individually or by a team (e.g. different Staff members J2, J3, J4, J6 and Chief of Staff could play individually a MS2G Scenario comparing their scores).
- Group Activities & Collective Simulation: Collective Simulation as well as activities in Cooperative and Competitive groups further reinforce individual and team engagement and improve impact of E&T programs or work together to solve a stimulating problem.
- Simulation Based Table Top Exercise: use of common simulation frameworks to support Table Top Exercises to involve Decision Makers on new scenarios interacting with Intelligent Solutions (Bruzzone et al. 2014b).
- Smart Planners and Aids: Development of AI able to support the users in using the simulation both in terms of supporting planning, management as well data analytics, helping the user(s) in addressing the decisions and review results; for instance the Commander plays the game alone but interacts with a virtual staff composed by IA that prepare the COAs (Course of Actions) and implement change requests as well as After Action Review.

4 STRATEGIS ENGINEERING AS CRUCIAL ENABLING APPROACH

In addition to previous mentioned elements, it is very important that not only for E&T, but even for planning and management it is very important to outline the importance to use the Strategic Engineering approach. Strategic Engineering relies strongly on combined use of Modeling & Simulation, Data Analytics and AI/IA to support decision making (Bruzzone 2018). It is evident that by adopting related

methodologies it turns possible to enhance the capabilities of simulation applied PMSEII-PE, in particular in reference to following aspects:

4.1 Modeling and Simulation

- The adoption of highly integrated simulation models with Data Analytics and AI systems allows to keep simulation update with scenario configuration and to process simulation results; the simulation could be run by humans to investigate specific cases or driven by AI to support intelligent planning and optimization of the COAs.

4.2 Data Analytics

- Data Analytics techniques and integration with multiple sources allows to integrate them in an effective way able to amalgamate the data and to guarantee the consistency based on data fusion and AI (McAfee et al. 2012; Wu et al. 2014); in this way automated scenario definition turns possible as well as the possibility to keep the models aligned with the external sources (e.g. real scenario components, changes by the different actors such as instructors). These techniques enables also to process simulation outputs, to correlate them and provide analytical approaches; obviously all these capabilities could be automated by using AI, but also driven by human user to investigate particular aspects.

4.3 AI/IA & Machine Learning

- These techniques are enabling the development of MS2G solutions where the multiple layers and objects are driven by IA as well as to support smart planning and data analysis (Bruzzone et al.2014a). Obviously AI could be used to create also opponents and threats (Barrat 2013)

It is evident that the synergy among these pillars of Strategic Engineering enable the use of Data Farming and Data Mining otherwise impossible with limited resource in short terms.

5 SOLUTION PROPOSAL

The simulation to be developed is expected to the innovative paradigm defined as MS2G and to combines interoperable architecture with immersive intuitive gaming solutions to maximize the usability and modularity of the models as well as previous consideration to improve its usability and effectiveness; validation and verification of the overall simulation should be tailored along the whole development process and should rely in strong synergy among simulation experts and operational people representing potential users.

The proposed solution to be implemented for the experimentation is based on the development of a new solution able to get benefit from available models (e.g. IA-CGF) such as that ones used in T-REX (Threat network simulation for REactive eXperience), SIMCJOH VIS/VIC (Simulation of Multi Coalition Joint Operations involving Human Modeling, Virtual Interoperable Simulation & Virtual Interoperable Commander), JESSI (Joint Environment for Serious Games, Simulation and Interoperability), DIES-IRAE (Disasters, Incidents & Emergencies Simulation & Interoperable Relief Advanced Evaluator), MALICIA (Model of Advanced pLanner for Interoperable Computer Interactive Simulation), ST_CRISOM (Simulation Team Crisis Simulation, Organization and Management), IDRASS (Immersive Disaster Relief and Autonomous System Simulation), etc. As anticipated, the overall architecture should adopt MS2G approach and use HLA standard to be open to further integration as proposed in figure 1; in addition it is crucial to define the capability to operate within different use modes from stand alone to collective users acting collaboratively and/or competitively; another important requirements is that one dealing with use platforms; in general the simulation architecture related to the capability to run on SPIDER (Simulation Practical Immersive Dynamic Environment for Reengineering) as well as on

Laptop, AR/VR solutions and on smartphones. Specific E&T Exercise and programs should be defined to guarantee to support VV&A along the whole life of the project and the experimentation.

6 TEST SCENARIO

Due to these aspects and in order to proceed with a real implementation and experimentation within a reasonable timeframe and with limited resources it is necessary to define a specific ad hoc scenario for initial experimentations. In the following the test scenario, representing a realistic and challenging case, is proposed and it will be used during the implementation of the simulator. This scenario has been created in order to combine different models already developed by Simulation Team based on stochastic discrete event simulation, agent driven simulation and MS2G.

Once parts of a former dissolved empire, two neighboring nations face a crisis that, if not properly handled, could turn into a global conflict. After the dissolution of the HATE (High Absolute Totalitarian Empire), among many, two major political subjects arose: U-land in the West side, R-land in the East side. Since the beginning, R-land manoeuvres to install in U-Land a friendly government, while large sectors of the U-Land Press to join the prosperous CoWS (Confederation of Wealthy States). Such growing polarization of the political debate in U-land ignites the rebellion of some districts close to the border of R-Land; unofficially, but very effectively, R-land supports the Secession of the eastern districts of U-Land, while the U-land government unsuccessfully copes with the crisis. When the president of U-Land, believing that the military and economic crisis is eroding the unity of the country, in a desperate move calls for the help of the Prime Chancellor of the CoWS, a personality that has been elected - among many - for its commitment to the cause of U-Land. The crisis escalates when a group of guerrilla announces on the media and in the social networks that they hold a nuclear plant, menacing to blow it up if the government of U-land will not stop its aggression against the pacific inhabitants of the rebel districts. At this point, the conflict in the cyber domain is unleashed to release its full annihilation power, disrupting the civil life in U-land.

Despite the denial coming from the first citizen of R-land, and the fact that the occupation of the military plant it is a fake news, the crisis further escalates when military combat teams from the CoWS are deployed as military advisors to support the push of the U-land troops in their weak willed attempt of regaining the control of the rebel provinces. However, military confrontation from both sides starts and continues in a total fog of war. The crisis could be developed along one or more weeks, where the opposing parties should try to prevail in the confrontation, but not at the cost of igniting a major global confrontation between CoWS and R-land.

The Players will be enabled to activate multiple actions on diplomacy, politics, economics, military, STRATCOM, INFOPS, PSYOPS; the Simulation will cover multiple domains including (i.e. land, air, sea, space, cyberspace). Assets will include traditional ones, autonomous and virtual. The networks to be covered, with different resolution levels, are expected to include power grid, financial network, transportation network, logistics, communications. Specific attention will be paid to model the population behavior and human factors as well the social media (Bouanan, Zacharewicz & Vallespir, 2016; Bruzzone et al.,2017a).

7 CONCLUSION

The evolving technologies and new simulation paradigms allow to extend the capabilities of M&S in E&T respect complex Scenarios and Strategic Decision Making. This paper outlines critical issues as well as possible solutions and propose an approach to create a new simulator to address a specific scenario in

this context. Currently the authors are working to finalize the implementation of these guidelines and the creation of a simulation solutions to be experimented with different potential users; currently the idea is to start by using classes of STRATEGOS, the International MSc in Engineering Technology for Strategy and Security of Genoa University and to activate collaboration programs with Institutions in other Countries. During this phase the different operational modes will be tested and fine tuned. Following step is to create sessions with operational people and decision makers to engage them in this process.

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