Strategic Decision Making Training
Through Serious Games
ARRC Report

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Through Serious Games

A study for Allied Command and Transformation with the support of Simulation Team and NATO M&S-COE

NATO ARRC
Report
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Executive summary

The goal of this study is to investigate how to enhance Education in Strategic Decision Making through Serious Games and Modeling & Simulation. In particular the main purpose is to evaluate the potential of Serious Games and IT Technologies in a critical sector: training in Strategic Decision Making. Serious Games represent an emerging solution for education and training, strongly based on innovative technologies and new approaches. Indeed by Serious Games it could become possible to improve skills even in new sectors such as Strategic Decision Making and to develop innovative solutions able to prepare the NATO resources to face new, evolving challenges provided by comprehensive approach in complex scenarios with limited resources.

The Allied Command Transformation is investigating technologies that could be used to augment or replace existing technologies for education and training of NATO staff. One of the investigative streams is in serious games. This report is addressed to complete a study about the use of serious game and/or innovative technologies for strategic decision making training. In effect a first study was carried out by Simulation Team and NATO M&S COE analyzing specifically the NATO Defense College Senior Course and providing suggestions and proposals to introduce innovative training methodologies just based on Serious Games.

In this report these issues are focusing on Commander needs within an Operative context and it is used the ARRC (Allied Rapid Reaction Corps) is used as reference case study to identify potential and requirements for applying Serious Games to Strategic Decision Making. Indeed the evolution of the world framework both in term of geopolitical aspects (i.e. reducing activities in South Asia) and in Defense Policies (i.e. reduced resources and Smart Defense) requires to move the Commanders to new mission environments; these scenarios needs a comprehensive approach, tailored on different frameworks with respect to previous ones, so the use of Serious Games could be useful to increase understanding capability, flexibility, evaluation of second level consequences, etc.

The research aim is to identify the potential related to the use of Serious Games as a methodology to support education at political level, operational level training and COA (course of action) analysis within ARRC (Allied Rapid Reaction Corps); the sector of application is challenging and broad considering that involves of ARRC Exercises and Training activities as well as mission rehearsal, decision support, and post-mission analysis within COA Analysis.

It is very important to outline that this study consider these issues at strategic level, so the attention is focused on Commanders that in this case are one to three star Generals; obviously these kind of users represent a challenge for applying Serious Games respect other classic cases (i.e. training Squad and platoon Leaders) however this is also an opportunity to use innovative technologies to enhance capabilities for operative decision makers; in addition, it is also interesting to evaluate the potential of these technologies in staff development for supporting Strategic Decision Makers.

This research was carried out in ARRC Headquarters through interviews to potential Users (i.e. Commander, Chief of Staff) and their staff (i.e. Commander Staff) in order to collect expectations, suggestions, concerns on applying Serious Games Solutions.
The interaction with ARRC in its main offices as well as during training exercise allowed identifying opportunities and critical issues on Using Serious Games and Simulation in Operative Strategic Decision Making.

Indeed, to complete this report the project team analyzed ARRC Exercises and Educational Program by visiting twice the ARRC Headquarters (June 2012 in Innsworth and October 2012 in Newquay). During this visit several meetings with ARRC Staff and Exercise Participants were held, material was collected and a questionnaire was distributed to gather information; the goal was to understand ARRC needs and possible field of applications as well as to obtain an insight about IT skills and knowledge of Games, Simulation and Serious Games of Commanders. In addition the Project Team attended the Noble Ledger Exercise in order to:

- Observe Exercise Dynamics
- Understand Exercise Goals
- Find critical Exercise areas to be supported and prepared by Serious Games or other tools
- Identify issues and aspects where Serious Games could support the Commander training program and capability development
- Observe Commander and Staff behaviour and identify opportunities to prepare them before the exercise by using Serious Games
- Understand what could create pressure and interest on Commanders and their Staff as way to increase the engagement of these high Level Users

Chapter 1 represents an introduction to the context of Serious Games and their potential for Strategic Decision making.

Chapter 2 presents the approach applied in this study and the ARRC case study and context to be investigated.

Chapter 3 summarizes the activities and outcomes obtained from ARRC as well as collected meeting notes, interviews, materials and observations.

Chapter 4 provides an overview of the state of art in the area of Serious Game Applications to training and education for Decision Makers and for Soft Skills Development. This is a summary of different sources of information such as scientific works, papers, projects and existing games including short descriptions and references. The focus in not just on Defense sector, vice versa this state of art provides several interesting concepts and samples that could be used as guideline for future development to be applied in ARRC.

From Chapter 5 the report enters in its proactive part, the title of this chapter is “Games and Tools Suggestions” and it proposes ideas of possible Serious Games to be introduced to support Decision Makers Training at the operative strategic levels within a comprehensive approach.

Chapter 6 describes different possible Courses of Actions (COA) for developing Serious Games for Operative Strategic Decision Makers. The recommended approach is COA#1, based on the introduction of Serious Games in ARRC as by a lean simulation approach; in the COA#1 it is expected the use of a solution in advanced phase of development for strategic decision makers in this area (i.e.
Understanding Dynamic Targeting Consequences) that could become operative on short term and be used to measure the achievable benefits, improvements and gaps. An alternative is COA#2 expects to proceed with the development of a new set of Serious Games designed for this context to be introduced on ARRC; COA#2 involves a large project, but it is characterized by higher risks and costs. A very conservative possibility is obviously to don’t activate any development in this context, at least on short term; this is the content of COA#3 that could be motivated by the fact that Commanders have usually consolidated experiences and are already acting quite efficiently without using these techniques; therefore this COA is not recommended by Project Team. In fact the Project Team suggest to proceed with the next phase of development of this research in applying Serious Games to Operative Strategic Decision Making; the main motivations for this suggestion are related to the fact that the Commanders are not currently really involved in any structured training process on Decision Making at Strategic Level, therefore the quick evolution of the general world framework requires to develop tools and aids (i.e. Serious Games) to support their understanding and flexibility over these complex scenarios; this aspect resulted quite important based on Commander feedbacks, especially in not-kinetic scenarios involving political and cultural issues on new areas. More Details of benefits, disadvantages and risks of the different COA are described in this chapter.

1 Introduction

Game applications and Serious Game are becoming very popular in many sectors (Defense as well as Industry) for training decision makers and staff at operational level as well as strategic and political levels. These applications are becoming more and more accessible on the web and on new technologies (i.e. mobile solutions). In addition the new serious games guarantee good and realistic environments, high interactivity and above all they engage the user by making the educational process more effective. The engagement concept is a step forward respect to traditional training solutions where trainees are requested to carry out their assignments, while in games players are self-motivated to use the game for fun. From this point of view Serious Games and the engagement issues are providing an additional atout ensuring a very high impact of the of training and education processes for participants. It is interesting to compare specific characteristics of Serious Games and Simulation; while Simulation is quite popular for operative training in Defense, Serious Games are diffused in a wide spectrum of applications; some significant differences are identified in the table below:

<table>
<thead>
<tr>
<th>Simulation</th>
<th>Serious Games</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientists / Engineers</td>
<td>“vs.” Game Developers</td>
</tr>
<tr>
<td>Commercial Software</td>
<td>“vs.” Game Engines</td>
</tr>
<tr>
<td>Professional Hardware</td>
<td>“vs.” Game Devices</td>
</tr>
<tr>
<td>Scenario Definition</td>
<td>“vs.” Game Level</td>
</tr>
<tr>
<td>High Fidelity</td>
<td>“vs.” High Physics</td>
</tr>
<tr>
<td>Training by doing, virtually</td>
<td>“vs.” Training by Playing</td>
</tr>
<tr>
<td>High Unit Cost</td>
<td>“vs.” Low Unit Cost</td>
</tr>
<tr>
<td>Few Users</td>
<td>“vs.” Many Users</td>
</tr>
</tbody>
</table>

Table1. Simulation and Serious Games
Several Allied Nations are committed to the use of serious gaming as part of training regimes and will likely be using more games in the coming years. An example of this is the US Army which has recently purchased 3500 licenses of the game Virtual Battlespace 2 (VBS2) investing around 17M USD. The vast majority of these gaming efforts have been for individual education (i.e. “first person shooter.”): “The military has adopted gaming as a training strategy because it delivers the goods, in some situations, better than traditional classroom instruction. However, it is not meant to replace, but only to complement live, virtual and constructive training experiences.” (R. Smith, US PEO STRI).

To assist M&S users in maintaining awareness of such M&S-related technology developments, ACT has activated a process to monitor technology developments by others (technology watch program) and to conduct its own technology-development activities in key areas not addressed elsewhere, the researches described in this report are part of this effort.

The focus of this work is to understand how to use Serious Games in the specific area of Strategic Decision Making. This is a broad and articulated environment where many techniques and methodologies could contribute to success; therefore the complexity of the context requires the development of specific courses able to improve user skills as well as their capability to interact with other people and finalize critical decisions within challenging situations (i.e. limited time and resources).

Decision making is central to all military operations both in terms of mission success and safety of personnel and equipment and in Strategic Decision Making, a major aspect is related to the necessity to handle complex problems involving several human interactions while facing challenges and contingencies; in addition the people involved in this process, even when they belong to the same organization, are usually directed by individual targets that sometime are competing with common goals. Cultural differences, language issues, leadership and management capabilities are additional factors that are usually critical in strategic decision making among a set of players.

The importance of training decision makers in military field, as in any other areas, cannot be underestimated, both for those undertaking the highest levels of command and control and personnel on the ground engaged in combat. Due to these factors it is crucial to properly train the decision makers to consider how to guarantee an effective process within a comprehensive approach in critical situations.

Decision making should be improved through training. Whilst it is not possible to provide generic decision making training, a number of trainable decision making skills have been identified including situation awareness, metacognition and resource management, in addition to specific skills which can be trained according to the different decision event types. The use of serious gaming in this framework should address the areas where a more immersive and engaging framework could provide a benefit for training and an opportunity to experience multiple problems and learning by experimenting them in simulated environments and conditions.

Considering these aspects, it is evident the importance to couple human behavior and serious games; in fact serious games usually have a stronghold in graphics, usability, interfaces and multiplayer capabilities; therefore games frameworks needs to guarantee proper fidelity and correct models for their specific purpose. Due to these reasons,
application areas under investigation for serious gaming introduce the necessity to add strong coupling with humans, both considering real humans interaction by multiplayer games and artificial intelligence (AI) able to add realism by introducing human behaviors as well as Intelligent Agents (IA).

Multiplayer games integrated with Intelligent Agents introduce new opportunities for serious applications, while Human Behavior Models enhance these chances. Furthermore, it is clear that there is potential in using Serious Game as technology enabler to empower learning experiences and also enlarge installations, to widen the User Community and extend Uses and Utilizations Modes; therefore, at the same time, it is critical to define a reference baseline for fidelity and the proper level of detail for games considering expected benefits, use modes and training targets.

Members of the project team had several experiences in different areas of education and developed solutions based on this “comprehensive” approach for different applications with very positive results. Furthermore it is evident that this R&D project provides very useful fall-out in other cases for NATO as well as benefits in other contexts: this kind of serious games could represent strategic assets for training future leader to face new challenges, where limited experience is available and high and various skills are required in term of decision making.

The success of serious gaming is today strongly enabled by the evolution of the audience of the trainees that are people with a strong background in computer use and sometimes even direct experience in gaming; the approach is supposed to be subjected to further growth in the future when the next generations composed of Gamers will substitute completely the Baby Boomer generation strongly based on TV; the change expected for decision makers in next 20 years will require serious games in order to comply with the expectation of Gamers for being appealing, while today these solutions need to be designed for a transition period. Despite the consideration of this transition, it is very important today to start using serious games in training and education for creating background and experience in this area and to achieve as soon as possible the benefits of this approach.

Well-developed serious games which leverage the properties of games, digital games, and simulation present big opportunities for creating immersive experiential learning environments for decision making training, enabling students to become active learners in a safe benign environment, but one which encourages them to take risks and explore the solution space, with the benefit of immediate feedback, and subsequent review of performance.
2 Study approach

The key aspects for succeeding in using serious games include the following elements:

- Choice on Technology & Infrastructure (i.e. Mobile Solution, Web Applications)
- Immersive Framework (i.e. Graphics, Reactivity)
- Usability (i.e. Learning Curve, Intuitive use, Interoperability)
- Player Engagement (i.e. Competition, Storytelling and Emotional Involvement)
- Player attitude (i.e. Background in Computers, Trustiness on Simulation, Games Appreciation)

Due to these aspects it is critical, first of all, to identify goals for education and training where to use Simulation and Serious Games, and then to address each specific aspect in order to identify effective and efficient solutions.

So it is necessary to study the context and to determine if and how to design new training solutions based on serious games.

Preliminary analysis on the correlation between serious games requirements (i.e. hardware, graphics, interactivity, interoperability, storytelling and emotional involvement) and training context (educational audience, training purpose and available resources and time) could be useful to figure out the above mentioned study.

Due to these reasons the current project plan is to complete two different studies regarding the use of serious games or associated technology to train NATO senior decision makers; in fact the research is directed to develop a scoping and feasibility study about how the serious gaming approach could be used to support existing academic courses and senior level exercises (with special attention to commanders training). The courses and exercises identified for the research are the NATO Defence College (NDC) Senior Course (Education Facility) and the training for the Allied Rapid Reaction Corps (ARRC) (operational level HQ).

This report is specifically focused on the ARRC Requirements and Training Program. The next paragraphs describe the approach and the developed activities, collected information and material as well as a set of Courses of Actions (COA) and suggestions for possible games to be introduced in ARRC training processes.

2.1 ARRC Training Activities

The Project Team collected information about ARRC Activities and Training Exercises by visiting ARRC Headquarters and interviewing ARRC Staff. In particular the team attended the Noble Ledger Exercise in Newquay (UK) during October 2012; this opportunity was devoted to understand based on observation and interview the decision making process and to complete knowledge acquisition as well as data collection on the framework of operative strategic decision making training.

The Project Team interviewed different ARRC Members and Leaders and Responsible of the different Joint Branches (i.e. G3 OPS, JFIB, G35, OAB/G5, Med Branch, AOCO, G6, G2, G5, Legal Branch, ECMI, COSARRC Office, COMARRC, PAO; CSS DCOS OPS). The interview was addressed to:

- Understand the roles and specific training needs
- Understand the decision making process
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- Identify critical issues during decision making process
- Identify stress points and variables stressing the decision makers
- Identify tools and applications already used for the exercise
- Collect interests, suggestions and expectations on applying gaming technologies in ARCC Exercise

This analysis allowed identifying problem boundary conditions, potential improvements and expectations for serious gaming as well as constraints and limitations for their use. Based on this analysis it has been possible to define and to propose different Courses of Action for introducing Serious Games in ARRC; in fact these represent alternative possibilities about possible games and tools to be used in ARCC Commander and Staff training at strategic operative level; the research focused specifically on Commander therefore it resulted evident the importance to consider even consistent training of Commander’s Staff.

2.1.1 Noble Ledger Exercise Description
The Noble Ledger Exercise held in Newquay on October 2012 was held at RAF St Mawgan (two and half week duration) in preparation for the NATO Reponse Force (NRF 2013). The exercise allows the training audience to really experience a Complex Multinational Joint Context where planning, refining and executing operations for Crisis Management.

The Exercise involved different branches and it addressed coordination and communication capabilities as well as decision making skills. The exercise included personnel assigned to the ARRC. Therefore the exercise was devoted to improve capabilities for rapid deployment as a collective-defense, crisis management or stabilization force, or to act as an initial entry force for a subsequent primary deployment. The NRF traditionally comprises land, air and sea components provided by NATO members, therefore Noble Ledger Exercise was more focused on land forces, even if it represented a joint scenario.

Indeed, the ARRC is currently scheduled to serve as the Land Component Command (LCC) headquarters for an NRF call-up in 2013. As an NRF LCC, ARRC personnel would essentially be in command of all land combat troops on the ground during the NRF deployment.

In addition to preparing ARRC personnel for any future deployments and support for NATO operations worldwide, the exercise included a NATO evaluation team who observed, evaluated, and officially certified the Headquarters, as well as all participating subordinate units, for their potential role. The exercise was carried out in a military camp holding the different involved branches and the Commander and Chief of Staff Office; and equipment and tools were available for each branch within the area. The exercise evolution and development was controlled by ARRC staff.

The starting point of the exercise was the Country Book about the scenario (i.e. Skolkan Scenario) developed by JWC. This book includes all the political, economic, social and cultural information about regions involved in the mission environment; a “Road to Crisis” is developed in order to create a list of events generating crisis and conflicts and to define friend and foe forces. For each exercise, training objectives are defined for the different branches of the Command which composes the Training Audience as well as for whole HQs.
3 Review of ARRC meetings and materials and Observations

As already mentioned, the Project Team (Simulation Team Members and NATO M&S COE personnel) visited ARRC Headquarters having several meetings to collect information and exercise material to be studied. The used approach is described in the figure below and includes the following phases:
- Collection of Data and Knowledge about the learning process, the exercise objectives and evolution
- Identification of needs and opportunities
- Proposal of a set of simulation models and/or serious games to be introduced among ARRC Training processes
- Assessment about the proposed solutions and Identification of the most interesting and the most useful for NATO
- Development of the model/serious Game
- Introduction of the model in training process as pilot experience
- Comparing the performances and the results obtained through traditional learning and technologies-based learning

3.1 Results of Meetings

The joint team involved in meetings and exercise observation activities has summarized the following critical issues for decision makers:
- Implications: Evaluate Consequences of Decisions in a Comprehensive Environment
- Time issues: provide the right decision at the right moment
- Trustiness and Confidence: trust staff analysis and advice
- National Issues: manage different regulations and different national needs
- Understanding of the situation
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- Information Management
- Options assessment
- Actions Effects and Implications

In particular from the different meetings it was erased the necessity of well understanding the context and the situation in term of comprehensive approach and global understanding of the environment and of the mission, some important questions are related to the following aspects which could increase the complexity of the context:
- Presence of Joint Operations or not
- Presence of Low or Intensive Conflict
- Multinational or Not
- Civilian Involvement or not
- Available Assets
- Identification of Key actors

Special attention was addressed to the elements stressing the Commander or Decision Makers:
- Time Pressure: complex scenarios affected by crisis or conflict and involving civilian require to be fast in taking decisions
- Uncertainty: lack of knowledge about the context and about the decision effects generates stress
- Asymmetric Threats: terrorism, cyber attacks, insurgency and other asymmetric threats increase the stress
- Risks: the impossibility or difficulty to evaluate correctly the risks of the decision increases the stress
- Legal and Political Issues: they can influence the decision makers and are critical above all in term of domestic opinion and country stabilization and normalization
- Cultural Issues: it is necessary to take into account cultural issues in order to not violate local population sensitivity to generate feelings of trustiness instead of hostility and to reduce risk of demonstrations and riots.
- Contingency: an unexpected event (i.e. an attack or an explosion or the death of civilian) could increase the stress.

In order to face these critical issues the serious game should train the following capabilities:
- Reactivity: capability to immediately analyze the situation and respond to a critical event (i.e. explosion and civilian death)
- Capability of Briefing: ability to identify the critical issues and present them to the media as well as to the involved military corps in a synthetic and precise way by highlighting the major problems and the best solutions
- Capability of understanding the situation: to have a clear map of the situation from both a geographical and socio-cultural point of view (i.e. number of involved people, tribes and ethnic groups, presence of Coalition Forces or international organizations)
- Capability of anticipate effects also in term of media and public affair: ability to take into consideration the decision effects on domestic opinion and on public affairs
- Capability of Listening: to be able to overcome problems related to English language and to match and organize information coming from different sources.
- Conflict Management: diplomacy and ability to address common objectives and to share a common plan among different nations, organization and roles.
As benefits and opportunities of introducing serious games in ARRC Exercises are considered:

- Social Network replication with special attention to the relationships between commander and his staff, with media and public affairs
- Intellation Stimulating in a multinational joint complex environment to improve capability of analysis and problem solving
- Training Conflict Management Capabilities to evaluate and improve diplomatic skills
- Training Capability of prioritization referring to the ability of identifying the major problem and the main action to be taken among different alternatives
- Training Meeting and Brief Management in order to train how to chair a meeting and how to present problems and solutions.

In order to involve the players and to train the mentioned capabilities, the serious game should have a set of features such as: easy and quick use, stand alone and distributed mode in order to involve several players and cooperative and team building.

In addition to reproduce stressing points for the game, it could be useful for instance to introduce noise disturbing the decision maker or external messages (i.e. from Home, from decision maker’s wife or child) or new rules (i.e. Coffee and Cigarettes not allowed).

Focusing on Commander, the following aspects should be considered:

- Different cultures and experiences management
- Complexity of processes and structures
- Commanders attitude towards staff
- General Cultural Knowledge
- Trust among different levels
- Personnel turn over and training for new comers

A good commander should have good communication skills and be able to create external relations, to manage meetings and to manage information.

At the end of the meetings the project team, composed by Simulation Team (Genoa University and MAST) and NATO M&S COE staff have highlighted some critical points to be investigated as opportunities for modelling and simulation use and have identified possible game ideas which are suggested in the next paragraphs.

### 3.2 Questionnaires

During the first visit to ARRC Headquarter, a questionnaire was compiled by Chief of Staff at ARRC staff to provide an overview and in particular his understanding and background on simulation technologies applied to education and training.

The questionnaire was divided in 3 main areas

- Basic Computer Knowledge;
- Usage Profile;
- Gaming and Simulation.

The first 2 areas were intended to collect information about generic IT skills and capabilities while the third area was focused on how familiar Commanders are with Simulation and Serious Games and to collect their point of view about potential uses of Serious Games for training and education.
There were also some open questions in the questionnaire asking for a description of a possible use of simulation or serious games in ARRC: we had 24 answers with 4 negative (no uses or low impact) while the other were distributed over different ideas:

- Real Time Simulation for instance for Nations and Capitals interaction
- Virtual Environment (like Second Life)
- Training in Risk Analysis, Decision Making
- Training Negotiation
- Learn Languages

4 State of Art in this Area

Game industry is, nowadays, a strong and consolidated business sector, nevertheless serious games are still a new emerging sector with a lot of innovative applications, continuously proposed to different communities (Industry, Defense, M&S, Training ...). Therefore several scientific researchers have been conducted along the last years on this subject, as well funded projects and also several products and tools have been developed (Abt C.C., 2002; Bergeron, 2006; Luppa, Borst, 2006).

This survey is mainly focused on applications of Serious Games for supporting and educating the decision making process and soft skills and communication and negotiating skills and other capabilities required to high rank officers.

Across the armed forces, operational, strategic and tactical decisions are taken on a daily basis, which determine mission success and the safety of personnel and equipment. The
change in the nature of warfare from fighting a cold war enemy with a fairly well known military doctrine, to asymmetric warfare incorporating terrorism with no doctrine or history to study, presents new decision making challenges for the highest levels of command and control through to personnel on the ground either engaged in war-fighting, peace-keeping or peace-support activities. However, decision making is hard to train since there is no evidence to indicate that it is possible to provide generic decision making training (Orasanu, 1993; Means, Salas, Crandall and Jacobs, 1993). Recent geo-political situation evolution introduces the necessity to consider even new mission environments respect the focus of last years in Middle East and South Asia; these new contexts request to cope with different frameworks: as example is pretty different to discuss with a Shura in an Afghan Town respect to the different political and local authorities within an European region. This evolution requires to develop new training aids and to provide support to self-cognitive capability development of the Commanders.

It is widely acknowledged that decision making training needs to be taught in an environment in which the decision maker can learn through experience. For this reason an approach based on Serious Games and Modeling and Simulation is more effective and cheaper than traditional training. The origins of Serious Gaming in Defence sector are related to the development and distribution of America's Army (a recruitment and a training tool for the U.S. Army) developed by Colonel Wardynski. This is now one of the most popular shooter game in the world; the game offers real-live adventures of an American soldier and has as main goal to help the United States Army with its recruitment. Different tools were developed for supporting strategic decision making in complex contexts characterised by crisis and conflicts and involving civilians and other actors. Training of strategic decisions in collaborative networks through serious games (Kracke R.; Hauge J. B.; Duin H.; et al.2006) was investigated in order to consider how they can be used to mediate experience in management and strategic decision making. The game is based on a virtual multi stakeholder environment, where trainees can experiment with new ideas without risk and effects on the real life. Europe 2045 (Sisler V. and Brom C. 2008): this is a preliminary theoretical framework, which has been adopted in designing an on-line multi-player strategy game as educational tool for high school social science courses, aimed at familiarizing students with political, economic, and social issues in contemporary Europe. Apart from learning facts, players develop a range of key skills: discussion ability, negotiation, teamwork, and group decision-making. This theoretical framework is based on a critical analysis of crucial issues, which seem to determine the success or failure of development and implementation of an educational game in the formal school environment. Other examples are proposed:

- **DREAD-Ed** is a multiplayer, online serious game that proposes a technology-based teaching methodology to train people on decision making, effective communication, resource and time management. The DRAED-ED serious game provide a training program to a broad range of different target populations: members of the emergency forces, decision-makers in local and central government and in industry, school teachers, school principals. Within DREAD-ED’s virtual environment, learners from different backgrounds cooperate to simulate group interactions and individual decision-making during an unexpected situation.

- **PANDORA** follows the aim to bridge the gap between table-top exercises and real world simulation exercises, providing a near-real training environment emulating a
complete crisis room: realistic 3D visuals and audio create a truly immersive, chaotic and stressful environment

- MACSIM a serious game for crisis management composed by different modules. In this case agents are used in order to support the background decision making processes.

- ESEM, developed as evolution of Civ IV Game, where participants will have the option to form trade, form alliances or go to war, and will gradually see that their local decisions affect the global environment, in terms of climate change and resources.

- SIBILLA Game (Simulation of an Intelligence Board for Interactive Learning and Lofty Achievements) developed by the Simulation Team; it is MultiPlayer Game for Intelligence Training and provides the opportunity to play interactively a competitive game, in a distributed environment where different “Agencies” operates concurrently with benefits and penalties connected to both common and individual objective achievements. SIBILLA game emphasizes the importance of communication, information sharing and cooperation even if the whole framework involves strong competitiveness among the players (Bruzzone A.G., Massei M., Tremori A., 2009).
DYTACCO is a serious game focused on Dynamic Targeting Collateral Damages and Consequences under development by Simulation Team.

Plague Inc is a game reproducing Pandemic on Mobile support developed by Ndemic Creation that proposes different containment policies as well as different plague types.

Moving to Decision Making in other contexts, like Healthcare, Environment, Industry and Business, Adoption of innovative technologies there are projects like Health Care Serious Games (Wit-Zuurendonk L. D.; Oei S. G., 2011). Computer-based (serious) gaming represents a new field even in medical education, and has a big potential to become an important tool for healthcare professionals in order to learn a range of clinical skills. A research conducted in June 2011 highlighted that in term of video games, education, training, gaming and healthcare there are about thirty relevant papers. The studies showed
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that serious gaming is a stimulating learning method and that students are enthusiastic about its use. In fact in addition to surgical skills, serious gaming is potentially a good method for learning clinical decision-making and patient interaction in this sector. Innovative studies are in addition focusing on investigating the clinical effectiveness of serious gaming on skills used in patient care.

For the industrial and business world CUMANA has been developed (Massei M., Tremori A., Pessina A., Tarone F., (2011). It is a Web Multiplayer Game providing the opportunity to play interactively a cooperative & competitive game. In a distributed environment players, as “Corporation Managers”, operate concurrently receiving benefits and penalties connected to general as well as individual achievements related to their role in their Corporation. The main goal is to share information in order to support Decisions Making in a corporation framework affected by risks, receiving updates and market reports. The identification of future market event in time is the key for the individual success of each Player as well as for the overall corporation, while risks not properly addressed generate losses for the whole players. Another application designed for industrial world is devoted to teach Supply Chain to students (Tobail, A.; Crowe, J.; Arisha, A., 2011 ). Supply Chain Serious Games are very popular and allows to teach student about cooperative behaviors among the different players (i.e. Automotive Supply Chain Management Game, Logistics Educational Game, Beer Game); these games allow the participants to develop an effective concept of how develop supply chain partnership strategy to enhance their supply chain networks. Deploying the game over the web encourages student interaction and group work. Most importantly the game will enable students to fundamentally grasp the impact of strategic decisions on other parts and players of the supply chain network.

Close to the business world is the theme of innovation adoption. Innovation Adoption by Serious Games (Remondino et al. 2008) is a research considering the problem related to the decision making processes related to the adoption of innovations; the context have been investigated using both international patterns and behavioral theories. In this research agent-based models are created to study the spreading of innovation in enterprises; in this serious game, the user is entitled to change the parameters and see what happens, so to make the resulting trend as similar as possible to the observed (Bruzzone, Tremori, Massei 2011).

In fact intelligent agents are very critical in order to develop new games where different players and entities are managed by the computer as already anticipated; from this point of view it is interesting to consider the IA-CGF (Intelligent Agents Computer Generated Forces) developed by Simulation Team (Bruzzone et al. 2004-2011; Bocca et al. 2007). By using Agent Driven Simulation based on Human Behavioral Models, in the last 15 years, the Research Team of the University of Genoa led by Prof. Bruzzone has created models for addressing different kind of Crisis to be managed, for instance Decision Support and Training for Country Reconstruction, Civil Disorders, Disaster Relief, Humanitarian Support and CIMIC operations (Mosca et al. 1996; Bruzzone et al. 1996; Avalle et al.1999; Bruzzone et al. 2004; Bruzzone Mosca Bocca & Massei 2004; Bruzzone, Massei, Tremori et al.,2009, 2010, 2011).

The development of CAPRICORN project represented an interesting step forward in modeling population behavior as well as actions and reactions among interest groups such as political parties, ethnical groups, religious clusters, lobbies etc. (Bruzzone, Massei, Tremori et al., 2011).
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For Decision Making applied to environmental issues we have Sim Parc for Biodiversity Conservation (Sordoni, Briot, Alvarez, et al. 2010): this research is related to the design of a serious game, aimed at computer-based support for participatory management of protected areas (and more specifically national parks) in order to promote biodiversity conservation and social inclusion. Its objective is to help various stakeholders (e.g., environmentalist, tourism operator) to collectively understand conflict dynamics and explore negotiation strategies for the management of parks. In this work, after introducing the design of the serious game, named SimParc, is described the architecture of the decision making agent playing the role of the park manager. In the game, the park manager makes final decisions based on its own analysis and also on the votes of the stakeholders. It includes two modules: 1) individual decision - based on a model of argumentation, which also provides a basis to justify and explain the decision; 2) participatory decision - to take into account the preferences/votes from the stakeholders.

With specific attention to Crisis Management there are several ongoing studies, projects, tools and Information Technologies (ITs) in support of Education & Training (E&T) such as MACSIM for Crisis Management (Benjamins T.; Rothkrantz L. J. M., 2006): a research on the development of a serious game for crisis management composed by different modules. In this case agents are used in order to support the background decision making processes.

There are also other works such as Training for emergency management: tactical decision games (Crichton M. Flin R., 2001). Training of the non-technical skills that are crucial to effective management of emergency situations is an issue that is currently receiving increasing emphasis in the petrochemical sector. A case study is presented of the explosion and fires at the Texaco Refinery, Milford Haven, UK, which occurred in July 1994 (HSE, The explosion and fires at the Texaco Refinery, Milford Haven, 24 July 1994. HSE: London, 1997), with particular focus on the human factors aspects of the event. A key issue identified by the official report into this incident was the importance of emergency management training. This research outlines a novel, low-fidelity training intervention, the tactical decision game (TDG), which is designed to enhance the non-technical skills (decision making, situation awareness, communication and co-ordination, teamwork, and stress management) required for emergency management. It is proposed...
that enhanced learning of these non-technical skills, through experience and directed practice following repeated exposure to TDGs, will lead to more efficient emergency management, particularly when dealing with hazardous materials.

In another interesting work authors (Warren E. W., Jordan G. Stuart A., 2011) start form the concept that organizations responsible for crisis management are already using such technologies in constructing crisis management systems (CMSs) to coordinate response to a crisis, provide decision support during a crisis, and support activities prior to the crisis and after the crisis. If designed with gaming in mind, those same CMSs could be easily used in a simulation mode to play a crisis management game. Such a use of the system would also provide personnel with opportunities to rehearse for real crises using the same tools they would have available to them in a real crisis. In this research, authors provide some background for the use of simulation and gaming in crisis management training, describe an architecture for simulation and gaming, and present a case study to illustrate how virtual environments can be used for crisis management training.

In this thematic area, as tools and platforms, it is possible to cite the ICONS project, developed by the University of Maryland: it is a training organization that offers skills-based training programs incorporating multi-player, real-time simulation exercises as a way for individuals, teams, and organizations to enhance effectiveness. The training is conducted either face-to-face or through customized web-based communication system, that is ICONSnet which provide a designed online distributed role-play simulations. Another example is EUTOPIA-MT (European Training Organization Program for Innovative and Alternative Mediation Tool) that is a European research project belonging to Leonardo da Vinci Program. It is an on-line platform that allows the production of serious game and, in particular, of educational Multiplayer On-Line Role Playing Games. EUTOPIA is designed to support distance learning. The platform provides functionalities, usually, featured by Multiplayer Online Role-Playing Games, as well as additional functions that allow a trainer to set up games, interact during the game flow, record specific phases of a game session, note down recordings, give feedback to the trainees, and share understanding with them. EUTOPIA seems to work well in such controversial situations, where it could be useful to have a filter instead of direct contact; trying to achieve a negotiate working through an on-line tool could help people involved to cool their emotional dimension, while working around a table could sometimes exacerbate the discussion. In other worlds, the distance (that initially seemed to be a barrier in relational dynamics) may function as a positive factor in a learning mediation skills process.

For Crisis Management a lot of Commercial Games exist as well, such as Darfur is Dying (Internet) An online game by mtvU that simulates life in a Darfur refugee camp (see figure 5 Sample of Games for Decision Making and Crisis Management).

Food Force is an humanitarian video game. The UN's World Food Programme designed this virtual world of food airdrops over crisis zones and trucks struggling up difficult roads under rebel threat with emergency food supplies.

If we observe how these games are designed an important consideration emerged: logistics is a critical issue in every crisis and operation. We have to consider that we need
to create an efficient Supply Chain to support overseas operations. Transportation is a critical infrastructure for Homeland Security in case of evacuation and delivering humanitarian support. There is also to consider the theme of security and vulnerability of commercial flows (i.e. in Harbors and Maritime). Related to these themes there are several researches for using simulation technologies and in particular applications of Intelligent Agents and Human Modelling to recreate complex and realistic scenarios (Bruzzone A.G., Massei M. Tremori A., Longo F., Madeo F., Tarone F, 2011).

Another interesting game related to a very critical, long lasting, international crisis is Global Conflict: Palestine is a 3D-adventure/rpg-game. You are given the role of a reporter in Jerusalem, and have to write articles for your paper.

Warren, Jordan and Stuart, in their research on 2011, cited the following games in Crisis Management area:

- **Advanced Disaster Management Simulator (ADMS) by ETC. Simulation**—A virtual reality system used to immerse an incident commander into a simulated crisis management situation. A combination of an immersive 3D environment and CM simulation that places the incident commander (and various role players) within the scene.

- **Incident CommanderTM by Breakaway Ltd**—A 2D, map based, top down CM game that puts the player in the role of an incident commander handling a wide variety of CM scenarios. The player has to co-ordinate the numerous agencies to respond to the emerging crisis.

Considering the figure of the commander, recently Swedish Rescue Services Agency Skövde has proposed **On Scene Commander** involving the player in an incident site where quick and correct decisions are fundamental in order to limit the damages on surroundings and victims. The challenge is to solve the given scenario with limited resources in a real-time virtual game framework. The game records all player input and the goal is to "solve" the incident, using methods and tactics used in real life incidents. Virtual Attain, developed RealTime Immersive Inc., is the winner of the “Best Business Game” Award, one of the six award categories of the Serious Games Showcase & Challenge, at I/ITSEC 2012. It is designed to be used by soldiers who have previously received training, such as patrol operations, casualty evacuation, call for fire, egress, and special operation tactics. The game puts the commander or patrol leader in a virtual driver seat with a real life scenario where things can go wrong before they step foot on the battlefield. It is designed to help soldiers start planning for what could happen given the history of an area of operation.
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Figure 7. Samples of Serious Games for Commanders and Patrol Leaders

There are many gaming products currently in the inventory that soldiers, leaders and trainers can use: from VBS2, VBS2 Fires, Video Creation Tool, Moral Combat, BiLat, UrbanSim, BioFor, Operational Language Trainer, and Training Support Packages, which have different goals from being a 3-D first-person game-for-training platform that provides realistic semi-immersive environments, to advanced artillery and mortar call-for-fire modules for VBS2 that simulate artillery, naval gunfire support, mortars and multiple launch rocket systems to a high level of detail. In "Full Spectrum Warrior" by ICT (Institute of Creative Technologies) the player plays the role of an infantry squadron commander operating in "Tazikstan", a fictional nation between Afghanistan, Pakistan and China. The leader of Mujahideen fighters, Mohammad Jabbour Al-Afad, converted his country into "a haven for terrorists and extremists" especially for "Taliban and Iraqi loyalists ". FSW is designed as a training tool for combat. The ICT is involved in many military projects: from Advanced Leadership Training Simulation to train military forces to crisis management and to improve leadership qualities to "Think Like a Commander", in cooperation with US Army devoted to develop leadership qualities to "Tom Clancy's Rainbow Six: Rogue Spear", for military training in leading operations of small units in urban context.

New projects are on going, for instance the U.S. Army Research Laboratory’s Simulation and Training Technology Center (STTC) is developing a variety of virtual environments for serious gaming. The Enhanced Dynamic GeoSocial Environment (EDGE) was developed by STTC in partnership with the Training and Doctrine Command (TRADOC) as a virtual representation of the operational environment. EDGE allows soldiers to become familiar with the political, military, economic, social, information, infrastructure, physical environment and time aspects of various regions. The environment will allow users to accomplish common “attack the network” training objectives and align with the Army Learning Model 2015 and 21st Century Soldier Competencies, to include critical thinking and problem solving.

Actually Modeling and Simulation provides new techniques to increase realism into a game, in particular intelligent agents are very critical in order to develop new games where different players and entities are managed by the computer. From this point of view it is interesting to consider the IA-CGF (Intelligent Agents Computer Generated Forces) developed by Simulation Team (Bruzzone et al. 2004-2011; Bocca et al. 2007). By using Agent Driven Simulation based on Human Behavioral Models, in the last 15 years, the Research Team of the University of Genoa led by Prof. Bruzzone has created models for
addressing different kind of Complex scenarios to be managed, for instance Decision Support and Training for Country Reconstruction, Civil Disorders, Disaster Relief, Humanitarian Support and CIMIC operations (Mosca et al. 1996; Bruzzone et al. 1996; Avalle et al. 1999; Bruzzone et al. 2004; Bruzzone Mosca Bocca & Massei 2004; Bruzzone, Massei, Tremori et al., 2009, 2010, 2011).

There are also several samples of researches to develop other kind of soft skills like developing glance capabilities for soldiers and officers or negotiation and communication skills. In this area we can cite researches like Games on Urban Road Pricing as support to investigate behavior in a not experienced future (Raux C.; Andan O.; Godinot C., 1994): this research deals with gaming-simulation applied to drivers to investigate their capability to adapt their behavior to evolving scenarios and policies.

Negotiation Skills by using on-line business games (Greco M.; Murgia G., 2007), where investigated by considering to adopt web multiplayer business games. In fact multiplayer technology allows a deeper learning, favors a greater commitment of the students and allows a continuous comparison between users boosting competition, fun and commitment through a more realistic approach.

Additional researches were conducted in the influence of interface for teaching negotiation and communication skills (Lane H. C.; Hays M.J.; Auerbach D.; et al., 2010); these researches allowed to investigate the role of presence in a serious game for intercultural communication and negotiation skills by comparing two interfaces: a 3D version with animated virtual humans and sound against a 2D version using text-only interactions with static images and no sound. In the study, the 3D interface led to a significantly greater self-reported sense of presence, but produced significant, but equivalent learning on immediate post-tests for declarative and conceptual knowledge related to intercultural communication. Log data reveals that 3D learners needed fewer interactions with the system than those in the 2D environment, suggesting they benefited equally with less practice and may have treated the experience as more authentic.

Soft skills education was investigated by studying a possible approach to designing a serious game using a tabletop prototype (Linehan C.; Lawson S.; Doughty M.; 2009); the initial findings of the study suggest that the game successfully created an environment in which it was advantageous to engage in appropriate collaborative decision making behaviors, as well as providing built-in opportunities for a tutor to guide under-performing groups.

Recently the Project Team has worked on some innovative applications of Serious Games to develop specific skills like contextual learning (Tremori A., Baisini C., Bruzzone A.G., et al., 2012). This research line suggests an alternative approach to develop the necessary competences to handle decision making in complex environments, stemming from the challenges that the military has faced in the past ten years of conflicts. However, the authors believe, the ideas suggested here can be employed and benefit any other field requiring agile and adaptive thinking (Baisini et al. 2009, 2010). The conflicts in which our Armed Forces are engaged are largely characterized by Interactive Complexity: the system is nonlinear, its proportions unstable and cause-effect patterns ambiguous. Large civilian presence and involvement, difficulties in identifying possible threats, high tempo, and dense terrain are typical features of the so called “three block war”, introduced by Gen Krulak (Krulak Gen, C., 1999), which requires the capability of making a broad range of decisions in little or no time at the micro tactical level. In order to obtain optimal situational awareness, it is necessary to provide the necessary skill set (not tools, not rules) that allows to ‘read’ the operational environment and understand its regulating rules, rather
than applying frames of reference that are derived from the Domestic environment. The capability of learning from the Context, stretching the dominant mental models and transcend the obvious is crucial. Research suggests that visual orientation can be an important feature for a group leader especially in urban scenarios; what one sees and how he interprets this can be decisive (Kolb, D. A. and Fry, R., 1975; Klein, G. 1998-2007; ). Furthermore, he must do it fast, which is why the visual dimension and Intuition emerged as so critical: he must get that “Coup d’Oeil” that was considered crucial by Napoleon, and by many after him. This work suggests a training framework to develop effective and innovative solutions by Modeling & Simulation (M&S) and specifically by Serious Games, to establish a solid ground for re-framing and creative decision making. The proposed approach moves away from traditional Simulation and Gaming products, where the tendency is to represent reality. We suggest a training that focuses on developing cognitive skills to recognize what is salient in an Operational Context characterized by a high level of Interactive Complexity.

Serious Games and Agent Driven Simulation based on Intelligent Agents and Human Behavioral Models Libraries are the proposed M&S methodologies (Bruzzone 2010). Serious Games provides an opportunity to improve performances with reduced efforts and great attention to story and emotional involvement; Agent Driven Simulation based on Intelligent Agents and Human Behavioral models allows to create complex scenarios, considering even the behavior of individual agents, and, at the same time, can be developed rapidly and cost efficiently (Bruzzone, Tremori, Massei 2011). In this work it is suggested an “educational path” from portable serious game solution to more complex and immersive synthetic environments which can educate the user’s intuitive thought in recognizing key patterns that are contextually salient. At the same time we want to encourage user involvement so as to support some of the key factors in tactical decision making process: speed and stress. The idea here is to develop an “educational path” to create a set of tools that move from general cultural models to very specific contextual elements using scenarios with validated notions of context “to drive” the acquisition of expert knowledge by different scalable architectures, representations, and methodologies for decision makers’ education. The use of Behavioral Models supports this cultural and technological “scalable” approach by providing common, well validated, basic models to re-create agents’ actions that could be applied to different scenarios (Bruzzone Massei 2010). This research will also sketch out some different solutions for ergonomic issues: from the simple hand-held device to immersive environment with all senses involved: sight, sound and smell.
5 Games and Tools Suggestions for ARRC

The Project Team proposes examples of possible simulation solutions and serious games that could be implemented to support NATO ARRC Exercise and Education Program specific for Commanders or high rank officers. The proposed ideas are related to the needs and the requirements collected during ARRC visits. Special attention is given to Players Engagement and to the Serious Game Attractiveness based on classical strongholds of serious games such as:

- Competitive Engagement: i.e. involving different players in concurrent or competitive use of the serious games for exchanging and comparing successes and problems experienced in their use
- Emotional Engagement: i.e. effects of the player actions and decisions on the career/benefits/awards for the Officer / Diplomatic virtual avatar in partnership with him
- Storytelling: i.e. continuous evolution of different played scenarios based on action performed and related impressive impact images and videos

Furthermore it is suggested to consider that, with a proper involvement of the Commanders in the tailoring of these serious games for ARRC will increase its attractiveness as well as the engagement of the trainees.

Goals of proposed tools are summarized as follow:

- Provide tools for a better understanding of the environment and the context
- Enhance Learning experience providing the Commander with the opportunity for
  - evaluating the second order consequences of his decisions
  - conduct cultural analysis
  - conduct self-testing
- Support the development of experience in new operative contexts and cultural backgrounds
- Make the Exercise more attractive and realistic respect existing scripts
- Provide Mentoring of “un-mentored” moments accordingly to exercise goals
- Augment realism of the events and support “artificiality” issues

5.1 Dynamic Targeting

5.1.1 Scope

Dynamic Targeting is a very critical subject for military strategists, planners, and analysts. The game could improve decision making capability under pressure and information management skills.

The main aim to train the Commander in evaluating the consequences of its decisions and the cultural background; so this training allows to evaluate the scenario understanding; for instance if the expectations of the Commanders were correct or if some aspects were missed during the evaluation or in the staff briefing.

5.1.2 Approach

In this serious game the Commander have to make decisions about the engagement of different sensitive targets during the execution of a planned course of action, based the briefing received from his staff integrating different aspects; the Commander is required to evaluate the reports provided by his staff describing identified targets in term of relevance, risks (i.e. collateral damages), available assets, caveats, etc.
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The Serious Game should allow to proceed in the decision making process and to let evolve the scenario to measure the direct and indirect effects of the actions as well as their impact on the social/political framework; this dynamically evolution of the scenario should be based on information coming from different sources driven by Intelligent Agents Computer Generated Forces (IA-CGF).
The serious game could be implemented as web application in order to be available always everywhere.

5.1.3 Expected benefits
This game goal is to Improve Commander understanding of Dynamic Targeting consequences respect different context; by this approach it is possible to evaluate impact of the alternative decision on the scenario evolution respect complex operative contexts and cultural framework.

5.1.4 Metrics to indicate success or failure
It is possible to relate scores with metrics of success for players in properly managing dynamic targeting; the commander could compare the scenario evolution with his expectations (i.e. second order effects, direct collateral damages, measure of force effectiveness).

5.2 Commander Under Pressure

5.2.1 Scope
To reproduce a complex scenario characterized by conflict and crisis and to teach how manage unexpected problems even ethic and social. Image for instance an Incident Inquiry with civilian casualties.

5.2.2 Approach
Provide a scenario and information about the environment and context. Inject a problem and evaluate the player response. The strategic decisions of the Commander could involve ethical aspects as well as critical outcomes; for instance it is possible to consider scenario involving CBRN (Chemical Biological Radiological Nuclear) attacks to highly populated areas where Commander need to make critical decisions and to interact with local and political authorities.

5.2.3 Expected benefits
A major benefit is expected to be the improvement of decision making and analysis capabilities under pressure as well as the effectiveness in identifying of possible Course of Actions in complex frameworks for both kinetic and not kinetic scenarios.

5.2.4 Metrics to indicate success or failure
Evaluate the actions planned to face the unexpected problem and the performance achieved. It could be possible to measure the effectiveness of Commander’s decisions as well as his attitude to attribute properly precedence to the different critical issues.
5.3 Play as Staff

5.3.1 Scope
Make the General plays staff officers roles in different field from logistic to intelligence in order to remind operational and technical skills and face problems at lower levels. For instance it could be useful to provide a scenario (i.e. logistic site allocation) and require the player making decisions (where allocate the logistic sites).

5.3.2 Approach
Provide a virtual environment and introduce different case studies to be played for instance a case related to strategic logistics: decide of moving or not assets and resources from a point to another point respect high level consideration, while the simulator consider even the impact of detailed issues on the overall performances.

5.3.3 Expected benefits
This serious game could improve decision making capability and remind to the Commander operational issues and problems related to lower rank roles

5.3.4 Metrics to indicate success or failure
The metrics are related to the performance of the players.

5.4 Brief to the Commander

5.4.1 Scope
This game is useful for Commander Staff and it is devoted to improve communication skills for Staff in order to effectively brief to commander.

5.4.2 Approach
The game proposes a situation and the player is required to prepare a presentation based on specific best practices and suggestions. In addition it could be useful to simulate a meeting with the commander in order to test synthesis capability.

5.4.3 Expected benefits
• Improve Communication Skills
• Improve Synthesis Capability

5.4.4 Metrics to indicate success or failure
The success is related to the performance of the player in term of identification of key elements in the presentation, structure of the presentation, use of key words.

5.5 Intellectual Coeup d’Oeil

5.5.1 Scope
Educate to catch the point over big amount of information and to develop intuition and agile thinking. The game provides a scenario including several actors and information and objects. The player should be able to identify elements that are critical from elements that create “noise” and don’t belong to that context. By this approach the Commander
capability to develop agile thinking is expected to be measured and improved progressively

5.5.2 Approach
The serious game provides a specific socio-cultural context and introduces some elements of noise. The player is required to identify these elements and to have a complete and consistent understanding of the environment being able to highlight critical issues and key elements. During the training session the scenario evolves and the Commander evaluations are compared in respect to simulated results.

5.5.3 Expected benefits
- To improve soft skills and intuition
- To improve context understanding and comprehension

5.5.4 Metrics to indicate success or failure
Metrics will be defined based on the player capability of understanding the context by identifying elements of noise and critical issues in the proposed environment.

5.6 Time Machine

5.6.1 Scope
Forward and rewind to observe long term effects considering that 6 actions (PMESII), 1 final effect. The serious game measures the combined effect of decisions related to military, political, economic, information and infrastructure aspects. So the player plays different case study and plans a set of political, social, economic actions in order to achieve a result by applying the comprehensive approach concept.

5.6.2 Approach
The serious game will provide a scenario and a list of decision affecting different elements, so the player will be able to plan the Courses of Action and to measure the final effects of his decisions in term of results achievement on medium and long term, so even considering consequence evolution.
Indeed the simulation is expected to reproduce complex operations considering the different aspects such as PMESII (Political, Military, Economic, Social, Infrastructure and Information) related to a specific area; the Commander decisions affects the simulation and provide feedback in term of Key Performance Indexes.

5.6.3 Expected benefits
- Improve Decision Making Capability
- Improve Scenario Understanding
- Improve Analysis Capability

5.6.4 Metrics to indicate success or failure
Metrics are measured based on the effects of actions planned by the player and on the achievements of fixed objectives.
6 Course of Action Recommendations for ACT regarding ARRC

We propose three courses of actions for ARRC:
1. Lean Solution for ARRC Strategic Decision Making Training
2. Development of set of new Serious Games tailored for ARRC
3. No Short Term Actions for Serious Games in ARRC

6.1 Course of Action - COA#1: Lean Solution for ARRC Strategic Decision Making Training

6.1.1 Scope
The scope is to introduce a lean Serious Game Solution for Strategic Decision Making as support for ARRC Commander and training aid for his staff. The Serious game will be used initially on High Level Decision Makers therefore it will be possible to extend it to other different training modes for different purposes; these will cover the goal to support the Commander, the opportunity to have a concurrent / competitive understanding among Decision makers on a complex dynamic target scenario and to train also their staff to properly prepare briefings and support understanding of the evolving situation.

6.1.2 Approach
It is expected the adopt lean simulation approach that use small teams and well defined procedures for collecting data, tailoring and VV&A (Validation, Verification and Accreditation) of the proposed solutions. The idea is to tailor a solution already in advanced new technological support with a lean approach to have the possibility to guarantee a quick and efficient introduction in ARRC of Serious Games as proposed in following picture

![Figure 8. Example of Serious Game with Questions to the Commander on Dynamic Targeting](image-url)
The tool should focus on Dynamic Targeting considering both collateral damages and indirect effects and consequences of the decisions; there are interesting researches where IA was used to reproduce complex scenarios considering interest groups and population reactions (i.e. CAPRICORN) that could provide useful models; indeed the solution will require a simulator able to include intelligent agents reproducing the interaction among the different players and their reactions; there are examples in this area that could be adapted for ARRC for being usable by Commander and High Decision Makers. The first use will be a cooperative concurrent use by the Commander and other Generals in analyzing consequence related Dynamic Targeting Decisions within a complex scenario; as follow step it is proposed to introduce other use modes: for instance the possibility to have as training audience the decision maker staff to use; in this case they will use the same Serious Game interacting with a Virtual Commander driven by an IA for testing their capability to provide correct and complete info and briefing reports and to identify the scenario critical issues.

We propose the following steps:
1. Definition of details for Dynamic Targeting use into ARRC training program
2. Identify the simulators and models to be tailored and introduced in ARRC
3. Collect Data and proceed with serious game customization for ARRC
4. Conduct preliminary test and measure on the use of the Dynamic targeting Game in basic mode
5. Develop a Training Program for using the Serious Game in ARRC
6. Extend the use of the Serious Game to other modes (i.e. staff use)

Considering the kind of users (i.e. Commander, other Generals, etc.) the VV&A (Validation, Verification and Accreditation) should be carried out since the beginning in order to guarantee trustiness, usability and effectiveness of this training aid.

6.1.3 Expected benefits
With this COA we could mitigate risks having the opportunity to reuse existing simulator and models and to apply lean simulation concepts. The results could be achieved quickly even if in a limited context and then extended to other cases. A major advantage of this approach will be the possibility to obtain quickly estimation of the capability to use Serious Games in training of Commanders by an experimental pilot case able to measure General engagement during the use; the result of this COA could become the input for future additional project and programs related to training aids for Commanders based on Serious Games and innovative technologies. This approach guarantees to properly tune and tailor available models for the dynamic targeting and to obtain an evaluation of the benefits and performances progressively with different use modes. In addition, the efforts in terms of costs and resources are limited over a short period of time.

6.1.4 Expected disadvantages
The major disadvantage of this approach is that related to the risk to engage Commander and high level decision makers in being engaged in the dynamic targeting mode; it will be critical to focus on their expectations, therefore based on the input received there is
interest among all Generals of ARRC with large majority quite positive in term of expectations.

6.1.5 Timelines
In the following figure the COA Gantt is proposed; the overall solution could complete preliminary test within 4 months from the kickoff.

![Gantt Chart](image)

**Figure 9. Gantt for COA#1**

6.1.6 Resources
It is difficult to define resources to be invested: in fact it will be possible to define it when the game or tool to be implemented is defined; therefore the efforts could be limited by the benefits of reusing previous existing models and simulators.

6.1.7 Metrics to indicate success or failure
Metrics will be defined based on engagement capabilities and benefits estimation by High level Decision Makers. Most of the expected results are related to the evaluation of the benefits for the scenario understanding and consequence evaluation.
There are several potential benefits for Commander and Generals in term of:
- Scenario Understanding
- Cultural Background Involvement on Future Developments
- Proper estimation of Collateral Damages
- Proper Estimation of Risks
- Consequences of the Actions due to indirect effect of decisions

An additional benefit is the improvement of decision maker self-confidence and time management skills during traditional exercise and real operations thanks to the experience with this serious game.

Other benefits could be measured for Staff when the Serious Game is used in this mode
- Improving Identification of Critical Issues in Briefing Report Preparation
- Improving Distillation Capability in Synthetizing the Dynamic Targeting Scenario

Additional benefits include among others:
- Possibility to have sponsors in high level decision makers able to further promote the diffusion of these technologies in NATO
- Creation of a Valuable Performance Dbase on operative strategic decision making
- Interactivity: training on interaction and cooperation through web based serious games could be an additional value in order to improve people skills.

In order to verify the model effectiveness the following metrics could be considered:
- Qualitative and Quantitative evaluations by users and by Project Tem
- Capability to predict Scenario Evolution
- Capability to properly rank the different risk factos

6.1.8 Requirements
To follow this COA and the proposed time line it will be necessary to activate the above described decision process:

Figure 10. Program Scheme and Decision Chart
6.2 Course of Action - COA#2: Development of set of new Serious Games designed for ARRC

6.2.1 Scope
To develop a set of new Serious Games specifically designed for supporting ARRC with special attention to training to high level Commanders. Indeed the final desired result of COA#2 is to introduce new technological supports (serious games) extensively both for supporting ARRC Training Program and Exercise.

6.2.2 Approach
This approach is based on identifying a set of serious games and simulation models to be specifically designed for Commander and Generals operating in ARRC and to proceed with the implementation, acquisition and installation in the ARRC. The proposed serious games included in this report could be used as examples for such development. Concurrently with the definition of the Serious Games to be introduced, it will developed the educational program for introduction of these systems in the training process of ARRC.

6.2.3 Expected benefits
By introducing different serious games specifically designed for ARRC we expect to have a strong impact on the Senior Course and we could collect feedbacks on the short term in term of impact on the educational program and continuous blended education of Commanders.

6.2.4 Expected disadvantages
This COA#2 is characterized by a higher risk of failure with respect to the other CoAs: indeed it would be necessary to start a complex implementation project focusing on design, development and introduction of different systems at the same time. Also the evaluation would be more complicated than introducing a single solution as opportunity to start to measure Commander engagement procedures. Similarly, from an economical point of view, we expect high cost on short term, while eventually the total cost could be convenient pushing providers and vendors on a large contract.

6.2.5 Timelines
We consider the time line described in the following, even if it is more reasonable to require more time for finalizing the acquisition of the serious games.
6.2.6 Metrics to indicate success or failure
Similar considerations made for COA#1 with a higher level of complexity, but at the same time more final results due to the expected higher impact of this COA respect the High Level Decision Makers.

6.2.7 Requirements
COA#2 is characterized by higher expectation in term of resources respect COA#1 considering the fact that it is expected to develop different Serious Games concurrently.

Resources
Similar considerations made for COA#1, with higher resources requested from the very beginning and much more concurrent work depending on the size of the Serious Game set.
6.3 Course of Action - COA#3: No Short Term Actions for Serious Games in ARRC

This solution is trivial, nevertheless it represents one decision among the different possible Courses of Actions.

6.3.1 Scope
The scope is clearly “not keep status quo and to don’t proceed with Serious Games introduction in ARRC, at least on short term”.

6.3.2 Approach
No any actions are required.

6.3.3 Expected benefits
There are no benefits from this CoA as well as no direct risks.

6.3.4 Expected disadvantages
Expected disadvantages are clear: this CoA is conservative and it is not driving to any evolution in using Serious Games for Strategic Decision Making and don’t provide advantages for ARCC. There will not be any improvement of the capabilities and no innovative supports will be delivered to the training program.

6.3.5 Timelines
- NA -

6.3.6 Resources
No additional resources are requested

6.3.7 Metrics to indicate success or failure
- NA -

6.3.8 Requirements
- NA -
6.4 Marketing for proposed COAs
There are different kind of marketing activities to promote the proposed COAs #1 and #2 as well as to encourage ARRC to use the introduced games and tools. We divide these marketing activities in different main areas:

- Dissemination and Promotion: with dissemination we consider the diffusion and promotion of this researches and its preliminary results in NATO, ARCC and in general in the M&S Community
- Exploitation of the Feedback provided by the Commanders involved in this experimentation
- Encouragement & Engagement: we mean to encourage and engage High level Decision Makers into actively use games and tools

It is clear that the two concepts are strictly correlated: Decision Makers will be motivated by the results achieved by ARRC Users and by the opportunity to use innovative training methodologies.

6.4.1 Dissemination and Promotional Plan
For the dissemination of results and promotion of an “evolved” ARRC Education Program based on innovative technologies such as Serious Games applied to Decision Strategic Decision Making in Crisis Management we see three informative channels:

- Scientific Community (M&S and Education Sciences);
- Defense Community;
- Media or newspapers out of the two previous communities.

The first two are clearly the easiest and more traditional to be engaged and it is necessary to work with both. Producing scientific papers with a description of the project and obtained results will provide necessary warranty on innovation and correctness of the adopted approach. Diffusion through the Military Community will grant consistency and solidity of the project.

The project team (Academia, Military and Industry) is a real joint group composed by well renowned people in the different communities and there is a high probability of success to disseminate information and results in these two areas.

We imagine informational actions on some of the main events such as I/ITSEC, ITEC SpringSIM and SummerSIM as well as good work on all the main scientific networks such as M&S: SCS (The Society for M&S International), MISS (McLeod Institute of Simulation Science), MSNET (M&S Net), etc.

In addition, it is a little bit more challenging to approach newspapers or magazines, out of the above mentioned communities, for publishing articles, devoted to target high level decision makers through prestigious international journals such as Newsweek, TIME, The Economist, Businessweek, etc.

Again, this action is challenging, but it is possible because we are working on an innovative idea that is mixing different worlds and concepts: NATO and Defense using Serious Games for training to Crisis Management… we feel it is a set of appealing concepts with even a potential out of the pure Defense.
6.4.2 Exploitation of the Feedback provided by the Commanders
The engagement of Commanders represents a challenge; therefore this represents also a strategic advantage. In fact the involvement in the Serious Game use of High Level Decision Makers such as the Commander and other Generals could be very useful in case of success to diffuse these technologies, methodologies and concepts in a wide community; this could represent a real big opportunity to develop new generations of training systems for Strategic Decision Making.

6.4.3 Encouragement & Engagement Strategies
By the above described promotional strategy we will work in a “pull” mode, but we have to consider also a “push” approach for ARRC Staff based on Commander actions.

For this it is possible to reuse experience carried out in the university about games used for improving student skills that guarantee very strong engagement: scoring and advancing in game levels are pillars to have engagement of players (Giribone, Bruzzone 1997; Massei et al. 2011).
It will be pretty easy to have well motivated players if their evaluation will be based also on games scores. Ranks could be used also for deciding the different roles in the Exercise. Competitiveness among staff (they are humans!) and new awarding strategies could provide a very solid “encouragement strategy”.
7 Conclusions and Recommendations

7.1 Conclusions

The study analyzes the potential benefits deriving from the introduction of serious games in decision makers training for ARCC.

The Project Team provides an overview of Serious Games use in Defense and in other sectors for training decision making process with special attention to the figure of commander. Many benefits are achievable by using new technologies and simulation for training programs and military exercise. For instance, serious games allow to quickly address complex problems and getting insight with strong user motivation by his engagement. Serious Games guarantee less costs for training and a great experience for trainees.

The Project Team has proposed some serious games ad hoc for Commanders and High Rank Officers training devoted to improve capabilities in communication, self-consciousness, understanding, consequence evaluation as well as in the decision making itself. The proposed solutions are devoted to activate Training Program for the Commander, Generals as well as for their staff.

Finally three possible main Courses of Actions have been proposed. Again for every COA Scope, Approach, PROs and CONs and a timeline with a Next Step Decision Chart have been described in this report. The Project Team strongly recommend to quickly finalize a decision related to the introduction of Serious Games Technologies in ARRC, defining how to combine them into Training Programs with special attention to Commander and High Level Decision Makers.
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