MSG-130: Exploiting Commercial Technologies and Games for Use in NATO (in the Maritime Domain)

Technical Evaluation Report

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1. PURPOSE

The purpose of this Summary of Proceedings was to document the NATO Modeling & Simulation Group (NMSG) MSG-130 Workshop on Commercial Technologies and Games for Use in NATO (in the Maritime Domain). Through discussion and debate, attendees provided knowledge and details about others' experiences. Technical presentations, demonstrations on selected commercial technology areas, and tours of local facilities educated attendees, and increased their understanding of the possibilities and challenges of commercial technologies and games so that they are better able to aid in the development of the strategy for the NATO and the Nations to exploit these technologies. The workshop convened from October 9-11, 2013 at The Navy Officer Club in La Spezia, Italy.

2. OBJECTIVE OF THE WORKSHOP

- Through demonstration, experimentation, discussion and debate, attendees will acquire knowledge and experience in the area of gaming in the maritime domain.
- Technical and application briefings and demonstrations on selected commercial technology areas will help the attendees better understand the issues so that they may better aid in the development of the strategy for the NATO and the Nations to exploit these technologies.
- Participants will develop a shared understanding of the issues and opportunities.
- Meeting proceedings will capture the presentations and provide recommendations for NATO and the Nations.

3. SCOPE

This workshop is a continuation on a successful MSG series. This particular workshop focused on the use of commercial technologies and games in a maritime domain. It is a starting point to identify innovative solutions and to define future S&T activities in this domain while gaining benefit from previous commercial technologies workshops. Topics included for discussion:

- How immersive technology could improve capability development in a marine comprehensive framework
- How immersive technologies are being effectively employed in support of training in a naval framework
- What areas of education and training along with exercises can immersive learning fill, and how can we integrate that into educational programs for training the next generation of naval crews
- What are the services and infrastructures expected and required by the maritime user community to get benefits from immersive technologies

- How can simulation and serious games help develop concepts, policies, and technological solutions to deal with evolving scenarios
- How immersive technologies could support the development and deployment of next generation solutions for homeland security
- The application of immersive technology in support of decision-making training in conventional and asymmetric maritime scenarios
- How can instructional designers develop and integrate immersive learning into the formal structural development process for building education and training courses for the naval community
- The application of immersive technology in support of the diffusion of innovation
- Anthologies and/or guidelines that will help policy makers and trainers understand the immersive technology and how their attributes map to specific training requirements
- Creative applications of immersive technology that show promise in support of military training or education
- Moving beyond training to use these technologies in direct support to operations (tactical visualization, course of action analysis, mission rehearsal)
- Measuring the level of realism achieved, assessing the degree of immersion, and determining how much realism is required to meet specific training requirements
- Understanding how immersive technologies can be considered as part of the training development process including training needs analysis
- Cost-effectiveness and return on investment for immersive technology in support of military training and education

This workshop facilitated the sharing of national experiences, explored commercial game technologies, increased understanding of best practices, and identified barriers and solutions for further exploitation. Meanwhile, this particular workshop began refocusing the vision and explored the next wave of questions to support a technology road map for the exploitation of commercial game technologies.

4. WORKSHOP AGENDA

Wednesday October 9, 2013

1330	Chairmen and Host	Welcome to La Spezia and Introductions
1345	Chairmen Update	Chairmen
1415	MOIRE: Virtual Environment for Collective Training on Marine Domain	Agostino Bruzzone, Alessandro Tesei
1445	Technology and Methodology for Building the Virtual Ship	Aldo Zini
1500	Break	
1530	Reducing Time to Market for Training in the Maritime Domain	Jose-Ramon
1600	Creating Products with the Customer in Mind	Martinez Nicola Toniazzi

1630	Develop Software Application in the Maritime Domain using COTS and Games	Lucio Barbucci, Luca Isgro (CBT)
1700	Daily Recap and Daily Adieu	Chairmen
2000	No Host Dinner / Navy Club	Chairmen

Thursday October 10, 2013

0830	Welcome	Recap from Day 1
0840	MyIG and MyOcean3D	Riccardo Rovelli
0910	Using Game Based Simulation for Close Range Weapons Training	James Short
0940	Havok and the Maritime Domain	Tom Gambill
1010	Break	
1030	Marine Training	Riccardo Caponi
1100	The Business Side of Simulaton and Entrepeneurship	Mattia Crespi
1130	Research and Development and Synthetic Policy	Roxane Heaton
1215	No-Host Lunch	
1330	VBS2 Maritime Improvements	Colin Hillier
1400	Use of the Havok Games Engine in Asymmetric Naval Warfare Training	Geoffery Tompson
1430	Hybrid Validation Test-bench (HVT) for Autonomous Systems	Alessandro Cignoni
1500	Artificial Intelligence Software for Expert Knowledge Capture	Claudio Taraschi
1530	Tour: Centre for Maritime Research & Experimentation	For people registered
1800	Tour: MBDA	For people registered
1945	Daily Recap and Daily Adieu	

Friday October 11, 2013

0900	Welcome	Recap from Day 2
0910	Virtual Pilot: Agent-Based Simulation For Effective Training	Karel Van Den Bosch
0940	Haruspex: A Tool Running a Fully Automatic Assessment of ICT Risk	Fabrizio Baiardi
0950	Cyber's Achilles Heel: The Human Operator	Stu Armstrong
1000	MIMOS Celebrates its First Decade	Paolo Proietti
1010	Break	
1030	A Lecture on our Naval Warfare Game	Anders Frank
1100	Platform Defend Game	Fabio Camponeshchi
1130	Interdependencies within the Maritime Transportation Sector	John Milam
1230	Naval weapons training using "Virtual Reality": an Hardware-in-the-loop approach	Davide Corsanini, Fabrizio Sciarra
1200	Wrap Up	Chairmen
1245	Adieu	

5. PARTICIPANTS

Name	*Affiliation*
Matteo AGRESTA	Simulation Team
Alessandro ANCIONE	IBM
Anders FRANK	Wargaming at Swedish National Defence
Spano' ANTONELLA	MBDA
Enrico ANTONINO	NATO CMRE
Stuart Alexander ARMSTRONG	QinetiQ
Lucio BARBUCCI	IBR SISTEMI
Christian BARTOLUCCI	Simulation Team
Lorenzo BAZZARELLO	Italian Navy
Rudy BOONEKAMP	TNO
Agostino BRUZZONE	DIME UNIGE
Wayne BUCK	ACT
Riccardo CAPONI	ECA Sindel
Petit Morris CAROLINE	MOD-UK
Alessandro CASAPIETRA	Simulation Team
Doma CHARLES ZOLTAN	Royal Canadian Navy
Roberto CIANCI	DIMS Genoa
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Davide CORSANINI	Oto Melara
Massimiliano CORSO	Simulation Team
Matteo CRESPI	Qvit
Claudio CUOMO	Italian Navy
Margherita DALL'ORTO	Simulation Team
Paolo D'ANDRIA	Presagis
Cecchi DANIELE	NATO CMRE
Luciano DATO	Simulation Team
Gough EDWARD	NATO CMRE
Thomas Charles GAMBILL	Havok
Gerald GENDRON	Support to NATO ACT
Sciommeri GIAMPIERO	MBDA
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Luca ISGRÒ	IBR SISTEMI
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Carla MILANI	IBM
Roberto Antonio NARETTO	Presagis
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Richard RADMACHER	Havok
Been ROBERT	NATO CMRE
Fabio ROLANDO	DIME UNIGE
Kessel RON	NATO CMRE
Riccardo ROVELLI	Antycip
Fabrizio SCIARRA	B&K
James SHORT	QinetiQ
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Geoffrey THOMPSON	Kongsberg
Giada TIBERI	Selex Galileo
Nicola TONIAZZI	Selex Galileo
Alberto TREMORI	DIME UNIGE
Alessandro VAGLIO	SAIPEM/ENI
Karel VAN DEN BOSCH	TNO
Anne WEINLING	IFMA
Aldo ZINI	Cetena/Fincantieri

6. EXECUTIVE SUMMARY OF PRESENTATIONS

Wednesday October 9, 2013

6.1 Welcome to La Spezia and Introductions by Mr. Wayne Buck and Mr. Stu Armstrong

Mr. Buck and Mr. Armstrong gave an introduction and background of the Modelling and Simulation Group (MSG) series on the use of Commercial Technologies and Games for NATO. This workshop – the 14th in the series – will focus on the maritime domain. Everyone in attendance introduced himself or herself. Many participants were attending their first MSG in this series. A few people have attended previous MSG events in this series.

Twenty-four presentations and two tours are included in the workshop – making this a very full agenda. This MSG started out as a workshop series about nine years ago to look into how small business and government staffs could get their national acquisition authorities to go after small game makers because of the perceived risk in working with small entities. This slowly evolved into what we see today. This background provided a good platform and baseline for all of the new attendees.

Dr. Bruzzone welcomed everyone and noted thanks to the Italian Navy for the use of the facility and to some of his colleagues who are providing administration and logistic support. He provided a brief summary of the Centre for Maritime Research and Experimentation (CMRE) and invited

attendees to attend the tour on Thursday afternoon. He also described the details of the no-host dinner, the lunches available for purchase, and encouraged registration for the tours at CMRE and MBDA Missiles.

6.2 Wayne Buck and Stu Armstrong - Chairmen Update

Mr. Buck provided a short primer on NATO, its members, challenges NATO has with relation to simulation, and solutions relating to the content of this workshop. The period through the Cold War and into events of September 11, 2001, provide a rich history on what NATO has accomplished and been through during its existence – growing from 12 countries to 28 with many over global partnerships reaching as far as Asian nations. ISAF has been a very prolonged event but NATO will withdraw in 2014. This will have a significant impact on the forces of NATO (provided by nations) as well as the structure of training. There have been no major exercises outside of Afghanistan due to the operational tempo. While this has provided the impetus for interoperability, it has made it extremely difficult to have any major exercises. Training is very expensive (transportation, sea movement, etc.) but we know we need to do training after 2014 to maintain the gains in interoperability.

After 2014, we will need to move from operational deployment to operational preparedness. This will come from the Connected Forces Initiative (CFI) to ensure interoperability remains high. CFI has three key areas:

1. Expanded education and training (individual and small group)
2. Increased number of exercises
3. Increased use of technology to support the former two

Much of this occurs in the MSG – and it will continue to focus on these areas. Now, all training responsibility rests with NATO / SACT HQ. In addition to maintaining interoperability, this will support the NATO Response Force. Exercises will help keep readiness high – especially those nations needing more opportunities for experience. Meanwhile on the technology side, the Military Committee gave the command five tasks to look at. This workshop fits tasks 1 and 3: improve education and training and improve exercises. NATO typically trains staff as opposed to troops on the ground and can last over a period of months. Mr. Buck believes games can help with that. Rather than pouring through pages and books of procedures – why not use games that introduce those procedures. Perhaps staff trainees spend an hour at a time over many days – at their desks – playing a game. This is just a different way of thinking.

We have many actors and players in NATO. modelling and simulation There are users, providers, advisors, Centres of Excellence, as well as the nations. There are also many simulations out there. In NATO, there are very few simulations – relying mostly on JCATS and JTLS as well some Bohemia products. We have some local, homegrown simulations primarily in logistics. This domain can get very complex – for good reason. Architectures and technologies change often, adding to complexity.

The group seeks solutions through forums such as this MSG. Mr. Buck described some of the events over the last few years. The group pays attention to standards and interoperability. The group must also watch not only technology but also training personnel. A problem is emerging – we may lose the two primary simulations in the near future. ITEC 2014's theme (occurring in Cologne from May 20 to 22, 2014) is about CFI – "From operational engagement to operational preparedness." NATO ACT will be at I/ITSEC 2013 as well.

Mr. Armstrong recalled that during the beginning of the MSG workshop series in 2004, there were difficulties caused by budgets. This series began to get government and industry inputs, including lessons learned. This helped support the development of VBS1. The group has kept this theme

going – using this forum to share knowledge, see how people are using the technologies, and to share lessons learned. Budget issues have not subsided and technologies are changing at an even greater rate of change. Therefore, this forum is as relevant as ever. The most useful part of these forums is the discussion among participants – both during the presentations and during the breaks. It is exciting to see over 20 papers submitted some 10 years after this series began.

6.3 Agostino Bruzzone and Alessandro Tesei - MOIRE: Virtual Environment for Collective Training on Marine Domain

Ms. Tesei presented the work done on MOIRE as a Virtual Environment for Collective Training within a Maritime Domain. The focus will be on anti-piracy although there are other uses. Another focus will be on intelligent agents. She began with an overview of the training process. Simulations types include live, virtual or constructive. Engagement, fun, and pleasure are important as characteristics of a good Serious Game. There must be a balance between "serious material" and fun. Some drivers towards serious games include fiscal constraints as well as the need to train very large groups. Safety is another aspect that is a consideration – simulations allow for safe environments.

Learning occurs at many levels, from knowledge to more complex skills like decision-making and strategy. Even more complicated is the development of "soft" skills. Serious games offer many advantages:

- ability to make better use of training time
- ability to link many users
- ability to reduce training time
- ability to increase usability
- ability to take training again to improve skills
- ability to measure progress

The systems used are primarily Commercial-off-the-Shelf (COTS). MOIRE is a training solution for navy training and operators of commercial ships. It supports many different types of tasks from ship boarding, use of rigid hull inflatable ships, firefighting, and underwater operations. Skills include two broad areas: learning procedures and developing collaborative skills. Dr. Bruzzone's group has conducted a great deal of research in developing serious games.

Ms. Tesei mentioned a forum called GALA, which is a web-based community that CMRE collaborates with to share experiences in the area of serious games. They discuss available technologies, describe experiences, assess state of the art, and then evaluate the learning impact of games. She invited all to join the community and take part in the discussion.

Dr. Bruzzone discussed the distinction between simulations and games. When we set up an exercise simulation, it takes months and months to prepare the simulation and the people. You concentrate on a two-week exercise followed by a very fast after action review (AAR). The latter is the portion intended to disseminate learning, but often the ending (AAR) is executed hastily. When we discuss games, we are talking about the complete opposite. People are doing this because they are fun and engaging – because they want to play. Improving the learning is the key point – not a quick ending like the AAR. We also see some advantages in using technologies that are a few hundred dollars to engage and really get some learning to take place – replacing things like on the job training or reading manuals.

Intelligent agents are things we have been using over the past several years. The purpose is to have a complex training event without having to seed the game with many "humans in the loop". The goal is to introduce complexity with an appropriate homogeneity for consistency. These agents will provide interesting

experiences. One challenge is in the validation of the use of intelligent agents. Dr. Bruzzone described some current work in serious games to train for terrorist threats and defending against them. The serious game is not just to train but also to collect knowledge. We will put subject matter experts into the game who will serve as a "sensor" to assess the performance of the event. They will be able to extract knowledge based on player's actions. Self-play mode makes it essential to implement intelligent agents.

When the game is developed, it is not very different from the simulation development process at large. Budget remains a concern, but games can be much less expensive. He noted the cost of a Kinect camera is about $80. However, when paired with a game engine that system can be more expensive than some government simulations available. A hybrid of various engines both commercial and GOTS are emerging. Nonetheless, it is important to pay attention to cost when assembling architectures. Another aspect that is interesting about this field is interoperability. One can combine existing sophisticated models. This will require validation. Other systems form with interoperability in mind ranging from anti-piracy to unmanned aerial vehicle.

Dr. Bruzzone then discussed the process of developing serious games. It is becoming refined but it does have areas of difficulty. A good development process can alleviate many difficulties. Take terrain and texture for instance. In the instance of VBS2, the process begins in 3DS Max and then worked through some intermediary tools to ultimately have a VBS2 item. Anti-piracy applications demonstrate some success because the measure of performance was visual identification – making the quality of the texture important. The implication is that there is a great deal of utility for training.

A number of considerations must be kept in mind when developing games. Scenario manipulation must be easy. Stress effects on the trainees have impacts just like in reality. The upside is that the experimentation at CMRE is yielding some data that shows the effectiveness of the games as compared to traditional training. As noted by a member of the audience, this has proven to be difficult and return on investment is very often a question asked of new technologies.

6.4 Aldo Zini - Technology and Methodology for Building the Virtual Ship

Mr. Zini presented his work of melding technology and methodologies of shipbuilding in a virtual space. This includes not only shipbuilding but also ship use. Ships are a System of Systems – very complex to design, build, and operate. Ships must struggle against environments not typically hospitable to the ship. This has resulted in a reliance on master ship builders to work with all the effects and design ships accordingly. Simulation (and testing/validation) are part of their tools. Nonetheless, some things accomplished manually are things M&S supports well.

Mr. Zini then discussed the role of M&S on an organizational level. For instance, two different divisions within the shipbuilding operation sometimes do not have clear insights on what other divisions are developing. Advanced use of visualization approaches can provide a near-real time insight as to production status. Visualization offers many benefits:

- ease of use without a great deal of training
- explore alternative possible outcomes and choices in design
- verify a requirement in extremely dangerous situations
- provide a more engaging way for builders to work with customers during reviews
- conduct as much review prior to cutting metal – reducing costs

As mentioned earlier, the use of simulation is critical in validating how the ship operates in a manner expected in many conditions that do not necessarily fit testing schedules. These validated models are also

useful in training and exercises – allowing collaboration with other NATO nations. Additionally, the simulation enables assessment of port capability.

Some obstacles exist. Cost is a consideration, but leaders may view them in terms of the overall cost of the ship building process. Unfortunately, the current culture is to keep the familiar and remove the new. Simulation is often the victim of cost cutting drills. Another obstacle is the concept of using games in such a serious operation. However, games have shown the utility of games in many phases (design, build, operation).

6.5 Roberto Antonio Naretto - Reducing Time to Market for Training in the Maritime Domain

Mr. Naretto presented an overview of the M&S Suite 13 product line available from his company, Presagis. The de facto standard for 3D modeling is Creator. It is also useful to output models in a number of formats for other products like VBS2 or Collada. Creator 13 has really increased the usability of the tool. Terra Vista is a terrain-modeling tool that supports many products like VBS2 and others. The current goal is to simplify terrain generation so non-experts can perform the function.

With Stage, he described it as a means to address differing needs from training to tactics. It provides the capability of a scenario editor and ability to work in an open environment with many architectures. With Vega Prime he noted improved effects (especially for maritime). It is really a toolkit. It is a closed – not an open – solution. It is completely customizable to fit customer need. It can also handle large areas in a database. The remaining products presented support the graphical interface. Developers can write them for use in real systems and platforms as well as on PC simulations.

The benefits of using the suite of software is saving time, reuse of data, and saving money. Use of the full suite does not lock users into a permanent relationship with Presagis because it works and integrates with many other widely used products. They now offer a new licensing policy that may be interesting to members of the audience.

Mr. Naretto did provide some particular use cases of how the M&S Suite creates maritime environments ranging from ship pilots to navigation training to mission training. The success of the past has been by providing a core technology and not the end products/end-user applications.

6.6 Nicola Toniazzi - Creating Products with the Customer in Mind

Mr. Toniazzi looked at the productivity aspects of developing training for maritime customers. The aim of the project is to enhance training in multi-force operations where a great deal of collaboration is required. One of the key benefits is that using the tool allows the reuse of the same scenario to multiple people to assess the true impacts of the training based on procedures. All data is recorded and available to the instructor. The instructors are interested in increasing training readiness.

Tracking Operations are a focus of the discussion. In the use case, they have employed two simulators for rotary wing assets. This enables trainees to operate the rotary wing craft in synthetic environments to practice tracking operations. The architecture based on VBS2 allows multiple players to see each other in the scenario. The other function is a communications mechanism to allow for interaction. They are validating the ideas by engaging with customers and performing technical assessments.

Mr. Toniazzi then went on to articulate the process his firm uses to engage with customers by presenting a series of questions relating to the form, fit, and function of the product with respect to the customer segments. Additionally, he highlighted the importance of understanding and communicating cost to the customer and organisations. Finally, he talked about how they are assessing the effectiveness of the product. This is not trivial and is a very important component of bringing the product to market.

6.7 Lucio Barbucci and Luca Isgro - (CBT) Develop Software Application in the Maritime Domain using COTS and Games

Mr. Barbucci opened the presentation with a video to serve as a case history of the company and their relationship with the market. The main area of interest includes engaging simulations that are cost effective. Their presentation of core capabilities served to establish a foundation for the context of the technical work presented by Mr. Isgro.

Mr. Isgro provided a technical presentation. Their history goes back to 1999 and includes one of the first uses of video gaming workflow in military training. Their core concept is that the simulation should emulate reality to the greatest extent possible. This requires a great deal of physics-based calculations regarding reflections, collisions, visibility, and all other elements. These all existed in video games. Their product, the Joint Tactical Theater Simulator (JTTS), is a multi-domain simulator from land to sea and air. The utility includes antipiracy, antiterrorism, ship boarding, collaboration.

JTTS is a complex suite of other simulations. The motion platform, for instance, reproduces stresses inside the training environment. This platform is fully controllable by the instructor. Mission planning and mission review are also functions for the JTTS. Developers use an object-oriented language to modify scenarios. Meanwhile, they are integrating JTTS with VBS2.

6.8 Daily Recap

Mr. Buck gave a brief overview of the purpose of the recap – noting they are looking for trends and general observations. Mr. Armstrong facilitated the recap noting a commonality in the day's briefings – specifically the technologies are coming together. From an industry perspective, what are novel approaches to these? Where are funds most effectively spent? What should we build that we cannot do live effectively or cheaply? A few key points:

1. We know we can do this – though we need more metrics and a good use case.
2. From an industry perspective, having seen training systems for the last 20 years the technology is available to everyone – not just the big companies. So where does business go over the next 20 years? We have lost the technology edge so what will become the value proposition? Is there a value added or will this business go small business/lowest price in the future?

A discussion ensued about the aspects of games, serious games, gamification, etc. The key point is that culture has a very strong impact on how games are accepted and used among the users. For instance, the word gamification was only used once today – a large difference from last year in Genoa. If you throw away all of the technology can we still use games to accomplish training? History has shown the answer is yes – used over the centuries and is the root of wargaming. Therefore, we have evolved to associate serious gaming with technology and not thinking about what immerses people. There is some research in the UK as to what motivates people to play games? Do people learn as a side-benefit of a good game or is it necessary to have pedagogy in mind?

The day ended and participants were invited to the non-host dinner event at 2000.

Thursday October 10, 2013

6.9 Recap of Day 1

Mr. Stu Armstrong gave a recap of the use of serious games in the maritime domain. He reminded attendees about the tour this afternoon and reviewed transportation logistics. Given the full day ahead, Mr. Armstrong quickly began the day's presentations.

6.10 Riccardo Rovelli - MyIG and MyOcean3D

Mr. Rovelli provided an overview of ST Engineering, based in Singapore covering many domains including Maritime. They are a growing company. The Antycip simulation division works on electronics ranging from large-scale systems, communications and sensors, and software. Antycip HQ is based in the UK. They also have a maritime group that designs and constructs vessels as well as ship repair and conversion. Antycip simulation began in 1996 in France and continued to grow operations around Europe through 2007. ST Electronics acquired Antycip in 2008. Three Area Managers are regionally aligned – the key operation in each is support.

Their core capability is to distribute a COTS product integrating source data selection and optimization as well as automated terrain database generation (such as .SHP files). Another core area is 3D modeling in real-time. In the terrain generation tools and services, they also have a runtime engine for visualization (a family of products). Their networked simulation, scenario generation and execution work over many platforms and clients. They are developing plug-ins for the various domains based on demand from marketplace. Mr. Rovelli discussed the work done in simulation and stimulated communications to simulate data links and look at excursions based on conditions.

Mr. Rovelli presented MyIG: a CIGI compliant GP image generator. Key features include six degree of freedom motion simulators. Architecture is broken into clusters allowing easy integration through their API. Advanced features include shadow, blur, and other effects. They also have MyOcean3D for motion oriented maritime simulation. It is open source software using physics based research. A key feature is the visual effect of waves as they interact with the coastline features. A next step is to attach the sensor simulation.

6.11 James Short - Using Game Based Simulation for Close Range Weapons Training

Mr. James Short discussed Close Range Weapons Trainer for close range training of weapons operators. It represents a good mix of serious games and use of visualization. Flexible, reconfigurable and expandable capability allows for individual and collective training. In the past, they had one room for multi-use training. Now there are multiple rooms for different uses. It runs on VBS2 and includes other platforms to provide a more precise system that gives feedback and integrates communications.

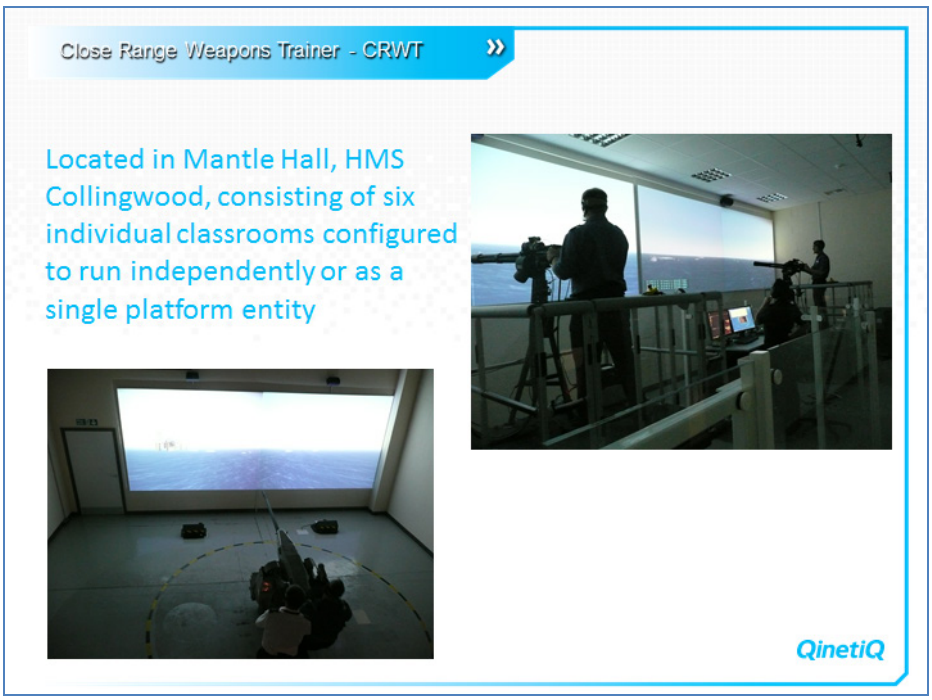

Figure 1: CWRT Facilities. Two of the classrooms where the CWRT is in use.

Figure 1 provides a visual feel for the CRWT facility in Mantle Hall, HMS Collingwood. Key features of the CRWT include:

- Proven COTS technology was used
- Engaging, effective training experience – cost avoidance of using deployable floatable targets and the ability to simulate various piracy situations. Some of the weapon stations are equipped with three degree of freedom to replicate some type of motion of the host ship. Very realistic weapons with laser and haptics incorporated – include ability to incorporate 'jams' and 'stoppages'
- Individual training – integrated with instructors to shape the training based on operator need. Have capability to train on GPMG, minigun, 20mm and 30 mm cannon
- Collective training – VBS2 multiplayer capability allows individuals to tie-in for combined training
- Reduced operations risk/cost – use of COTS hardware and software provides a low-risk approach to the delivery, maintenance and upgradeability of the system
- Adaptable for future training needs – very adaptable because many, many people know how to create scenarios and adding threats or waypoints on the fly. Brand new scenarios can be developed in just a few days
- Interoperable – VBS2 is HLA and DIS compatible

Overall, CRWT demonstrates utility of COTS games/technology to real world military training. Additionally it shows an ability to interface gaming technology with other hardware and systems. Finally, military training operators can adapt to using COTS technology for effective training.

6.12 Tom Gambill - Havok and the Maritime Domain

Mr. Gambill gave a short overview of Havok including capabilities, scope, and growth. He described the basic components of the Havok suite and many new customers who find it easier and cheaper to use the COTS solution than construct their own. He then gave an example of a crane simulation based on the physics engine.

Havok ocean simulation features:

- 60 fps+ in real application on consumer-level hardware
- Dynamically scalable from 1 square km to 10 square km
- Sea states can vary by location
- Surface details: foam, wakes, reflections, etc.
- Underwater and infrared sensor view

GPU based visual simulation based on DirectX 11. It is a completely deterministic simulation as well as multi-channel support. Parametric Gerstner – "sum of sines" provides single GPU adaptive Tessellation Mesh (2M+ simulation points per frame with 20km+ view distances). Local wave areas may have different sea states than the global ocean (trench, reef, wind area). Seamlessly blended with the ocean, it supports random surface foam and whitecaps using wave physics. Ships and buoys leave foam trails. Graphic artists define the start point then the engine fades it over time.

Primary and secondary wave trains exist in the model (height field textures attached to bow; move along ocean surface with ship). Spray effects occur in real time by calculating the friction of surface and water based on "probes" located on the moving object – this also works for surfacing vehicles. None of this is canned animation. Particle effects show effects from thrusters. All these effects are applicable to anything that intersects with the water. Lighting effects include reflection, refraction, and underwater light absorption.

The engine also supports infrared solutions – whether that is organic simulation integrated into Havok or developed in Havok. Some of the newest features include Round Earth and Ice Breaking.

6.13 Riccardo Caponi - Marine Training

Mr. Caponi discussed the Mars Line for use in ocean simulation. Established in 1982, the company supports many navies around the world. Their three main philosophies are reliability, modularity, and COTS based. Architecture allows designs of systems that can start very simply and expand over time. This is a cost effective method for many customers. They are compliant with HLA and DIS protocols. The model operates at three levels:

- Scenario level – applications for weapon manager, instructors, etc.
- Engine level – does the calculations like gun, optics, communications, radar, etc.
- HMIs level – handles the human-machine interfaces

Mr. Caponi provided an example of fully developed system architectures to demonstrate the three levels described (see Figure 2).

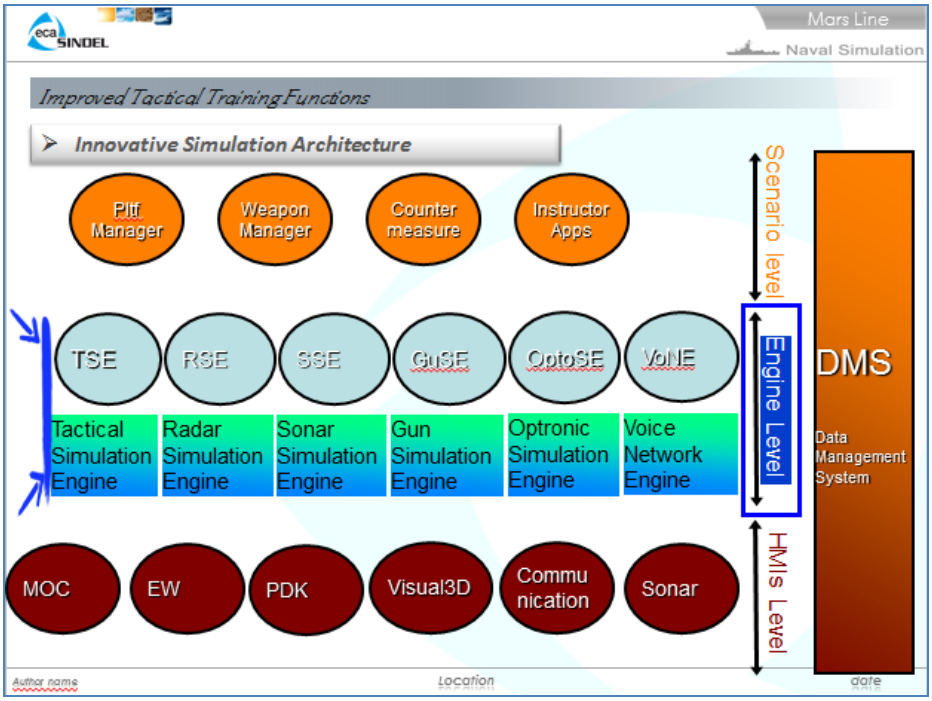

Figure 2: Innovative Simulation Architecture. An approach to tie many protocols together.

The system allows a host of experiences ranging from individual to platform to multi-platform training. It also allows scenarios from tactical to strategic levels. Mr. Caponi provided details on a number of specific trainers:

- Anti-sub Warfare Team Trainer – multi-platform simulator
  - Many platforms including air and sea systems
  - Includes debriefing room
  - Faithful replica of the consoles

- Submarine Team Trainer – used to train crews of this new platform
  - Includes four multi-screen; four single screens and plotting station
  - Very compact and flexible
  - Reconfigurable to training needs (standard, all sonar operators, tracking, or sub-on-sub)
- Naval Combat System Team Trainer
  - Full replica of Thales Netherlands TACTICOS Combat System
  - Used for Anti-Air and Anti-Sub Warfare
  - 12 multi-configurable consoles
  - Many systems simulated ranging from radar to guns to torpedo
- SimulNav NG (French Navy)
  - Includes several installations to satisfy various needs
  - Large system to simulate the working stations of various naval platforms
  - Includes horizontal plasma screens to simulate the view of water to aid in mooring
- Addestratore Avanzato (Italian Navy)
  - Simulation for new system coming online
  - Complete replica of the overall platform
  - Also has capability to simulate different types of ships
- CRISIS Management Simulator for Brazilian Navy
  - Focus on sinking, search and rescue, oil spill, etc.
  - Many stations to address many different functions
  - Enables planning, execution, and debrief of events
- Database Management System
  - Holds the data for the system
  - Showed the interfaces of the system to input data and view calculations

6.14 Mattia Crespi - The Business Side of Simulation and Entrepreneurship

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Mr. Crespi discussed some future views covering the next 10-20 years. His presentation material comes from the research accomplished by the Institute for the Future (IFTF) in Palo Alto CA.

The current age is one of Big Data based on elements like mobile devices, sensors, social networks, and intelligent interfaces. Mr. Crespi categorized the data available from tine world in four different dimensions: planetary, cities, people (social network), and microscopic. We are able to see world through these four dimensions in scales and bring all this data together to better understand how things work. We are taking lessons learned from the internet to redesign our whole world like designing smart cities. The internet is in a way becoming more and more human. We initially designed the internet as a means of communication: exchanging data, numbers and text. Now it represents multimedia, videos, sound, music, and, in a way, it is becoming more human and reshaping the way we live our societies, our work and how we connect with one another – the human internet.

We truly understand how our ecosystem works – people, plants, and animals – and we are creating a world where living and non-living things are connected. This is the coming age of the internet – the Internet of Things (IoT) – and it will last for the next ten years.

Mr. Crespi began his discussion about the IoT by showing a picture of how Google Car sees the world. It is very different from how we humans see it. He then took the audience on a journey to look at some of the mechanism that characterizes the IoT:

Human task routing - essentially deriving from crowdsourcing, but allows us to source people, systems, and tasks where you need them and when you need them. For instance, *MobileWorks* is a task platform where you choose a task, price it, and runners find someone to accomplish the task. You pay when the task is completed. Other examples include *GigWalk*. You tell the platform what your business needs right now and where. The internet will find people in that location and will assign them tasks. Meanwhile you get real-time data, confirmation, photos in your email. This is very useful for marketing. It can change the way you are promoting things.

From "crowd sourcing" to "here sourcing"…destroying distance and hyper local awareness. We see applications like *PulsePoint*. It is an iPhone app, which allows people with heart diseases to be registered and press a button if they have a problem and CPR enabled assistance, can immediately find you and assist you.

We have the future of moving things called matter routing. This term comes from the days of routing data, but now we will route things like automated drones to bring medicine in places dangerous to reach.

We are changing the way we gather and meet. We are creating "do-ocracies" (the first platforms for self-organizing and make groups of people take coherent actions around something, for example, *Liquid Democracy* is an internet participatory democracy. An example of this is in Italy during the campaign "5-Stars" where they exactly matched their capability with real live activities in the squares and pushing the model to get people to participate in decision-making.

We have social bot swarms. We are building autonomous algorithms to go around social networks and collect followers to catalyze interactions. We have more complex algorithms like narrative science that are able to gather text from different sources, put it together, and rewrite an article that makes sense – very powerful.

All of these things and new structure of the internet implies realignment. An alignment by all our organisations the way we think, work, live, our creativity…how we organize all this…policies. This would include topics like citizenship, learning, community, communication, manufacturing, and logistics. We can now put together products by buying pieces from around the world and assemble at the final destination.

All of this composes what we call the Human Internet, or the Internet of Things. More examples:

- Interaction improvements: through emotion, motion, and movements
- Total recording and transcription: for example, *Lifelapse* is an application where you put your phone in a pocket and takes pictures every 30 seconds recording steps of your life. One gentleman has the first documented repository of how we learn by recording childhood from 0-3 years old
- Algorithmic arms race: predictive software that regulates actions in the stock exchange where we had a "flash crash" where $100M's were lost due to bad data; Polyworld. It's the first environment to allow artificial intelligence to evolve and develop
- Digital cognitive networks: we are understanding how patterns are designed and learning amazing things like neurons are alive; IBM is working on the first cognitive computing devices
- Energy efficiency engineered: *Greenlight* monitoring system that visualizes and suggests ways to reduce the carbon footprint and use of machinery and energy; Georgia Tech has developed transparent, flexible device to scavenge energy from particles in the ambient and store it to create electrical energy

- Cybersecurity: *PittPatt* is an example of first software development kit to enable open source facial recognition into any application – free to use for anyone; Digital ants is a cybersecurity program. They move around network to find and fight viruses but they also leave 'digital pheromones' so nothing arises there in the future.
- New operating systems for personal data: *DIDATA* the UK government is working on voluntary program to create a mobile device to store all personal data; *DATABANKER* is a tool that tells you how dangerous it is for yourself the data you share on social sites
- Seamless and intelligent devices: the ability to simply transfer content from any device to a screen such as the Samsung smart window which is able to convert any window to a touch screen
- A large number of autonomous web applications: enable users to integrate a type of interoperability through algorithms
- People as Peripherals: *Soylent* is a plug in for word processors invented by MIT that permits users to insert writing written by others on the fly while you are writing a paper. If you would like a paragraph on the history of NATO you can ask people to create this and send them to you so you can evaluate which one is better to fit in your document

This is the Internet of Things, which is happening now and over the next 10 years. It paves the way to the next era, which we call the Era of Networked Matter.

Things become rather strange in this era because the difference between atoms and bits is becoming less and less. Imagine a world where everything is connected. There is no difference between artificial and biological. Mr. Crespi showed a picture of a tree, but it is more than a tree. It is a very powerful sensor to help us understand how the air around us is polluted or clean. In other words, this is the best sensor we have already available to measure the quality of the air we breathe. However, we are building artificial sensors to do that. Why? Because the tree has all the information inside itself but the problem is, we do not know how to extract its data. We do not speak the same language as the plant, but we know there are patterns within the plants that allow communication between networks and they carry the information on our ecosystem better than anyone else does.

This tree represents but one example. Here are the four scales presented earlier to see how things will change:

Planetary scale:

- We have the space junk map. We have a problem with space waste. We have satellites in danger by space waste. This project from the *US Space View Project* is to protect satellites in space
- The *Atlantic Rainforest Network Project* to understand how networks of plants communicate with each other and what information is retrievable from plants
- Mobile tsunami sensors as we learned we can get more precise predications on where tsunamis are likely to happen if you constantly measure data using ships that move around the oceans. If you can merge and cross this data you have a better prediction
- Google drones working in partnership with the World Wildlife Fund to monitor species and using drones and RFID technologies to monitor groups of animals likely to become extinct and learn ways to protect them

City scale:

- IBM designed Istanbul's public transportation network. What is interesting is it is the first network designed by taking data from mobile phones and social networks. They used geographic data and information social networks to redesign the transportation map

- Weightless Special Interest Group is developing a new chip for new low frequency waves to allow certain data analysis
- New York University Center for Urban Sciences: actively studying evolution models of smart cities
- *Munisense* is an urban sensor network that allows the measurement of anything happening in a smart city at the infrastructure level like energy, transportation, or water

People scale:

- Birmingham University has built the first predictive software based on social networks and mobile phones to predict the movement of people for given areas
- *DRM (digital rights management) Chair* is an effort by Swiss students and is a chair that destroys itself after eight uses. It is a statement about digital intellectual property and the problems we face
- *Cathaphora* is a system that constantly monitors and studies the behavior of people in certain areas and creates clusters of people and highlights where disorders are likely to happen in an urban to act in advance
- *MyRobots*: the first Facebook for robots. You can register you bot provided it connects to the internet and it will send data to the social network where other bots will make use of it

Micro scale:

- *BRAIN Project*: brain research through advance in neuro-technologies to fully map the brain
- *Project Cyborg*: on Autodesk using CAD to design modifiable matter like the change of state in matter. In the future, designers will design objects that will change properties according to outside conditions or properties we give them
- *BIOFAB*: international open facility advancing biotechnology with public DNA sequences in a repository so they have the latest data
- *Millimotein Robot* from MIT: the first robot that changes its state and shape and properties according to what is happing around it

These are just some of the things that will happen in the coming years and bring great changes. Imagine a world where you can manipulate matter. For instance, 3D printers will be able to print not just objects but also a vegetable or any type of living organism such as organs on demand.

In conclusion: this Era of Networked Matter is an era of great opportunities, daunting pitfalls, and great weirdness.

6.15 Colin Hillier - VBS2 Maritime Improvements

Mr. Hillier gave a brief explanation of Bohemia Interactive and overview of VBS2. The latest add on is TerraSim. It allows manipulation of a large amount of data – not only to use but also to push back out. Focus of talk was on two areas: maritime and VBS3.

VBS2 Maritime Capability added many new views for different functions as well as visualizations. A lot of the success is based on the open community and hard work of the engineers to model the physics of water. Scuba diving and moving from sea to land is a key new capability of the maritime capability. Wet docks are available as well.

Physics improvements take a while to get the buoyancy characteristics right for various ships. How does the mass difference among compartments affect the motion of the ship?

Use of proxies has broken the limitations of the number of polygons available per scene. In other words, building a single fire extinguisher proxy represents the 400 units needed on the ship. This removes limitations of the software – machines and processing are the new limiting factors.

Bohemia delivered VBS3 to the US Army with roll out in early 2014. They estimate issuing 40,000 licenses each calendar year. New features include:

- Size of terrain
- Bigger battlespaces
- More individual interaction
- Modular approach to enable scalability
- Allow multiple computers to handle the calculations
- Support for multi-cast for further network optimization
- Improvement of the VBS open architecture – plug in based architecture; reuse
- Modern User Interface – more logical and easier to read
- Suppressive fire
- Snow layers – effects on movement, speed, and how units and equipment sink
- Pattern of Life simulation – "crowd ambience"
- Launchpad – to better enable network maintenance
- Biotopes – procedurally generated terrain features created algorithmically
- TerraSim - TerraTool Integration – improved generation of complex terrain
- Inverse Kinematics – precise hand placement, door handles, hatches
- 2D Map Redesign
- Destructible buildings – Nvidia PhysX Apex Destruction; different each time
- Improved graphics – the goal of making things look very nice; creeks, rivers, particle effects, ambient life (insects, ambient environmental sounds 3D cloud Simulweather
- Improved Artificial Intelligence – get collisions working properly
- Better animations
    - Change uniforms, gestures, finer animation steps
    - Improved mine simulation, animation interpolation
    - Parachuting, particle, ragdoll animation
    - Rendering and lighting
    - Slots on weapons, swim and dive, UAV enhanced, and weapon simulation

6.16 Roxane Heaton, Research and Development and Synthetic Policy Staff Officer; Maritime Training and Acquisition Organisation (MTAO)

LtCdr Heaton discussed the barriers, challenges, and opportunities as well as a way ahead. She began by noting that although the Royal Navy has VBS, it also has many legacy systems of which the Royal Navy does not own the intellectual property. There are a number of military drivers towards the use of synthetics:

- Immersion
- Blended
- Investment
- Reuse
- Deployability
- Interoperability
- Optimum us of technology at the right place and time to increase operational capability

This all provides a better understanding of many things and is important for adapted force structures to provide a more agile force. Another area of interest is managing content for mobility (computer aided instruction, mobile learning, and concept demonstrator)

- Security is a continued issue
- Ecosystem – specifically the software
- Networks: ship to shore, shore to shore
- Distribution of training
- Intelligent creation of content for training transfer (e.g., gamification)
- Standards

LtCdr Heaton highlighted a number of current challenges:

- Culture
- Risk
- Educating audience/users
- Technology building vs. lure
- Connectivity and security
- Human factors
- Evidential training benefit
- Recruitment and retention and reserve forces

LtCdr Heaton provided data from Gartner Consulting noting, “80% of games fail to meet business objective primarily due to poor design.” Meanwhile, the use of 3D visualization successfully helps train new recruits to navigate around the ship. This is most helpful when those who have never been aboard a ship face their new mission sets – at night – with full gear. Their performance can improve if they understand how to navigate around the ship. LtCdr Heaton expounded on a number of opportunities (as shown in Figure 3) including data indicating an operational improvement from 30-50% due to the technology such as marksmanship and smalls arms training, respectively.

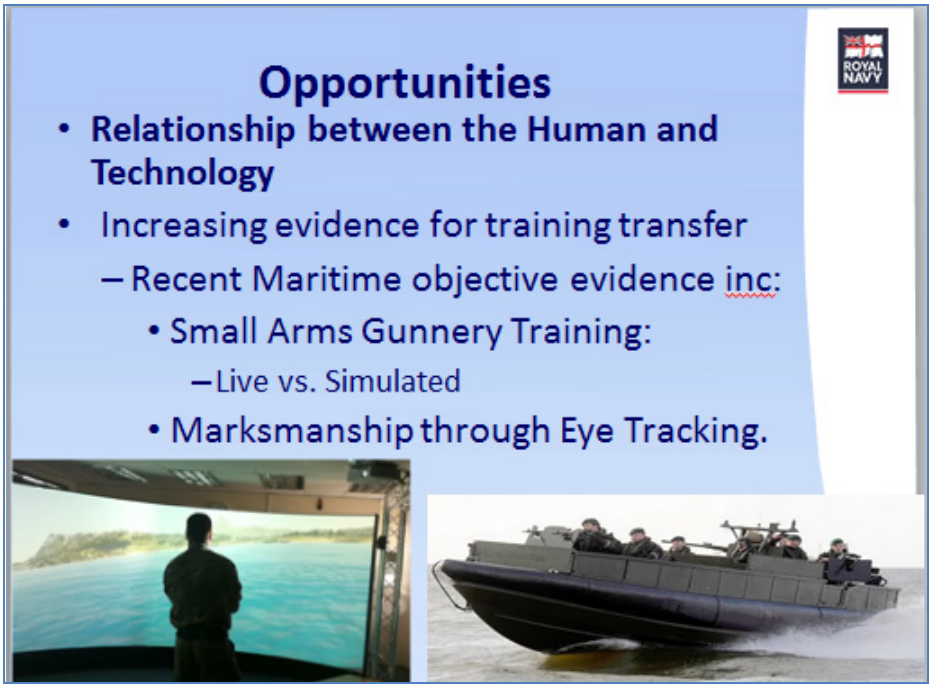

Figure 3: Opportunities. How simulation may help training in the maritime domain.

Other topics noted:

- Ways to achieve immersion
- Low to high motivation vs. low to high ability is the goal
- Learning how to optimize the immersion to maximize motivation and ability
- Fidelity: motion, all senses, and psychological

LtCdr Heaton noted another future opportunity, the Defence Training and Education Capability Programme, which is available online. It is a programme focusing on exploitation of modern simulation to give better training at reduced cost. One such project was the pilot Defence Simulation Center (pDSC). It managed to save £2.6M. It serves as a data repository and a place to design.

Her organization (MTAO) was set up to acquire and support training through best practice. Policy is still a need area. Lastly, human factors lie at the heart of the focus.

6.17 Geoffery Tompson - Use of the Havok Games Engine in Asymmetric Naval Warfare Training

Mr. Tompson discussed the use of Havok Games in naval training, specifically to train for asymmetric threats. Current naval platforms have a powerful capability, both offensively and defensively. This leaves the enemy to counteract the power with asymmetric approaches such as mine warfare, suicide vessels, and fast inshore attack craft attacking in a swarm. He stated the problem as many navies are adopting a myopic view of the asymmetric threat posed by swarms of fast attackers.

Although the area of coverage (defensively) is about 2km, the area of concern is beyond visual range. Mr. Tompson noted there is a false premise that nothing can get close enough to the naval vessels to be a true threat. The real threat was explained as (a) close threats (suicide boats, RPGs and mines); (b) near threats (unguided rockets and torpedoes); and (c) far threats (guided anti-ship missiles). This requires a training

philosophy that presents a layered defence. Figure 4 provides a graphic representation of the threat environment.

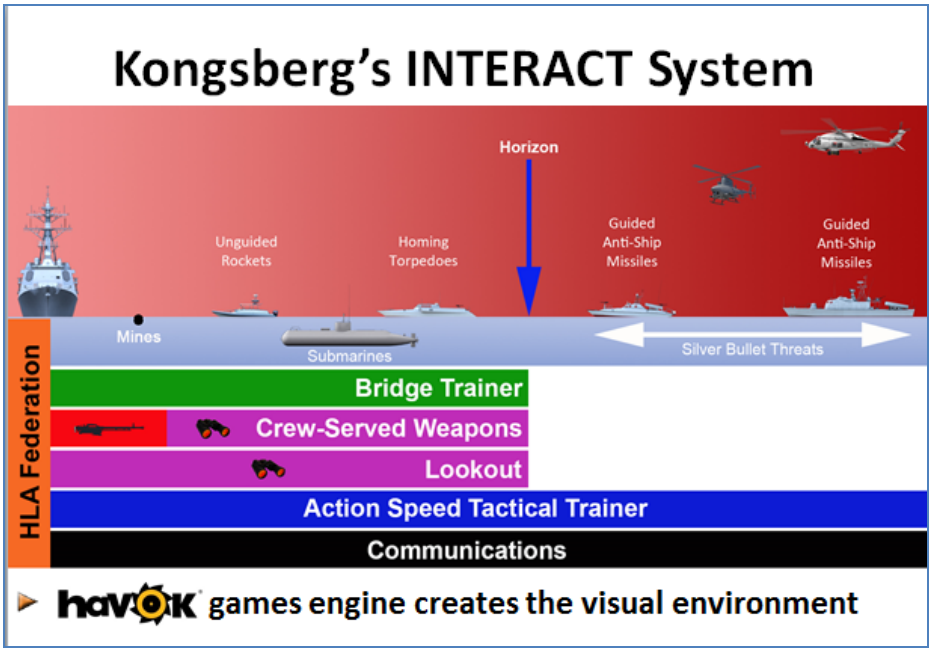

Figure 4: Maritime Environment. Shows the danger areas for large ships at sea.

One must not ignore threats. Rather, consider and engage them as follows:

- Close threats: by crew served and remotely operated close in weapons
- Near threats: using own ship guns and guided weapons
- Far threats: by main guns and guided weapons using third party targeting and possibly by arm UAVs
- Threats beyond the range of own ships would be engaged by helicopter or UAV

In order to train, one must consider the pros and cons of live training versus simulation training. Simulation provides the means to replicate the situation of over 300 unguided missiles hiding a few guided missiles within that mass. One must scrutinize simulation as well because scripted training inhibits innovation. In the case of the Norwegian Navy, they have developed a competitive training environment that provides many benefits including increased discussion and innovation to improving understanding of swarm tactics and enhancing crew cooperation in a high-stress training environment.

Mr. Tompson then discussed the selection process for choosing Havok, namely: performance (especially visual), flexibility, speed of development, and support. Another tradeoff they needed to assess was whether to build a serious game or a federated system. Given the legacy systems of the Navy, the serious game did not prove as the best choice due to development cost and time. High fidelity 3D visualization and animation has proven to be the most important aspect of the training experience.

6.18 Alessandro Cignoni - Hybrid Validation Test-bench (HVT) for Autonomous Systems

Mr. Cignoni presented work of the M&S COE and requested the gaming experts in the room for input and comment. He began by defining the terms autonomous, autonomy, and autonomous systems. He noted different definitions exist within the community. His working group adopted the definition that highlighted self-governance and decision making independent of human interaction.

He then described the purpose and function of the test-bench project. It does not use HLA because the real life systems were using another mode of sharing real time communications. Robot Operation System (ROS) blends the real and virtual elements. The virtual world operated through a virtual world connector, which provided the data driven DDS message into a 3D model. Figure 5 presents the details of this connector. The tool used was a NADS product.

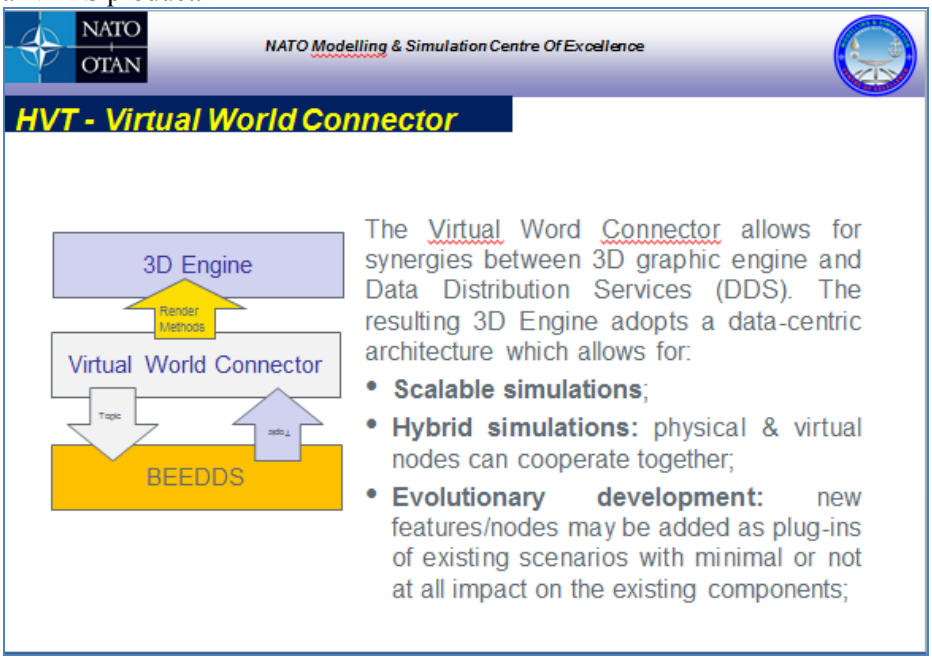

Figure 5: Virtual World Connector. A key element of the HVT is connecting architectures.

A key consideration is the use of simulation for interoperability. The Afghan Mission Network has stressed the need for effective coalition forces interoperability. Modelling and Simulation is a powerful tool to verify interoperability and to reduce costs of exercises. Mr. Cignoni also posed an interesting statement, "Games generally have many limitations for operations training." The thought behind this was addressing the question, "How do we train high level orders?" An upcoming conference (M&S for Autonomous Systems Workshop) will occur in May 2014 to address some of the concerns about interoperability and to consider the connections between game play and simulation.

6.19 Claudio Taraschi - Artificial Intelligence Software for Expert Knowledge Capture

Mr. Taraschi briefly described TESS-COM and their role in developing products for various LVC needs. He then described a software company (called Discovery Machine Inc.) initiated from the U.S. DoD/DARPA. It is an artificial intelligence software company focused on knowledge capture of world's top SMEs and enhancing training simulation by providing understandable software for instructor use. The approach is manifest in systems like JSAF and VBS2.

The DM Knowledge Service Modeler allows SMEs an ability to capture and encode knowledge in order to display and share it. Activity occurs automatically through a knowledge model and object-oriented programming. The basic strategy is taking the tasks, methods, and procedures and decomposing them into decision trees. Figure 6 shows the interfaces for defining characters.

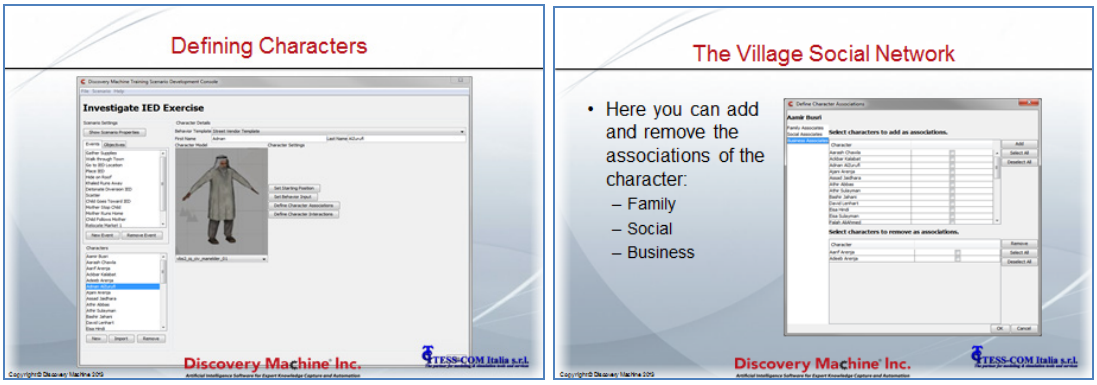

Figure 6. Defining Characteristics. Examples of screenshots.

One use case discussed was the maritime console done by the U.S. Navy. The problem was the need to have aviators train against realistic enemy submarines of several types. The solution focused on playing out this situation and capturing expert knowledge as opposed to designing software. Mr. Taraschi demonstrated the use of Discovery Machine inside a JSAF example.

Discovery Machine also has a console that can interact with VBS2 characters (like culture, skills, etc.) and the character behaves described by console inputs. It is extendable to land platforms, sea platforms, and air vehicles.

6.20 Lab Tours - Centre for Maritime Research & Experimentation (NATO CMRE) and MBDA

Friday October 11, 2013

6.21 Recap of Day 2

Mr. Wayne Buck led a short discussion on the presentations from Thursday. Some points that emerged:

- How might M&S support the discussion on the Human Internet presentation?
- It was interesting to see Gartner forecasts showing gamification lies at the "peak of heightened expectation" within their established framework
- Use cases and the lessons learned from yesterday were very good and he would like to see more of these in future events

6.22 Karel van den Bosch - Virtual Pilot: Agent-Based Simulation for Effective Training

Mr. van den Bosch presented a use case of an autonomous agent based pilot. He provided a brief overview of his organization, TNO, whose focus is to apply science to basic research and today's problems.

His problem statement noted the military requires more agent based training. It is important to collect the right people as a team at the same time and place under the guidance of capable experts using the right tools. These tools exist in training simulations, primarily as autonomous training in agent based modeling.

He presented a use case via video (it is available on You Tube using term "Virtual Pilot Netherlands"). Numerous challenges exist under current methods in training helicopter directing officers. The training audience is the Helicopter Directing Officer. A staff member serves as a role player and an instructor to oversee. Issues they must manage:

- Pilot availability is scarce
- Training requires two people
- There is no way to help standardize the language skills

Key to the solution is a speech recognition engine. This allows for elimination of the need for the staff pilot. Mr. van den Bosch noted an engine must provide a total view of required expertise:

- Didactical – learn from experience practicing strict procedures and clear speech; instructor must be able to maintain control and allow for post training analysis. Many examples of the procedures exist, but there any so many that they can often interfere. This requires an effective method of modeling
- Modeling – using BDI to model behavior (beliefs, desires, and intentions); the model uses XML to cue steps in the model based on the trainees speech
- Speech technology – language is a difficult element to master; work has been accomplished to improve speech recognition (phonemic models, language models for grammar, and lexicon); must model a lot of variances in the speech model
- Teaching methods – this depends on the acceptance of the new technology over the next year as a delivered product is provided to the school

In closing, he presented another example of a project using intelligent agents. It generates humanlike behavior and is understandable to people. It must be consistent with human information processing characteristics (cognitive modeling). Finally, agents generate behavior that is appropriate for its purpose (e.g., training). For example, individual training of team tasks executed using agents for on-board firefighting training. One trainee is able to get team training by effectively using agents to substitute the remainder of the team.

Overall, TNO is investigating agents in four categories:

- Virtual team mate: for individual training of team task
- Companion agent: acts as buddy of trainer to elicit reflection
- Intelligent opponent: provides realistic
- Tutoring agent: diagnose gaps in knowledge and skills and intervenes as necessary

Someone asked Mr. van den Bosch if they use the speech recognition program provided by Stanford Natural Language open source tools? He indicated TNO is using Nuance Loquendo for speech recognition. To deal with background and ambient noise, they use directional microphones. These appear to take care of this sufficiently.

Another question arose about how they deal with situational matters. Mr. van den Bosch stated the model checks if the Helicopter Directing Officer (HDO) is abiding by all procedures. An example is that helicopters must remain two miles from oil platforms. If the HDO does not keep the helicopter in the right profile then the model reacts accordingly. He concluded by noting system assessment by experimentation is planned as part of the next deliverable in January 2014.

6.23 Fabrizio Baiardi - Haruspex: A Tool Running a Fully Automatic Assessment of ICT Risk

Mr. Baiardi discussed the tool Haruspex. It is a tool to help simulate cyber-attacks for training:

- Build a model of your scenario (using Monte Carlo simulation)
- Run a penetration test on this model
- Tell you…
    - The defects of your infrastructure
    - The attacks that can be implemented against it
    - The probability that each attack is successful
    - The defects to remove to defeat your threats

Figure 7 provides a sample of the number and type of defects the Haruspex tool has been able to detect over the last decade.

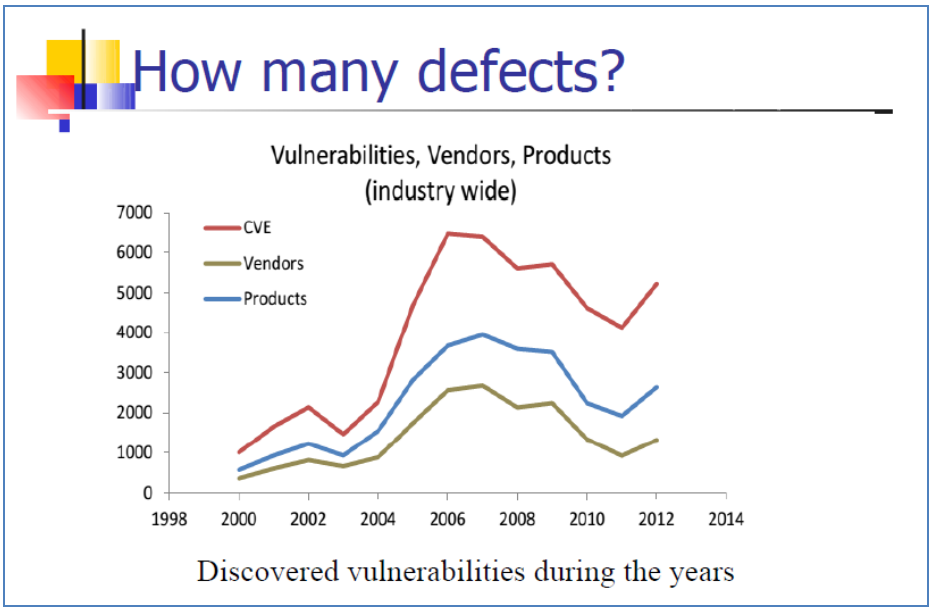

Figure 7: Characterizing cyberspace. Number of defects found using Haruspex since 2000.

This allows users to implement countermeasures in the infrastructure and determine how well they work to mitigate risk. This tool executes in a couple of hours using a highly parallel processing machines to build the model and run a Monte Carlo penetration test to discover vulnerabilities. Currently, his team is conducting case studies. They will analyze various infrastructures and describe results.

6.24 Stu Armstrong - Cyber's Achilles Heel: The Human Operator

Mr. Armstrong presented a short paper on the inside threat as it relates to education. The presentation began with discussion of EVE online – a persistent online game with as many as 350,000 online players in one world. The players – not the computer – introduce all content and conflict. The game has led to interesting lessons about human behavior. He noted two online crimes (not real crimes as they are all right within the game world) but included a Ponzi scheme and an embezzlement of a large online EVE corporation.

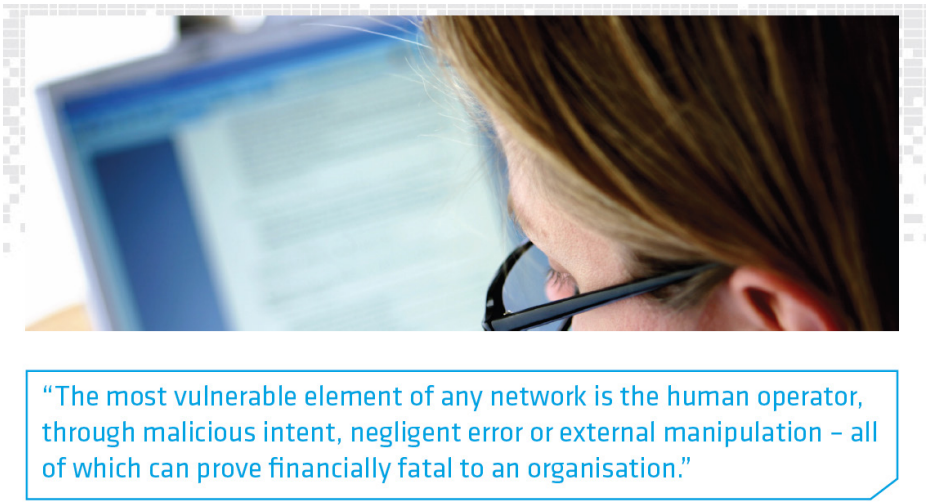

Figure 8: Vulnerability. The human operator remains the greatest threat in cyberspace.

These examples parallel two examples in the real world that had great impact on society, and neither had to do with technology. Rather, they occurred because of employee actions (or inactions). Mr. Armstrong punctuated this point with the description in Figure 8 noting the human operator as the most vulnerable element. He pointed out the best offense is overpowering defence. As a hacker noted, "you don't hack the system you hack the people." The interest for future consideration is balancing information access with information protection.

6.25 Paolo Proietti - MIMOS Celebrates its First Decade

MIMOS is an organization with a strong web presence to help educate groups about what is going on within Italian M&S. Figure 9 provides a screen shot of the portal at www.mimos.it

Figure 9: MIMOS Portal. A screen shot representation of the portal designed to give a great access of work going on within the M&S community.

Over the last ten years, they have held a number of multi-day and single-day conferences. In 2013, the MIMOS focus turned to more of an international perspective. Future plans (2014 and beyond) include:

- Support to ITEC
- Serious games in education
- Events such as MASAS 2014 and I2M 2014
- Industries such as automotive, food & beverage, logistics, medicine, virtual cultural history, and Sim & Sea

International focus will continue as demonstrated by work with Simulation Australia, Liophant, ETSA, ITSA, ADIS, M&SNet, and MISS.

6.26 Anders Frank - A Lecture on our Naval Warfare Game

Mr. Frank spoke on education and wargaming as a means to learn naval warfare. He provided a brief overview of the meaning of wargaming, highlighting simulation and people making decisions in response to players representing opposing sides. The Swedish Armed Forces has a wargame research program focusing on classroom exercises consisting of wargaming having low transaction costs in order to do more on a smaller scale. This is possible by identifying key aspects from learning objectives – games with low fidelity (good enough), without sacrificing learning.

They focus on three functions to make wargaming viable:

- Research: the key question is, "What can be learned from wargaming?" The answer is that it depends. They have taken a different focus: is it the game, the gamer, or gaming? This leads to many elements as well as fields like game based learning, gaming studies, and behavior psychology
- Development: the key question is whether to "develop games or modify existing regardless of medium or format in order to fit the pedagogical context?" Purpose dictates game arrangement that gives results. The game was summarized as preparation, the game itself (a small part of the greater context), and reflection/debriefing. Three examples of games used at his organization:
    - Simple Surface Warfare
    - Asymmetric Warfare Boardgame
    - Master of Air Operations
- Practice: this provides game support to courses as game controllers and instruction. It is a terrific way to get output, insights and basically is the *unit of analysis* for research

Mr. Anders provided more on the Simple Surface Warfare game by means of example. It is a low fidelity, simple model game. Two assumptions commonly exist in the learning community:

- higher fidelity equates to better training
- training is good if a subject matter expert thinks it is good

There is little evidence that support those assumptions. Other aspects of training are more important than fidelity: guided practice, feedback, performance measurement, and scenario construction. Low fidelity games provide many benefits:

- easy to learn
- few number of operators required
- low development costs…saves time and money

This must all ensure it does not come at the expense of gaming:

- Dynamic environment against a live, thinking opponent
- Competitive environment
- Follows the logic of gaming, hence learning
- Design the activity based on the key learning objectives

He presented the overall flow of the training course showing Week 6 of the 8-week course. The game is five days including planning, execution then reflection. An observation is that when the students play the game again, evidence of learning emerges. The week concludes with feedback. They have used the game for three years and at many different levels of student from cadet to senior officers.

6.27 Fabio Camponeshchi - Platform Defend Game

Mr. Camponeshchi discussed the use of the serious game called Platform Defend. It relies on the concept on gamification in order to use games to engage users in solving problems. Serious games are not simulations alone, but a have a look and feel of a game with a chance to win. Within the commercial market, documentation shows it enhances learning and retention.

The game Platform Defend is in a state of demonstration. It revolves around a situation to defend a platform inside of host-nation territorial water that is close to an important undersurface archeological site. The mission is to assure platform security by destroying any hostile targets without harming friendly targets and wildlife. The threats include small boats, small aircraft, divers, and small undersea vehicles. Sensors include camera, passive sonar, radar, and unmanned surveillance vehicle camera. Weapons include reactive sonar, USVC warhead missiles, and heavy weapons.

Rules of engagement exist in simple logic tables. They go beyond common sense in that they are military orders. They are written at the commander level – focusing on understanding and verifying the situation in order to give appropriate orders.

The objective of the project is to demonstrate how gamification and application of some serious game principles can help to improve the user ROE knowledge. Game flow revolves around target detection, identification, and application of ROE. Other targets appear until the last target appears, provided the platform is not destroyed before then. The game ends with feedback and an evaluation.

Mr. Camponeshchi presented a view of the game interface. They noted it is not much different from games available on the internet or through console game providers. The user interface includes a sight picture, the ability to conduct actions, and review history of game play. Most important is the evaluation, which includes the score, how many ROE applied correctly or incorrectly, as well as summary statistics of the activity during the game (such as type of targets destroyed.) This information enables an after action review to discuss how well the players adhered to the ROE.

In conclusion, they are using Serious Gaming. There is reliance on other elements such as the immersive environment, game features, ad hoc scenarios, and skill improvement. Development costs are very low – approximately 4-weeks of work and few thousands of dollars. Presenters provided a brief demonstration of the game.

6.28 John Milam - Interdependencies within the Maritime Transportation Sector

Mr. Milam discussed the use of serious games to promote an understanding of the analytic aspects of port security and consequence management of the critical infrastructure. The work is for the Department of Homeland Security and is a process of creating small exercises for small to large teams. The driver in this project is to enhance profitability of the port operations. There is a large interdependence between the ports

and many other economic domains like health, tourism, energy, and the like. So in the in the event of a natural emergency, what should the port operators consider and act upon?

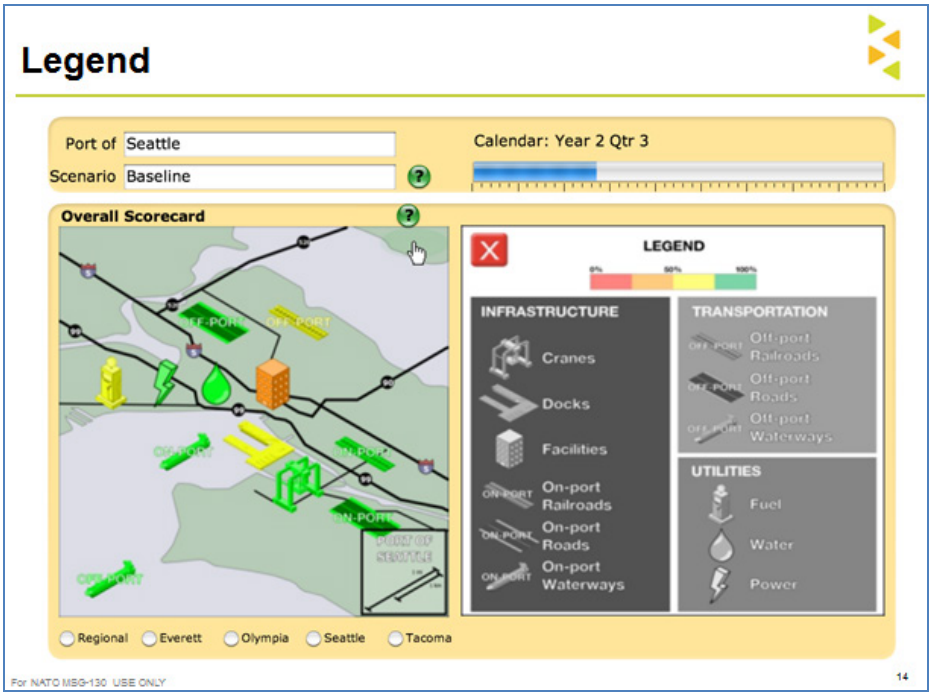

Figure 10: Seattle Port. Visualization of the model data for one of the ports being studied.

Figure 10 shows one of the many screen shots provided to describe the work. The tools help them data (static and interviews with domain experts) to create the algorithms that simulate the flow of assets and stocks. Impacts depend on where the issue strikes. Assets include the workforce, cranes, berthing spaces, road, buildings, marina, the repair team, and labor costs. All these building blocks connect to create a generic model and customized for the four ports of interest. A fifth model than brings the ports together into a holistic view.

One lesson learned is that trying to force the "calculus" on the port operators does not work. Rather, the user experience must be one that is based on mappings and very simple color-coded, pictures. Dashboards are used communicate information on resources and financial implications. One important aspect is capturing the constraints because constraints help force decisions – often, hard decisions. Outputs include dashboards that are similar in look and feel to those used by the current operators to extend the metaphor. It also includes rollups of the data in order to allow management by objective – drilling down into details of interest.

The overlying interest is that in the case of disasters ranging from Kobe, Japan to Haiti, areas take a long time to recover if they recover at all. This is because the systems have a way of rerouting flow to operable facilities. Therefore, by showing operators with the impact of decisions they can consider the long-term effects of actions today on economies tomorrow.

6.29 Davide Corsanini and Fabrizio Sciarra - Weapons Training Using "Virtual Reality": A Hardware-in-the-loop Approach

Messrs. Corsanini and Sciarra talked about the training of special machine guns using virtual reality. The Hitrole Training System uses an approach to training that combines real weapon systems and a virtual reality environment in which both interact and influence the other. Advantages include:

- Safety
- Economical (no ammunition or target loss)
- Can prepare more complex scenarios than available in the real world
- Use the same weapon with the same logic
- Training can be performed on the ship…not required to use it in a classroom

A case study described integration of the real weapon with the SIMSUITE. The Hitrole is a small caliber machine gun that be operated manually or remotely. SIMSUITE is an integrated 3D viewer and simulation development system. It has been adapted to include required optical system characteristics, represent light, sea, and weather conditions; represent effects like smoke, explosions, and splash; and simulate and sustain the fire rate of 600 rpm.

The architecture explained how the simulation infuses an optical representation of a threat into the actual system placed in training mode. The weapon reacts as if it were a real target because of the hardware in the loop approach.

Mission planning includes a 2D representation of the world and use different platforms and settings (for both threats and friendlies). It uses standard iconography to build the scenario. The operator (trainer) can add targets and waypoints. All data lies in the SQL DB including details about the mission, entities, and platforms. A short demonstration depicted the user interface. Features in the existing 3D engine account for light and weather conditions. The 3D image transmits to the trainees' workstations.

Integration, in this case, includes:

- What happens when gunner moves the weapon
- What happens when gunner shoots

The SIMSUITE logs all the events for each projectile and target. Leaders can review results to assess gunner performance. Previous training sessions are accessible for comparative analysis. The future work includes integration of the weapon tracking where the servos will actually move during training as well as terrestrial weapons training.

6.30 Wrap Up by Mr. Stu Armstrong and Mr. Wayne Buck

Mr. Wayne Buck began the wrap-up. He provided a summary about predications made over the past years. Five years ago (2008) the predictions included:

- Highly realistic scenarios are affordable for others than just governments/soldiers (attained)
- Training games are becoming more realistic than those for entertainment (attained - although entertainment industry has continued to improve)
- New types of training scenarios are driving new type of training technologies (attained)
- Joint missions are driving interoperable solutions (attained)
    - This garnered much discussion about sharing among companies and organisations
    - Generally seen as a prediction that has been attained but more questions have emerged over the last five years
- Greater emphasis on end-user experience (attained)

This helps to demonstrate that we – collectively – have grown towards these. A key objective of this series of workshops has been to bring together the right people from government, academia, and industry to progress the field.

Mr. Stu Armstrong noted the technology has come along quite well with some interesting technology as well as some good use cases and analysis. He still believes it is very early data and there is the risk of focusing too much on a subset of the possible solutions. It would be unfortunate to have a few successful use cases and then extending them beyond their utility without exploring other approaches to different use cases.

Dr. Augustino Bruzzone noted the value of feedback and value of the work underway. At the beginning, the concern was that the technology was just games and it could induce negative training. Evidence shows this is not the case. However, now the questions focus on the value in terms of cost, time, and enhanced learning. Getting a better understanding on the return on investment would be a wise area to invest our time.

Mr. Wayne Buck gave a special thanks to the participants, the hosts (Dr. Bruzzone, and Alessandro Tesei, and the presenters. He then bid everyone adieu until the next time.

7. CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

Participants and workshop organizers assessed this session of MSG-130 as a complete success. The workshop met its stated goals:

- Through demonstration, experimentation, discussion and debate, attendees will acquire knowledge and experience in the possible topic areas.
- Technical and application briefings and demonstrations on selected commercial technology areas will help the attendees better understand the issues so that they may more properly aid in the development of the strategy for the NATO and the Nations to exploit these technologies.
- Participants will develop a shared understanding of the issues and opportunities.
- Meeting proceedings will capture the presentations and provide recommendations for NATO and the Nations.

NATO partner nations currently use commercial games and technologies. The workshop participants concluded that a need to continue pursuing these technologies is essential, and additional effort could focus on validation of technologies, education of users, and the evaluation of existing acquisition and procurement guidelines.

Finally, NATO and ACT enjoy an organisational infrastructure and innovative partners to facilitate these types of workshops in the future. They should continue to do so.

7.2 Recommendations

Technology has come along very well but it is more than just technology. There are cultural aspects of gaming that should be recognized and studied to serve trainees. Overall, the process is still early for Serious Games and if a focus remains solely on technology, there is a risk of becoming shortsighted. Meanwhile, feedback is a very valuable asset in this current time of Serous Games. Whereas early concerns about Serious Games being harmful has been put to rest, the next line of questioning focuses on the cost and time of games for learning. The group felt it was wise to understand the return on investment and would welcome inputs at future workshops on this aspect.