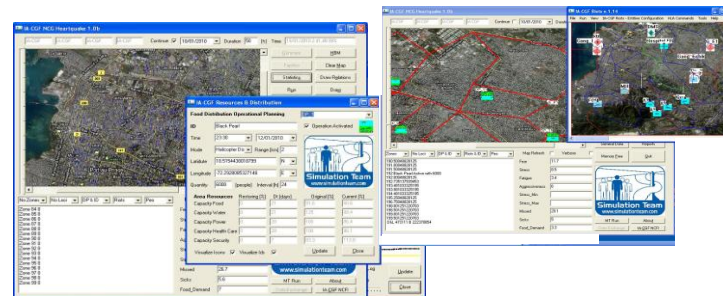




Human Behavior Modeling Federated for Supporting Training

Agostino Bruzzone
Simulation Team
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agostino@itim.unige.it
www.simulationteam.com



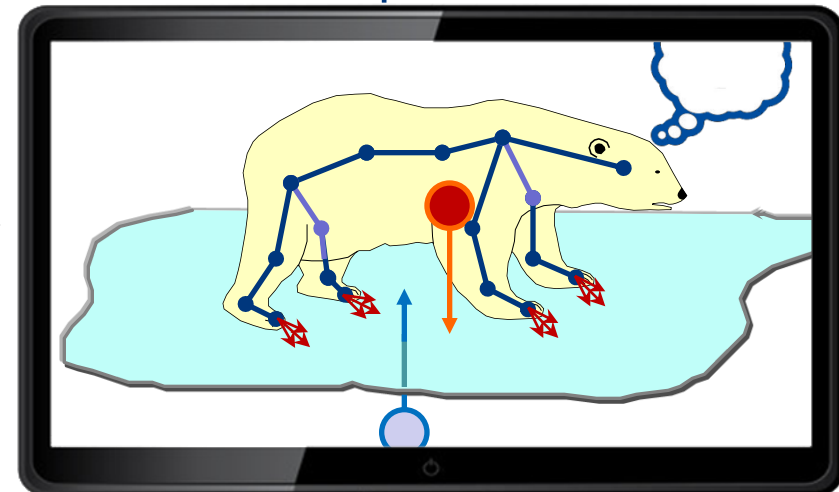
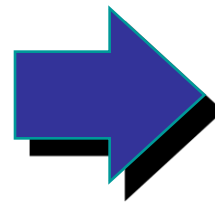


What is a M&S and HBM?

Simulation is the reproduction of the reality by using computer models. The Simulation allows to build up a **Virtual Environment** and to run dynamic scenarios in order to analyze or optimize the real system. A simulation project is devoted to develop and use Simulation to solve problems



HBM means **Human Behavior Modeling** and/or Human Behavior Modifiers that are used for simulating the human components



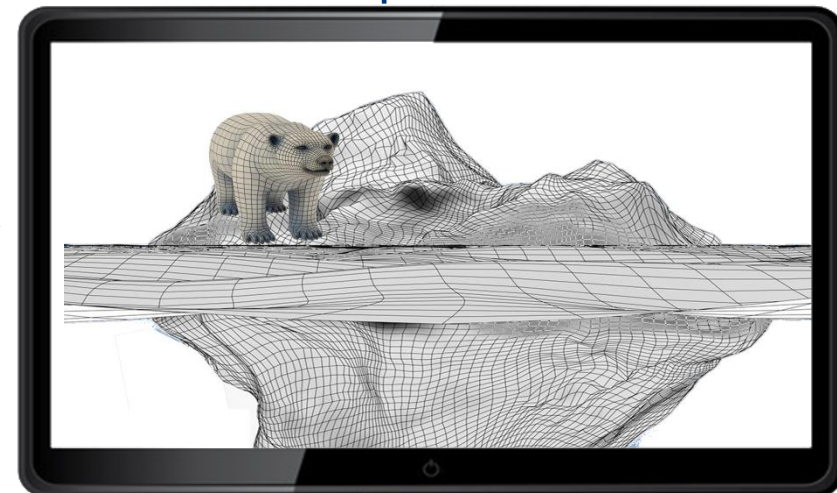
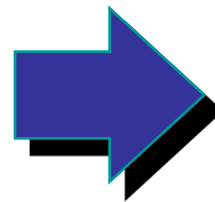


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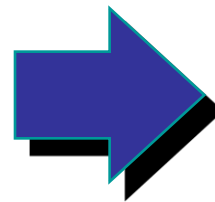


What is a M&S and HBM? Hot Bear Modeling... No, but...

If we move from the technological and physical plan to operation and interaction the modeling **Behavior** become crucial.

In case of interest into modeling Bear Activities over the ice, it emerge the fundamental need to reproduce social interactions and emotions that affect their behaviors.

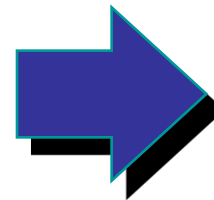
In this case the fear of the Bear Cub, the Leadership of the Mother and their collective action should be model.





What is Human Behavior Simulation?

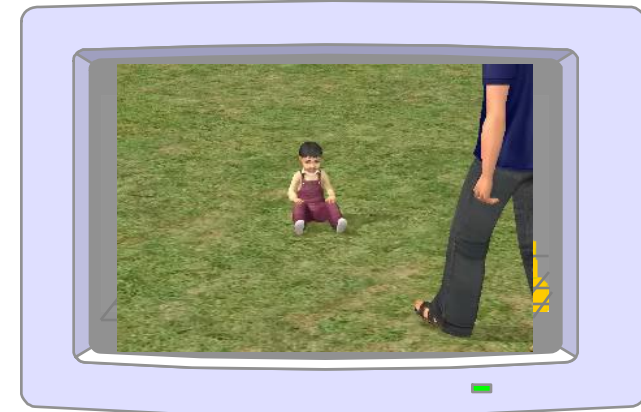
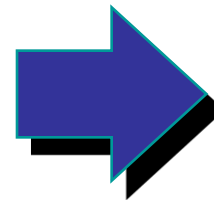
Human Behavior Modelling & Simulation (HBM&S) is the reproduction of the Humans by using computer models. Usually this requires to simulate aspects related to **Emotions, Rational Thinking, Psychology, Ethology and Sociology** with the detail required by the specific Modeling & Simulation Project





What is Human Behavior Simulation?

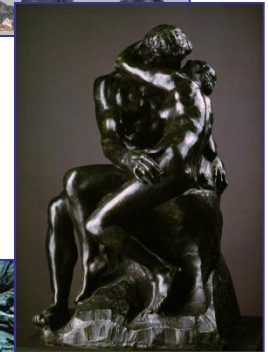
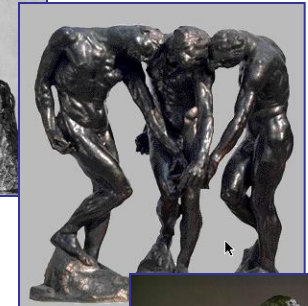
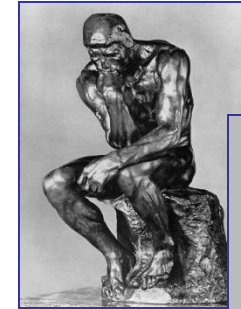
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Human Behavior Modeling Challenges

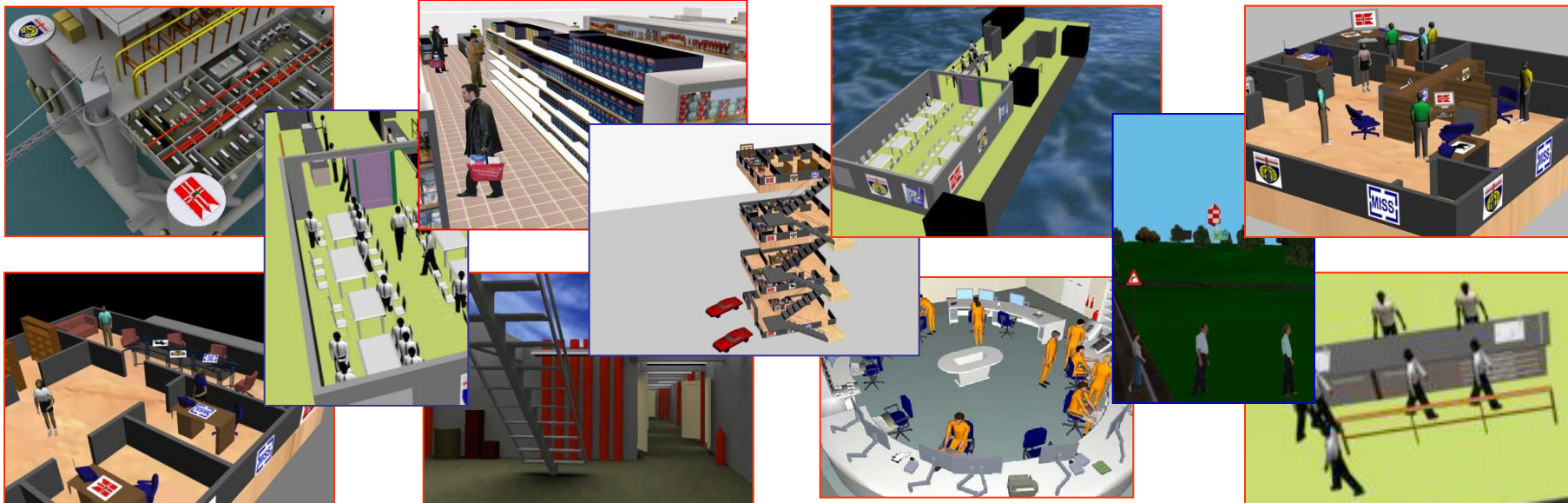
- **RATIONAL DECISION MAKING**
 - Intelligent Individual Behavior
 - Organization & Hierarchies
- **EMOTIONS & ATTRIBUTES**
 - Psychology, Culture, Social
 - Crowd Behavior
 - Social Networks





Human Behavior & Simulation

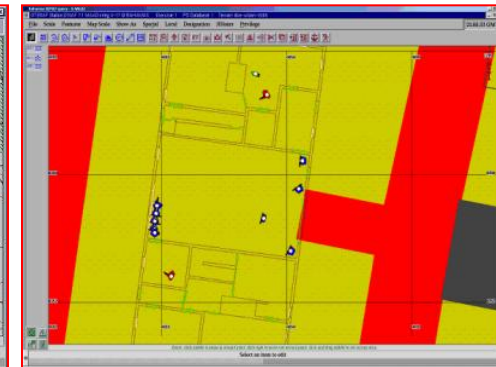
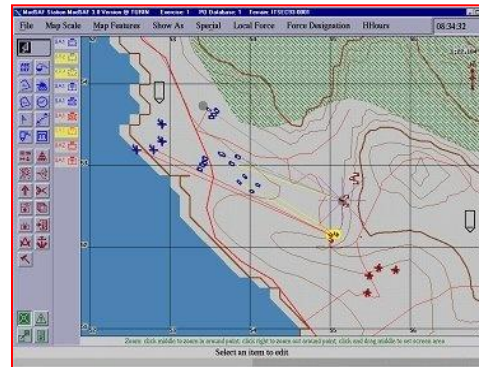
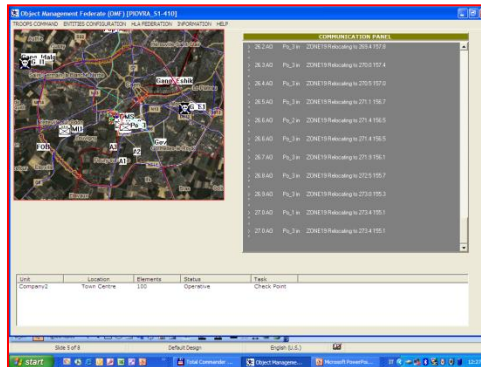
The data flows, business processes are usual in use in current simulation. The human behavior models (HBM) are present in these aspects and have sometime have a very strong impact, so it becomes more and more important to properly consider these aspects.





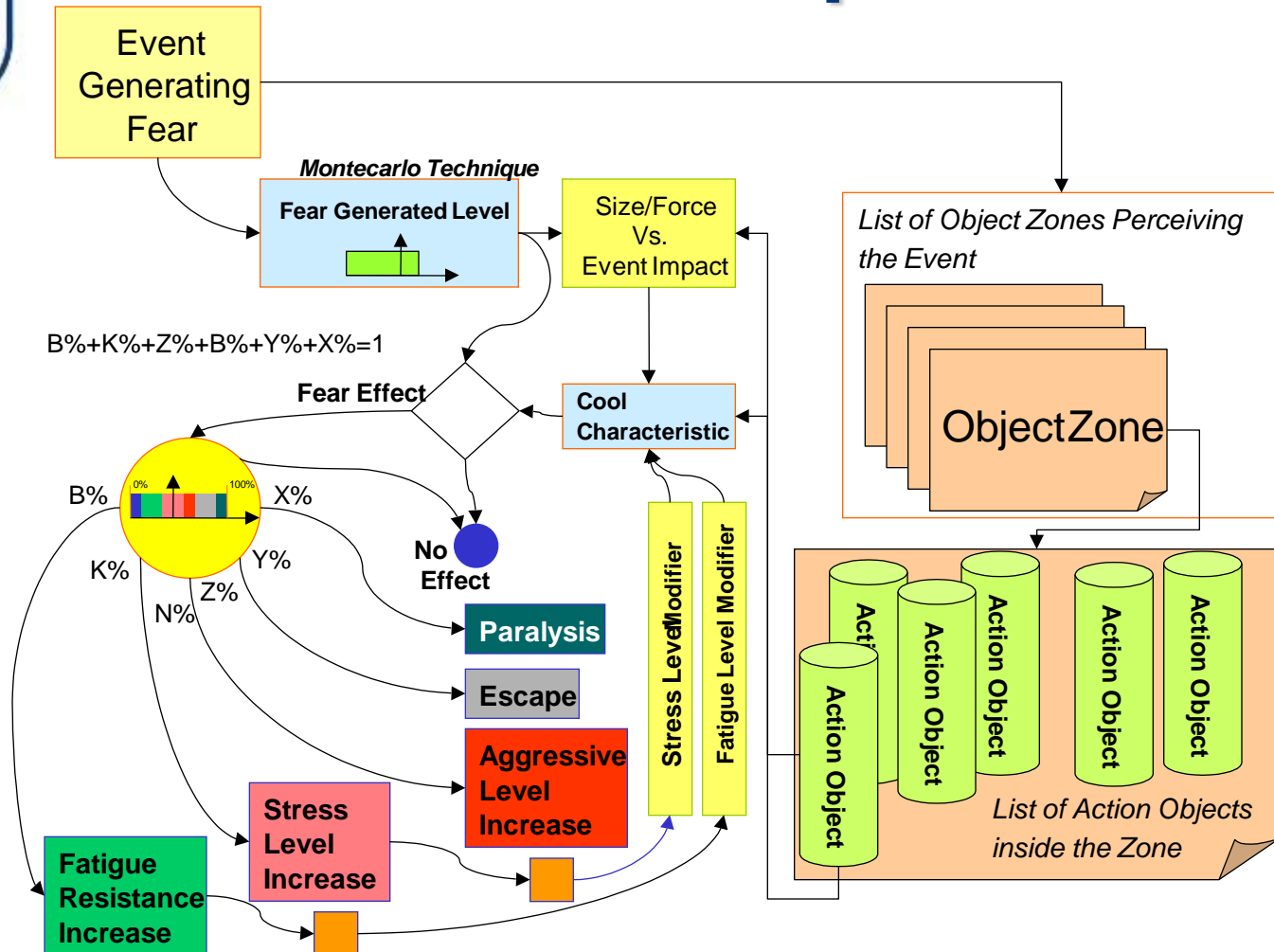
What kind of HBM?

- Medal of Honor (Shoot Game)
- Americas Army (Game/Training)
- 2nd Life (Massively Multiplayer)
- Comadreja (Business Simulation)
- Brainsim (Sensorial Model)
- Sims (Strategy Game)
- IA-CGF (CGF)
- Piovra (CGF)
- Modsaf (CGF)
- MAAD (CGF)





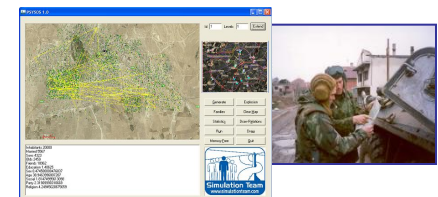
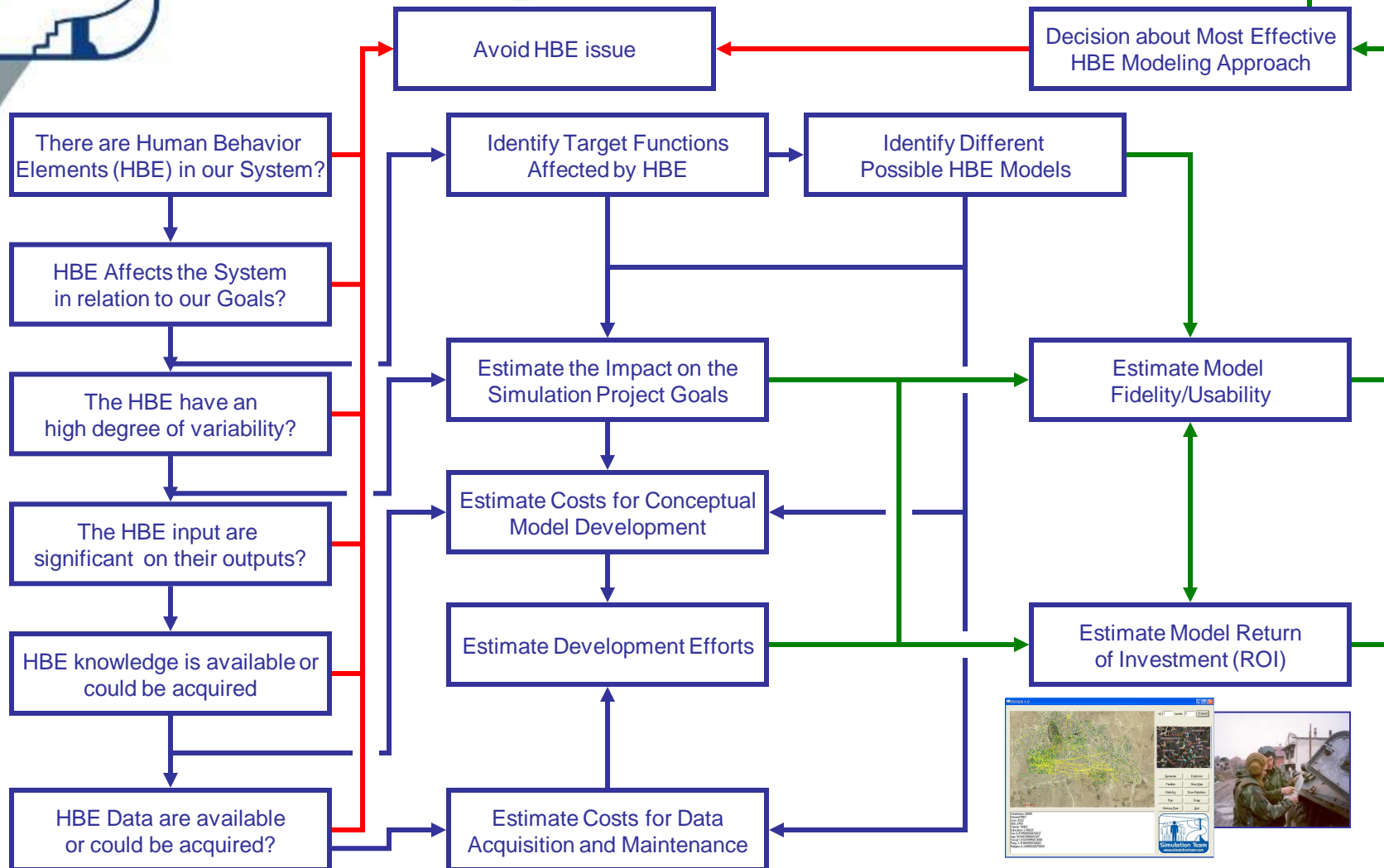
Fear Model Example





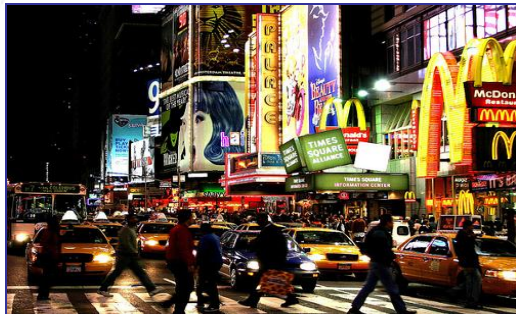
Modelling Human Behaviour

Project for M&S HBE

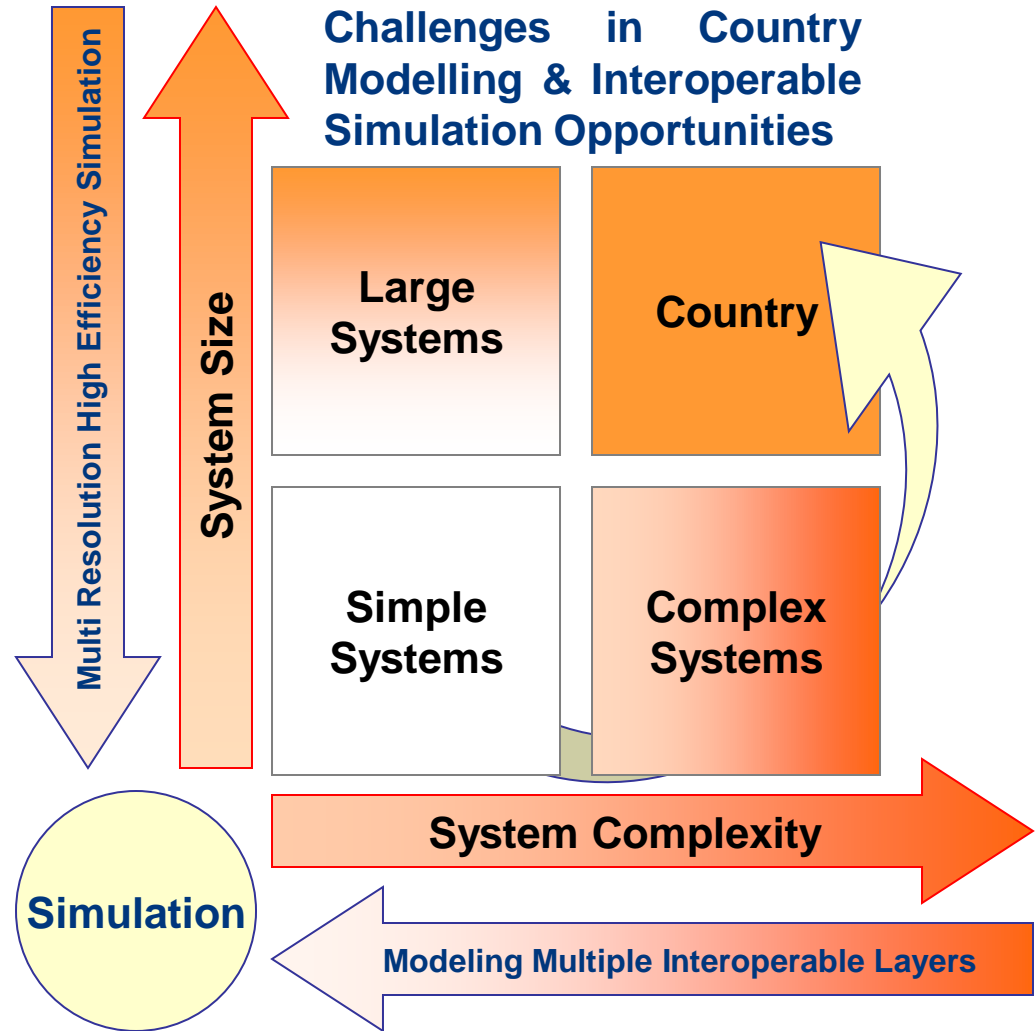
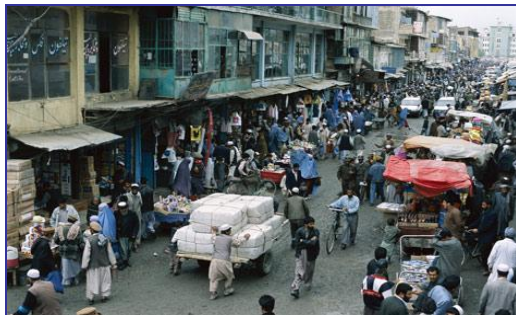




Boundaries and Constraints



This new Generation Simulations have to face big challenges





Military Scenario Evolution



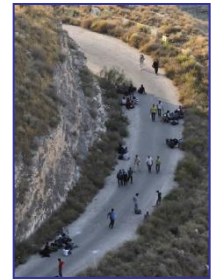
Scenarios evolution due to:

- Non conventional threats (i.e. insurgency, guerrilla warfare, terrorist attacks, CBRN attacks etc.)
- Involvement of different coalitions from different Countries (i.e. NATO, EU, USA, Russia, Japan, China) with different rules of engagement (i.e. Piracy in the Gulf of Aden or Operations in Libya) in different World |region
- new operative needs (i.e. management of migration flows from war zones, civilians evacuation from high-risk area, support operations in asymmetric warfare, etc.)



Critical Issues

All recent theatres (Afghanistan, Libya, the Horn of Africa), have strongly highlighted many of critical issues such as:



- The importance of human factors (i.e. fatigue, stress, fear, aggressiveness) for military operations in complex scenarios
- Joint coordination among different forces
- The presence of new actors interacting with the military (i.e. police, Civil Protection, GO and NGO, etc.)
- Civilians involvement in military theatre (i.e. refugees, evacuation compatriots, civil protection, interaction with local populations, etc)
- Scenario Complexity

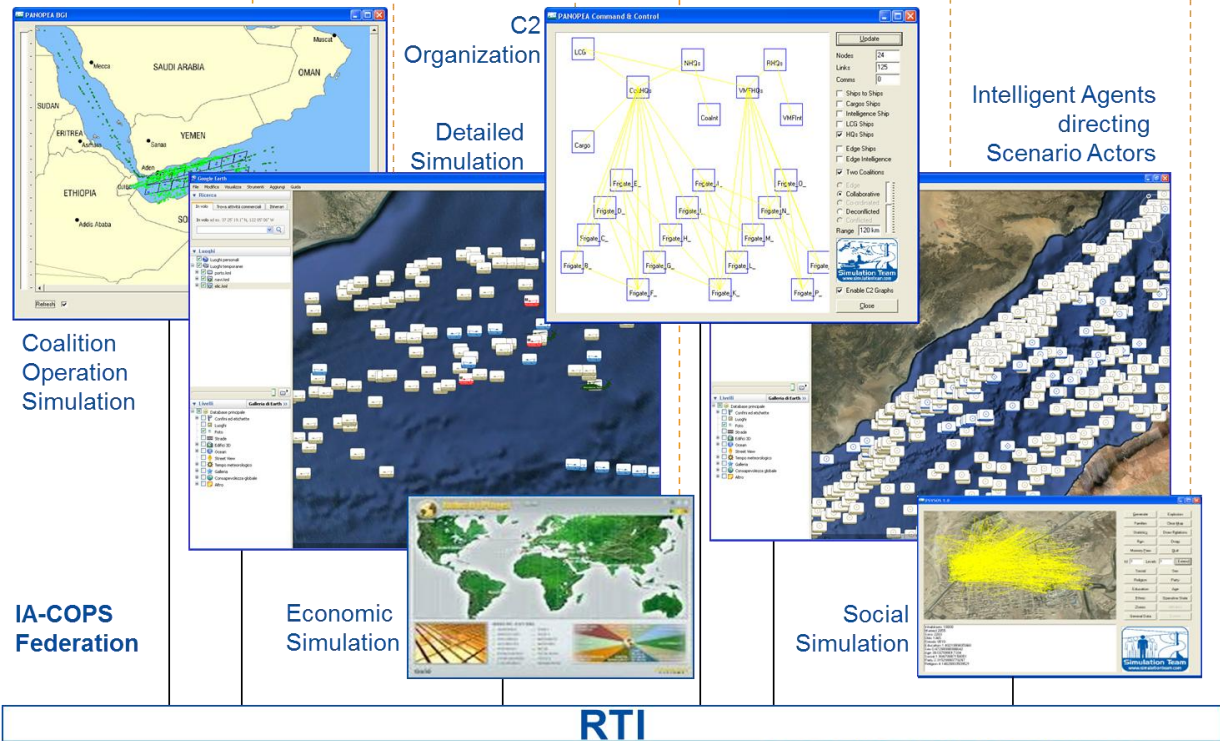




Example of how to Move to a Comprehensive Approach



Panopea Simulator could be integrated with different layers in order to address piracy problem in a comprehensive approach



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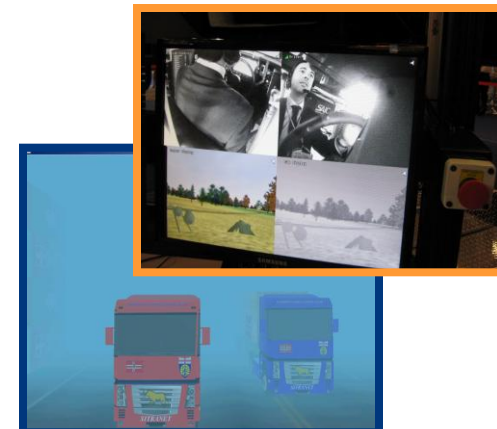


HBM for Training

- Simulation for Training in Large Initiatives requires to model many humans on different sides
- HBM could allow to consider complex interactions moving from pre-defined scripts to dynamic scenario evolution
- Subject Matter Experts could use HBM as Scenario Preparation Tools
- Training Audience could interact directly with HBM during the scenario evolution

Most Scenarios strongly involve Humans Behavior (HB)

HB M&S introduces new opportunities for Simulation Based Training

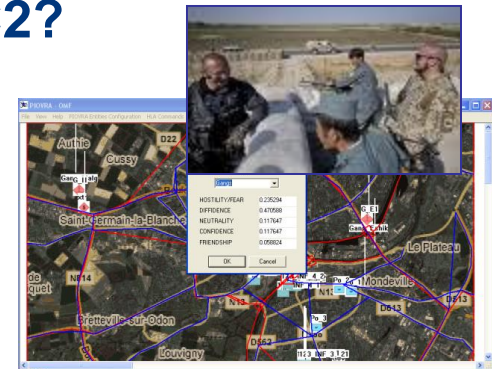




Human Factors Challenges on Modern Scenarios related to Forces on the Field

Human factors such as stress, fear, fatigue, etc. have a very strong influence on all the decision-making steps and, in particular, on the following topics:

- The strategic Corporal-How can he affect C2?
- Every soldier is a sensor-How can he affect C2?
- Isolation syndrome?
- Using communication tools-Human Factors?





Different Way to Integrated HBM in CAX

- A priori: as Support tool to create the Scenario and investigate in more effective way a large spectrum of alternatives
- On-Line: as interactive federate during training session able to generate dynamically reactions and new events

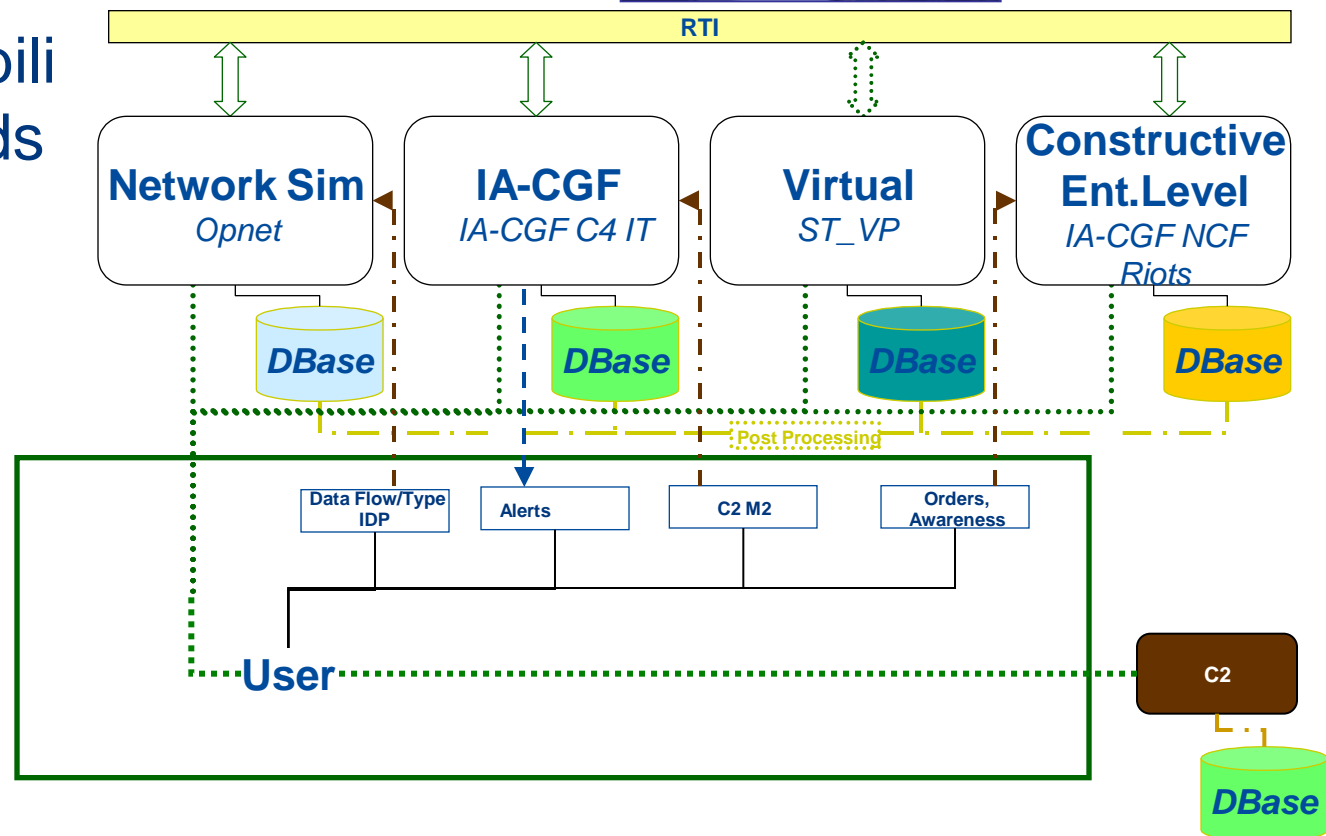




Example of How to Federate HBM?



- Interoperability Standards
- Proper VV&A of each Federate and whole Federation

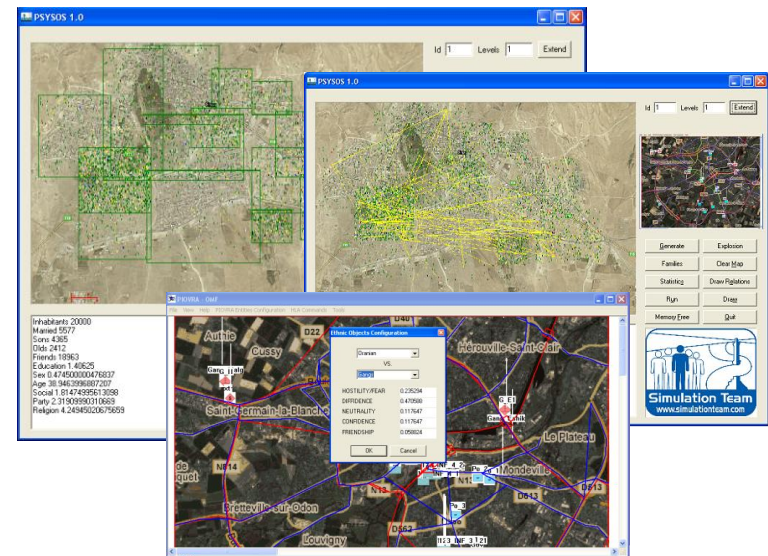




Simulation Approach and Technologies

- Interoperable Simulation (based on HLA Standards)
- Intelligent Agents for Computer Generated Forces (i.e. IA-CGF by Simulation Team)
- Constructive Simulators (i.e JTLS, JCATSM, E&U)
- Virtual Simulators (i.e. VBS2, DI-GUI, ST_VP)

Less impact on the Live layer of a Federation considering that there the humans are already embedded





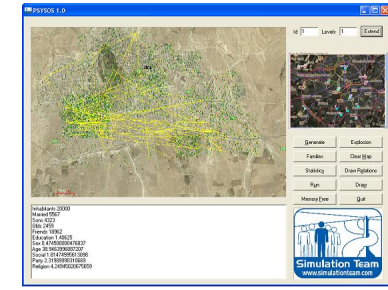
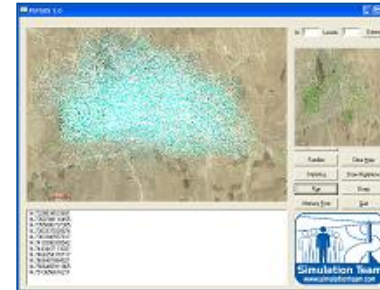
Benefits of HBM within Interoperable Simulation

- Possibility to integrate specific models to re-create particular phenomena (i.e. riots, epidemics or events that can happen during or after military operations)
- Improve Scenario Evolution fidelity over complex Scenario (how, when and where something driven by HBM happen)
- Improve Opposite Force and Civilian Representation
- Improve HBM Effects on Force (i.e. Fatigue, Stress, Fear)
- Move ahead in terms of integration between Live, Virtual and Constructive systems





Agent-Based Simulation Benefits

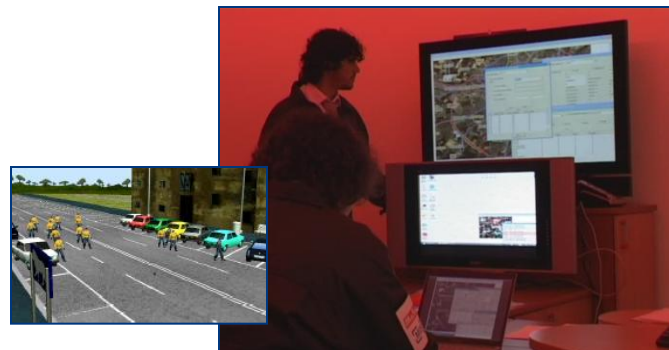


- Simulate civilians, organizations, entity and resources involved in the mission environment
- Carry-out simulation experiments with a reduced workload (thanks to the agents autonomous behavior)
- Execute a greater number of simulation runs and replications
- Involve a lower number of personnel during training
- Achieve significant savings in terms of offices involved
- Achieve a greater accuracy and reliability of simulation results in the case of experimental analysis and training
- Set-up a greater number of exercises given the same amount of available resources
- Support SME Contributions and Creativity in a Realistic Framework



Benefits from *IA-CGF*

- Introduction of New Elements in the Simulation
- Reduction of Workload
- Speeding Up Exercise Preparation
- Interactive Dynamic Representation of Gray/White Cell
- Supporting Data Farming and Experimental Analysis
- Simulate Complex Non-Conventional Asymmetric Scenarios
- Introduce Capability to consider Impact of Second Effects

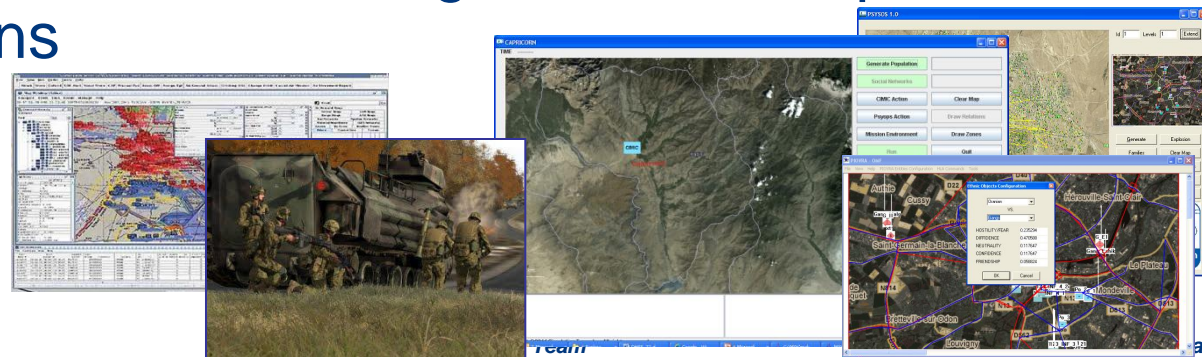




Example of Federation including HBM

HLA federation should include:

- Agent Driven Simulators based on the use CGF managed by Intelligent Agents (I.e. IA-CGF)
- Virtual systems
- Constructive systems (i.e. IA-CGF NCF, JTLS, JCATS or other simulator)
- Other systems devoted to consider impact of communications among different components and coalitions





IA-CGF MODULES

The new *IA-CGF* Modules devoted to create the simulation of complex Scenarios include:

- *IA-CGF Units*
- *IA-CGF Human Behaviors*
- *IA-CGF Non-Conventional Frameworks*

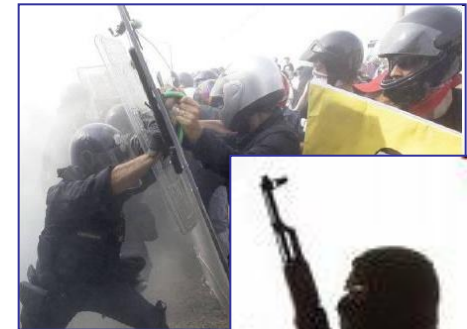




IA-CGF Units

IA-CGF Units are a set of interoperable units with capability to be integrated in constructive simulation

- Police
- Gangs
- Local Population
- Rioters
- Insurgents
- Terrorist
- Local Authorities
- Warlord
- Criminal Organizations
- NGOs (CIMIC ops.)
- Civil Personnel (CIMIC ops.)
- Domestic/National Situation (for instance for troops moral):
 - Population
 - Media
 - Lobbies
- International Public Opinion
- International Diplomacy
- New Threats (i.e. 2nd Generation Terrorists)



These are examples of non-conventional units controlled by IA-CGF

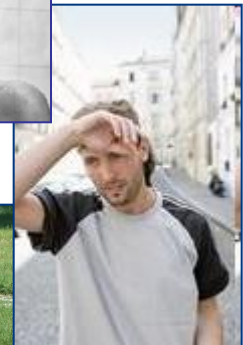




IA-CGF Human Behaviors

Specific modules with *IA-CGF Human Behaviors*:

- Fear
- Stress
- Fatigue
- Training Level
- Aggressiveness
- Ethnic Factors
- Religious Factors
- Combat Skills/Experience



IA-CGF Human Behaviors operate as a set of further characteristics to be added to each unit in constructive simulation.

i.e. now in constructive simulation every unit in the scenario have infos about status and type of ammo, by *IA-CGF* it will be added dynamic information about level of fear and stress and the Units performing according to it



IA-CGF Non-Conventional Frameworks



It is important to consider the integration in a scenario of the *IA-CGF-Non-Conventional Frameworks (IA-CGF-NCF)*, each simulating specific events:

- *IA-CGF CIMIC/HUMANITARIAN FRAMEWORKS*

- Food Distribution
- Reconstruction



- *IA-CGF Homeland Security and Civil Protection FRAMEWORKS*

- Natural Disaster (i.e. Hurricanes, Earthquakes)
- Man Made Disasters (i.e. Explosion, Hazardous Material Spills)
- Evacuation



- *IA-CGF PSYOPS and INTELLIGENCE FRAMEWORKS*

- Integration *Sibilla*® Serious Game for Intelligence Officers training

In non conventional scenarios for particular training purposes.

We can imagine to have active different non conventional Frameworks, in different locations, with different level of detail inside the simulated theater.



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PIOVRA

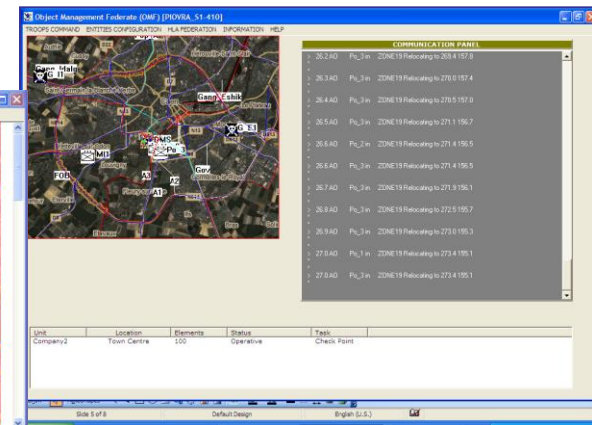
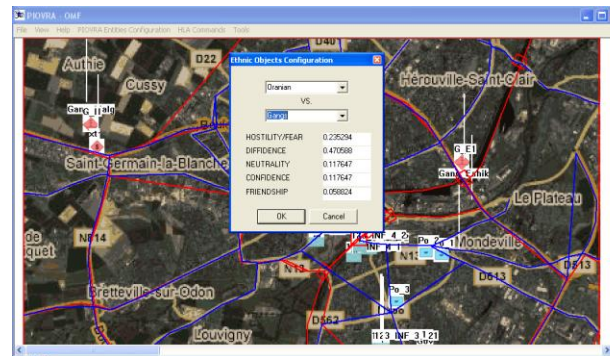
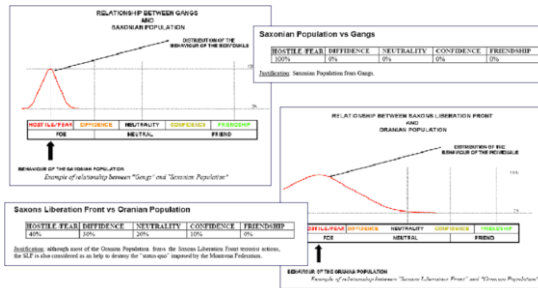
Polyfunctional Intelligent Operational Virtual Reality Agents



PIOVRA was an EDA Project developed in cooperation with Italian and French MoDs in partnership between MITIM DIPTM & LSIS.

PIOVRA allowed to develop a new Generation of CGF able to simulate “Intelligent” behaviors, filling up the gap between user requirements and current available CGF performances

PIOVRA demonstrated the new intelligent agents directing the CGF as effective models integrated in HLA Simulation reproducing Urban Disorders integrated in a Theater Simulation





RATS

Riots, Agitators & Terrorists by Simulation



RATS is a demonstrator based on Intelligent Agents for simulating Riots, Civil Disorders as well as Agitators and Terrorists actions within Urban Scenarios considering different entities and influence of Human Factors such as :

- Paramilitary Forces*
- Police Forces*
- Military Units*
- Population*

- Terrorists*
- Firefighters*
- NGOs*
- Protesters*

- Warlords*
- Health Care*
- Governmental Entities*
- Ethnic Groups*



	ORAMIAN POPULATION	ORAMIAN MINORITY	SAHARAS LIBERATION FRONT	SECURITY FORCES	SECURITY POLICE	SECURITY MILITARY	SECURITY CIVILIAN
SIMBIEN'S POPULATION	Neutral	Neutral	Friend	Neutral	Friend	Neutral	Neutral
ORAMIAN MINORITY	Neutral	Neutral	Neutral	Friend	Neutral	Neutral	Neutral
SAHARAS LIBERATION FRONT	Neutral	Neutral	Friend	Neutral	Friend	Neutral	Neutral
SECURITY LOCAL POLICE	Friend	Neutral	Neutral	Friend	Friend	Neutral	Neutral
SECURITY FEDERAL POLICE	Friend	Friend	Friend	Friend	Friend	Friend	Friend
SECURITY MILITARY	Friend	Friend	Friend	Friend	Friend	Friend	Friend
SECURITY CIVILIAN	Friend	Friend	Friend	Friend	Friend	Friend	Friend
RED FORCES	Friend	Friend	Friend	Friend	Friend	Friend	Friend



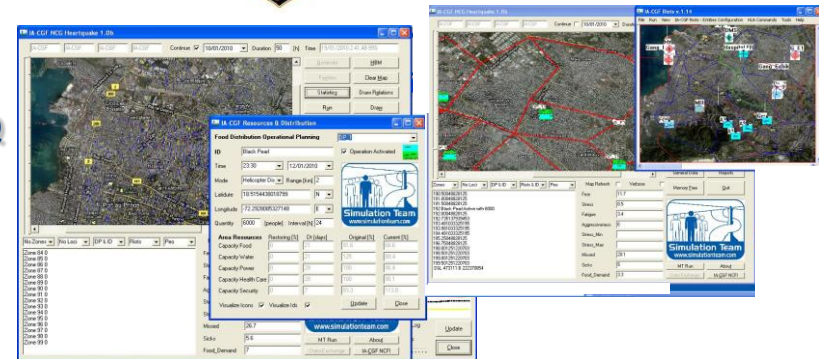
Haiti Case

IA-CGF NCF Riots & IA-CGF NCF EQ

The Demonstration was based Haiti Earthquake 2010 and presented by USJFCOM at ITEC within 2 months.

The demonstration was devoted to show the potential of interoperability in combining different simulators for full coverage of a complex problem such as that one of Haiti.

Simulation Team was involved by using his interoperable IA-CGF reproducing Population Behavior, Human Factors (famine, stress, diseases, fear, aggressiveness), Riots and Gang Activities as well as the impact of the Simulation Earthquake

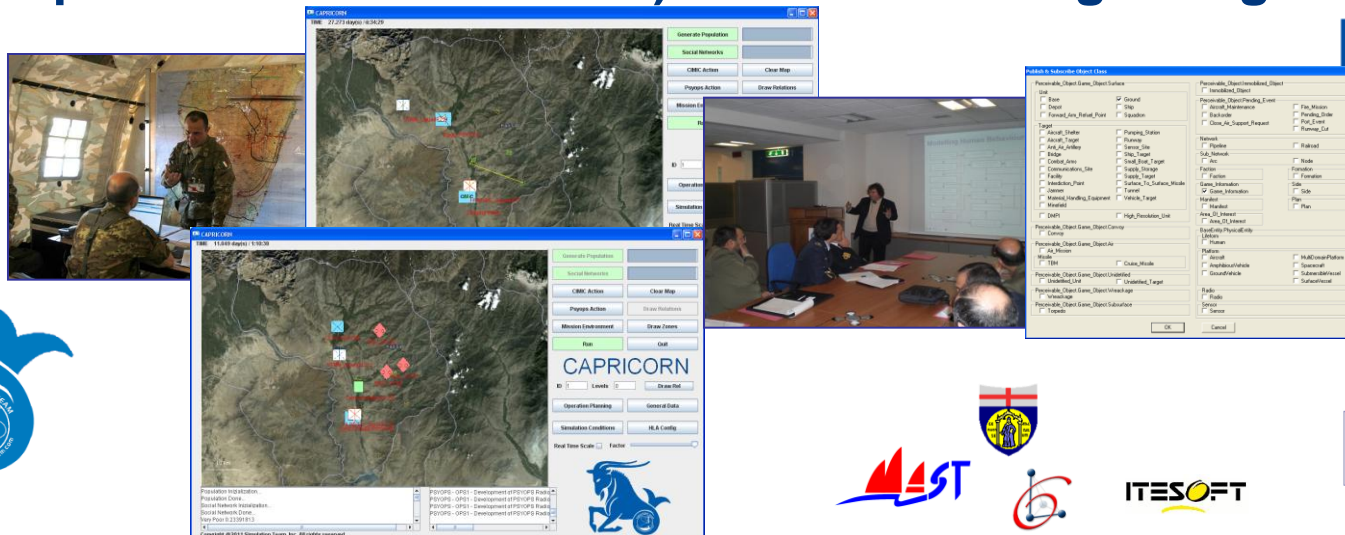




CAPRICORN

Civil Military Co-operation And Planning Research in Complex Operational Realistic Network

- CAPRICORN is an active EDA R&D Project devoted to develop capabilities in the complex and critical sector of Military Operation Planning, specifically for asymmetric warfare scenarios involving CIMIC and PSYOPS, by using CGF (Computer Generated Forces) based on Intelligent Agents (IAs)



Simulation Team



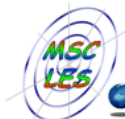
SIMCJOH Project



The SIMCJOH (Simulation of Multi Coalition Joint Operations Involving Human Modeling) project is a joint R&D initiative coordinated by University of Genoa (Italy). SIMCJOH objectives are to study and develop new simulation models, in order to support the decision makers in Joint and Multi-Coalitions scenarios, considering a strong involvement of human factors with a particular focus on issues of refugees and civilians, natural disaster relief with presence of civilians in a theater of military operations; the initiative get benefits from innovative researches in population and human behavior modeling



DIME
Università
di Genova





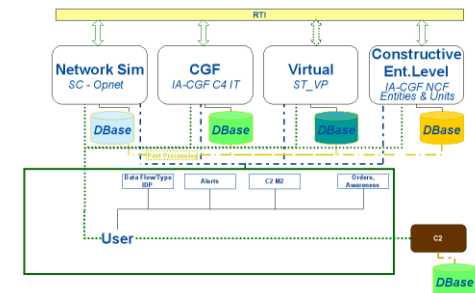
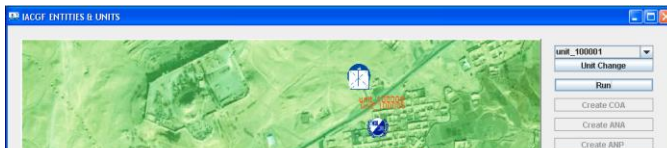
CeSiVa

CGF C4 IT

Computer Generated Forces C4 for Italian Army



CGF C4 IT Project allows to measure the effectiveness of different C2 Maturity Models involving local and coalition forces, police and other resources in an foreign urban framework. This Federation is based on use of IA-CGF and SC and is devoted to support Italian Army Simulation in term of experimentation and analysis of technologies and policies



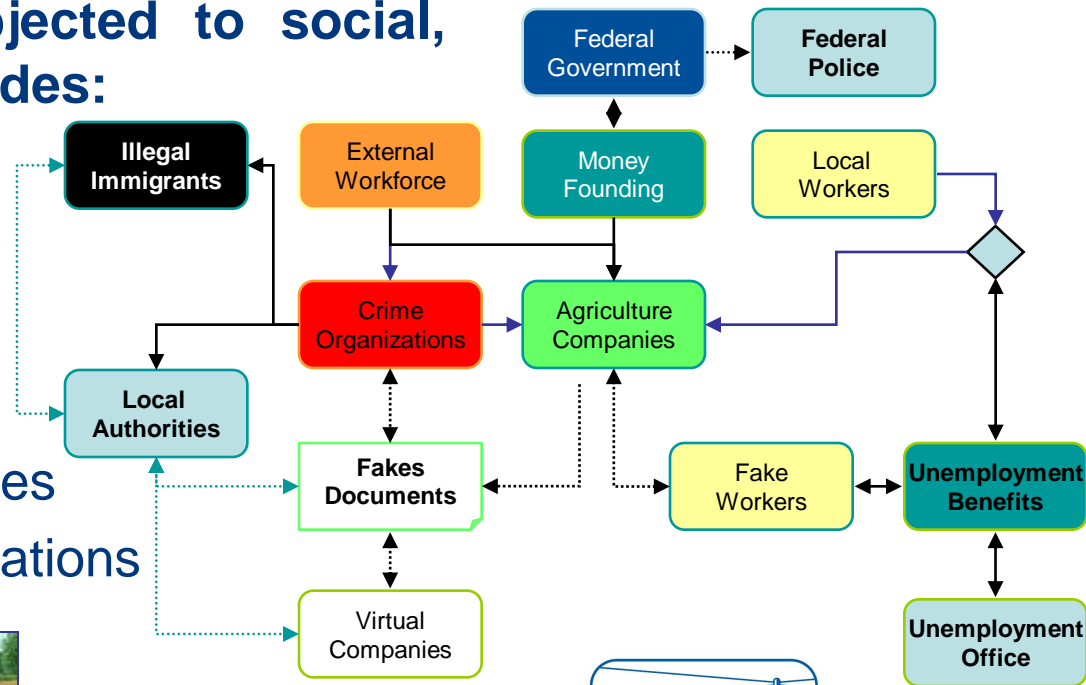


INDASTRIA

This model is inspired by real case and simulate a region subjected to social, economic crisis, it includes:



- Small Region Simulation
- Social Multi Ethnic Reality
- Real & Fake Economy
- Civil Disorders
- Federal vs. Local Authorities
- Polices vs. Crime Organizations



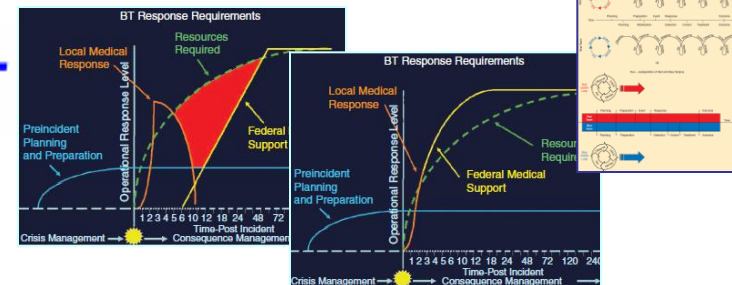
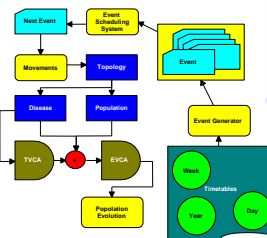
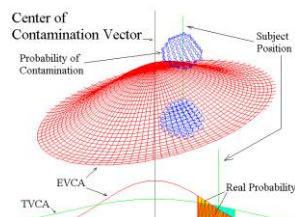


PANDORA

PANdemic Dynamic Objects Reactive Agents



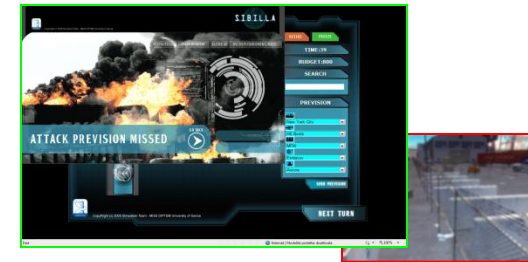
- PANDORA addresses the dynamics of the spreading of a Pandemic and experiments are on-going on H1N1 influenza A virus by a joint simulation project involving USA, European and Australian R&D Centers (MITIM DIPTM, Dartmouth College, CRiCS).
- PANDORA proposes to use an evidence-based approach whereby statistical data (census) and ethnographic surveys are source for the model and integrated with Human Factors representing the psychological and social parameters impact on people behaviors and their reaction to containment measures and policies
- PANDORA evaluates the efficacy and cost benefit of various mitigation strategies such as school closures, target anti-viral prophylaxis and other mitigation measures, level of absenteeism, and its impact on commerce, industry, economy and functioning of society as well as population attack rate, risks related to specific groups and on flows across State borders.





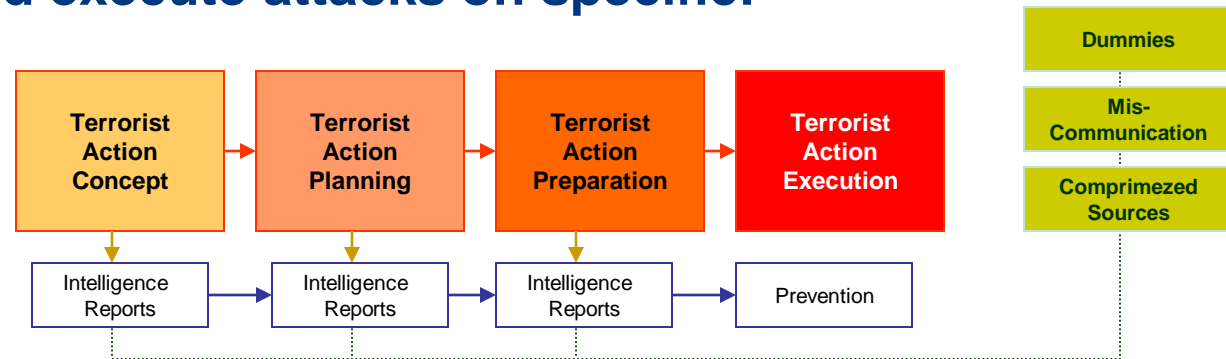
SIBILLA

*Simulation of an Intelligence Board
for Interactive Learning and Lofty Achievements*



- SIBILLA is multiplayer web strategy game that simulate Terrorist Actions organized by different organization directed by IA that plan, prepare and execute attacks on specific:

- Location
- Site
- Time
- Threat Type



- The intelligence reports are distributed among the players based on their capabilities and shared by a stochastic engine
- The Identification of the attacks in time is the key for individual success; the players cooperate and compete for budget and success
- Threat missed to be identified generate terrorist attacks that reduce global trust and support to intelligence agencies



SGT-SDM

Serious Games for Training in Strategic Decision Making



ACT has activated the SGTSDM as a R&D Project to investigate the use of Serious Games for Training in Strategic Decision Making. The project involves an international team including ACT, NATO Defense College, ARRC, M&S COE, Simulation Team, MITIM DIPTM University of Genoa and MAST.





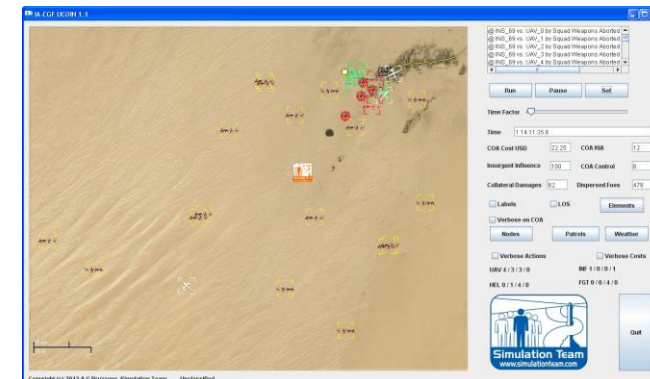
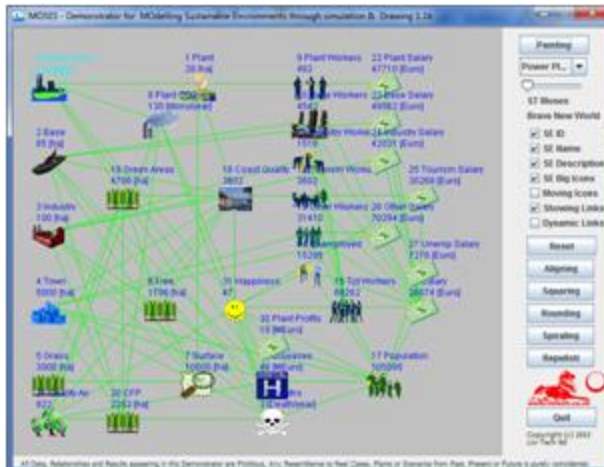
DYTACCO

Dynamic Targeting Collateral Damages and Consequences



Simulation Team

DYTACCO is a Dynamic Targeting simulator focused on evaluating collateral damages, risks and consequences of operations in complex operative contexts. DYTACCO is a Serious Game conceived for commanders and intelligence staff training. The Simulator proposes challenging Dynamic Targeting Cases to the JFIB (Joint Fire and Intelligence Branch), requiring them to define the Decision Making Briefing for Commander considering risks, collateral damages, consequences, available assets, caveats, etc. The Commander finalizes the decision on the Dynamic Target case that is elaborated by this simulator providing direct and indirect outcomes of different alternatives on the scenario evolution.





CRYSTAL

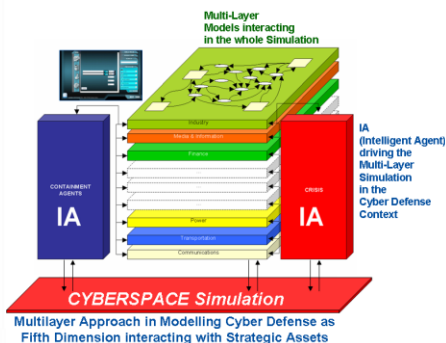
Cyber Reality Simulation for Threat Assessment and Defense Learning



Simulation Team



The CRYSTAL is a PNRM Proposal to the Italian MoD coordinated by Genoa University. CRYSTAL Goals is to develop a simulation framework able to simulate Cyber Defense scenarios related to the Different Layers representing Strategic National Assets (i.e. energy, communication, finance, transportation); CRYSTAL is a modern interoperable architecture allowing a modular approach aimed at advancing the research in a Cyber Defense by using a federation of interoperable stochastic simulators driven by IA-CGF (Intelligent Agents Computer Generated Forces).





PSYSOP

Psychological and cultural Simulation Of Population

PSYSOP is a Simulator Reproducing a Town including Psychological and Cultural aspects affecting the Population behavior and reactions. The model includes social, cultural, educational, psychological, gender, age, religion and many other parameters including the social networks related to family and work environment and their influence on the scenario evolution.



PSYSOP 1.0

Id | Levels | Extend

PSYSOP 1.0

PSYSOP 1.0

Simulation Team
www.simulationteam.com

Générer Explosion
Families Clear Map
Statistics Draw Relations
Run Draw
Memory Free Quit

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Inhabitants: 20000
Manned: 5567
Sons: 4323
Olds: 2458
Friends: 18952
Education: 1.40525
Sex: 0.474500000476837
Age: 38.9463996987207
Social: 1.81474995613058
Party: 2.31909930310669
Religion: 4.24545620675559



MIAC

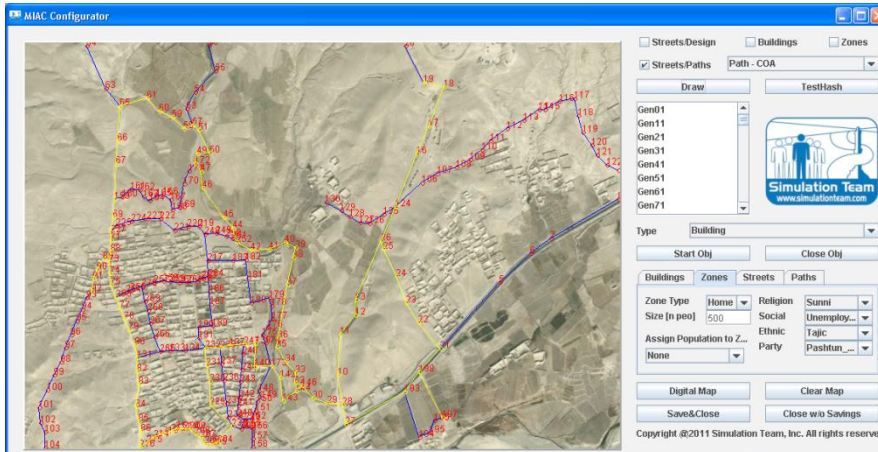
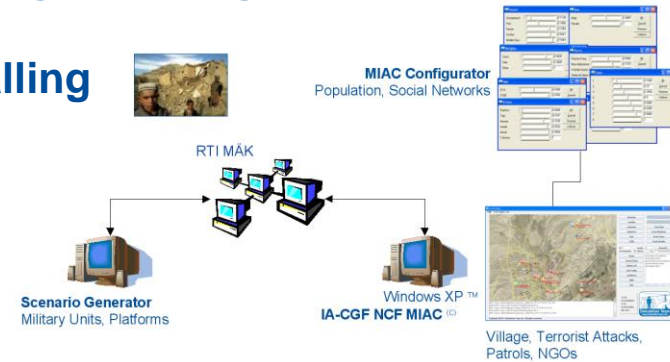
Models of Intelligent Agents for Computer Generated Forces



Simulation Team



MIAC NCF and MIAC Configurator are designed to drive a Federation where the IA-CGF allows to reproduce population within an Afghan Village. MIAC Federation is designed to operate under HLA using RTI MÄK on Workstations using Windows XP™ O.S. and installing IA-CGF NCF MIAC© derived by IA-CGF NCF PSYSOP© MIAC is interoperable with other federates (i.e. Scenario Generators) while the MIAC Configurator supports the Scenario Definition





Conclusion



- Training is required more and more to address Human Factors in order to prepare to operate over new scenarios within a Comprehensive Approach.
- Federating HBM in future CAX could allow to consider:
 - Constraints and Interactions among the actors involved (military and civilians)
 - The different layers characterizing social structures
 - Military elements with a major emphasis on C2 aspects (but also including intelligence and logistics).
 - Human Behavior and cultural factors
 - Quantitative estimations that will clearly support the experimental analysis.



References



DIME

DIME University of Genoa

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www.simulationteam.com

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