



# Strategic Engineering & Innovative Modeling Paradigms



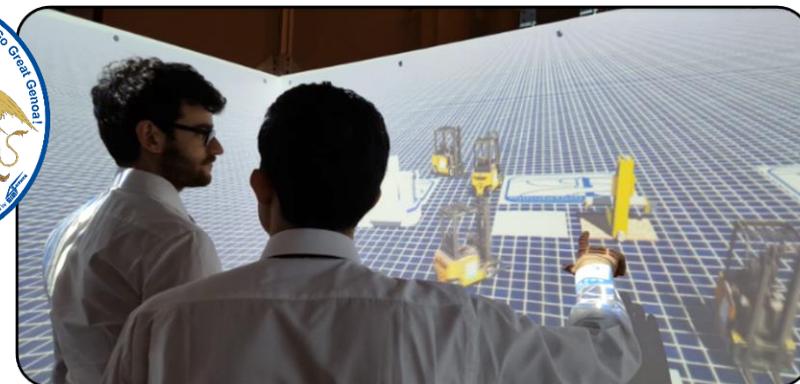
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HMS\_05



DIME  
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## Objectives



**New Modeling Paradigms offers, nowadays, interesting capabilities in extending use of Simulation for new application and new users**

**Strategic Engineering is investigated as effective approaches to find solution to many actual problems, starting from training of personnel and up to strategic planning and development.**

**MS2G (Modeling, interoperable Simulation and Serious Games) is analyzed as promising approach in developing new generation simulators to support Strategic Engineering**

**Cultural evolution of analysts and decision makers is a key point to further develop these concepts and promoting new E&T initiatives based on M&S is fundamental to succeed**

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# Strategos & Smart Simulation



夫未戰而廟算勝者，得算多也；  
未戰而廟算不勝者，得算少也；  
多算勝，少算不勝，而況於無算乎？  
吾以此觀之，勝負見矣。



Sun



Now the general **who wins** a battle makes **many calculations** in his temple ere the battle is fought. The general who loses a battle makes but few **calculations** beforehand.

**Thus do many calculations lead to victory, and few calculations to defeat: how much more no calculation at all! It is by attention to this point that I can foresee who is likely to win or lose.** Sun Tzu, Art of War, Laying Plans, 7, 500 BC



## Challenges along Millennia...



**440 BC**  
 τοσοῦτοι ἵπποι τε καὶ ἄνδρες διεστέθαι κατὰ  
 ἡμερησίην ὁδὸν ἐκάστην ἵππος τε καὶ ἄνθρωπος τεταγμένους· τοὺς οὔτε ψροτός, οὔκ  
 ὄμβρος, οὔ καύμα, οὔ νύξ ἔργα μὴ οὐ κατανόσαι τὸν προκειμένον αὐτῷ δρόμον τὴν  
 ταχίστην.  
**HERODOTUS, Book 8, 98**

### Neither snow nor rain nor heat nor gloom of night stays these couriers from the swift completion of their appointed rounds

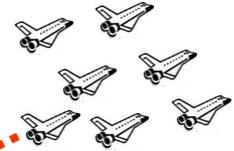




... Corresponding Today to...

# ...Science Fiction!

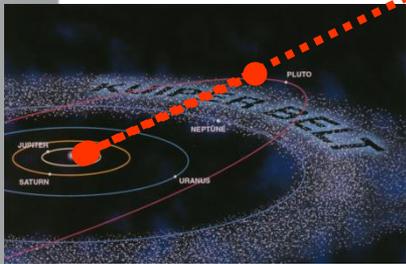
3 times more Far Away than this Distance!  
7 Days To Communicate!



10'000 times  
more than that!  
70'000 Space  
Shuttles!



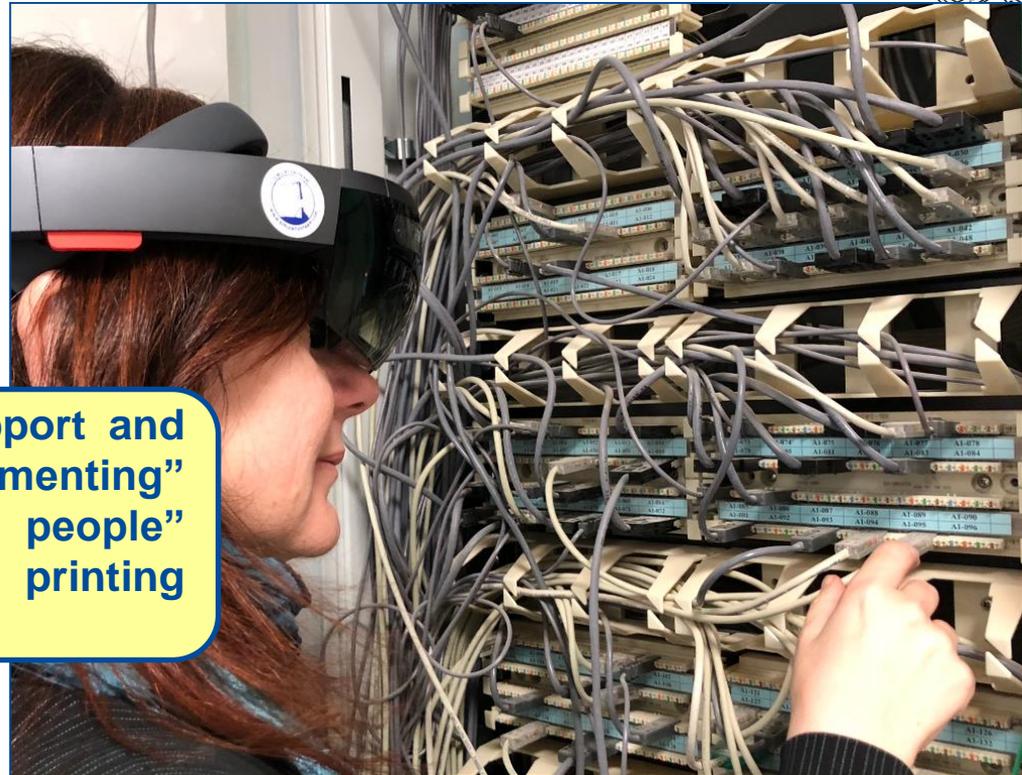
Over 20'000 times  
more Expensive  
than the full  
Gross World Product!





... Corresponding Today to...

## ...Science

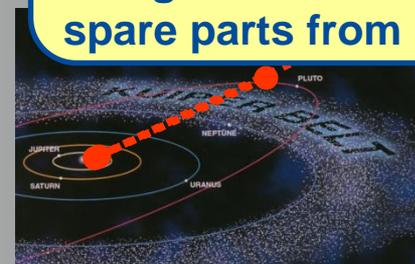


100 times  
more than that!  
10 Space  
Shuttles!



Today we can guarantee support and service on the field by “augmenting” capabilities of our “on site people” using new Technologies & printing spare parts from dust

than the full  
Gross World Product!





# Costs & Services in Logistics: UPS Point of View

## Best Service and Lowest Rates



*Jim Casey, Founder UPS (1907 with 100USD as teenager, in 2016 38'000 MUSD sales and 70% US Market Share)*

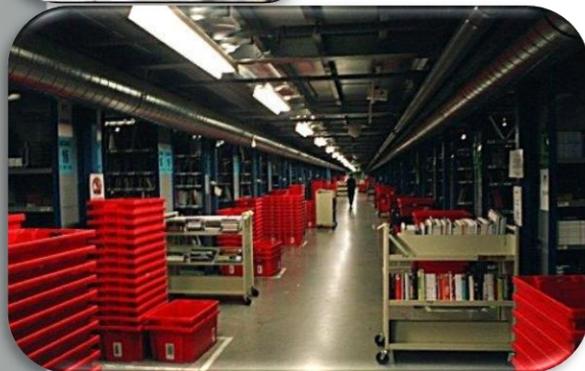


The opportunity emerged from finding out that several customers were available to pay more, respect the pretty good US Postal Service, just to obtain an even more efficient service.

# The Best .Com Retailer

We are far from being experts at managing inventory, even though we turn our inventory faster than you know, almost every physical retailer and it's not because we're inventory brainiacs

*Jeff Bezos Founder & CEO Amazon.com (in 2004 Ranked 1129th World Company and 82th World Richest Person, 5.26 GUSD Sales, 40 MUSD profits, CEO Salary 82'797 USD/year, 2018:26<sup>th</sup> World Company, 135 GUSD Sales, 2'371 MUSD Profit)*



Design of new Web Based Supply Chain produced a Profit increase of 590% over 14 years



# Alibaba: Hangzhou is Back



*[Hangzhou] most noble and beautiful town of the world [...] with over 10'000 bridges [...] someone allowing passage of a Caravel (Marco Polo, 1299 AC)*

**You can talk about the miracle of ecommerce in China or in the world, but the logistics industry is where China's real great miracle has been over the past decade.** *Ma Yun (马云) alias Jack Ma, co-founder and executive chairman of Alibaba (2018, Personal Net Worth 42.2 GUSD; Alibaba 462th World Raking, 23.8GUSD Revenues, 6.2GUSD Profits, 56% Growth in Net Revenues, Stocks +15% 1*



**"Companies need to be considering logistics problems of the future, like delivering to space stations"**



# Today: Living in a Paradox

*In 2018:*

Uber, the world's Largest Taxi Company,...



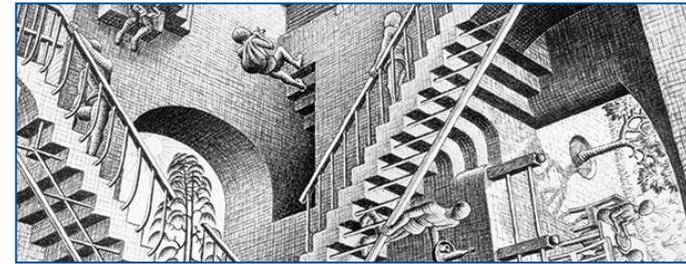
Facebook, the most popular media owner,...



Alibaba, the most valuable retailer,...



Airbnb, the largest accomodation provider,...



owns no Vehicles



U B E R



creates no content



has no inventory



owns no real estate



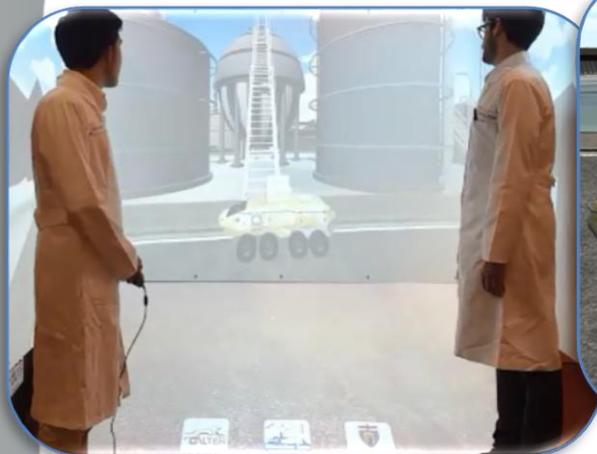
sitive | airbnb





# MS2G Paradigm as new Enabler

The innovative concept of MS2G (Modeling, interoperable Simulation and Serious Games) allows to develop interoperable scalable and reusable simulators with benefits of new Immersive Solutions. MS2G is very flexible and enable use from different platforms: regular laptops, computers, CAVE (Computer Automatic Virtual Environment) large enough to immerse 4-5 people in the Virtual World, HDM, HoloLens as well as Smartphones and Tablets



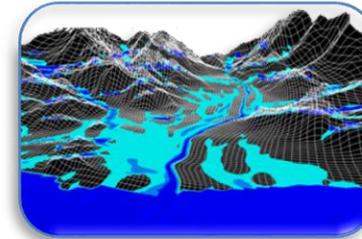


# MS2G Paradigm as new Enabler

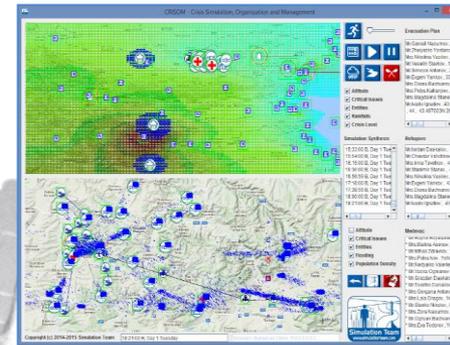
MS2G



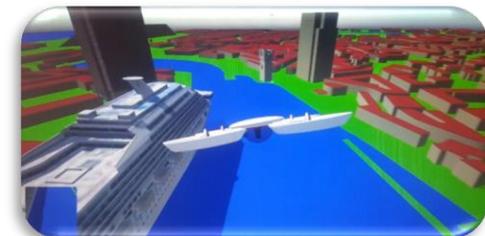
Modeling



interoperable Simulation



Serious Games





# Interoperable Virtual Simulators & Models

Simulation Team



The Smart Simulators represent the crucial element to support advance and revolution in Engineering, Management and Training. The Virtual Simulators are aids for Operative Resources, Technical Staff & Decision Makers. The Interoperability of simulators could be based on most advanced standards and paradigms (i.e. HLA High Level Architecture, MS2G, Modeling, Interoperable Simulation & Serious Games). These Solutions enable stand-alone and Federated Simulation of Operations, Activities and Processes.

*Simulation Team have very long experience in Project with major Industries and leading International Agencies and Institutions*



Simulation Team



AI & IA

Smart Planner

# Example of Overall Architecture

**Simulation**

**Man on the Loop**

**VR & AR**

*Real Situation*

*Manual & Automated Planning*

*Simulation for Optimization & Alternative Evaluation Based on Intelligent Agents*

MR

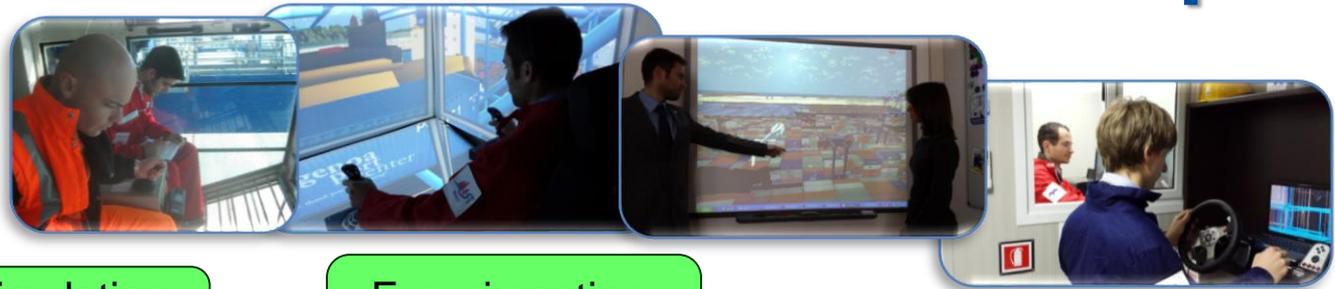
*Multiple Methods for Analyzing Historical & Current Data*

**Data Analytics**





# ... Serious Games Evolve into Simulation Team Roadmap



Training on the Job

Simulation for Training

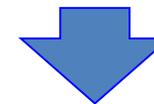
Experimenting on the Simulator

Serious Games for Training

Playing while Learning

Experimenting on Games

Many More Installations  
Many More Users



New Education Modes  
New Utilization Modes

[Nuclear War]  
..a strange game the only winning move is not to play  
*Joshua in War Games Movie*





# Strategic Engineering

**Strategic Engineering** is a pretty new approach, emerging in Excellence Centers around the World, where New Technologies and Methods face Challenges & Uncertainty in Complex Systems



**Strategic Engineering** is the process of designing and analyzing New Solutions in order to achieve Strategic Results against *risks, uncertainty, competitors, threats and within critical environments*

**Strategic Engineering** is crucial to develop Modern Solutions for *Defense, Homeland Security, Government* as well as for *Industries, Companies, International Agencies & Public Authorities*



# Strategy !?!



Classic Definitions: **Strategy** relies on effective plans able to achieve success in challenging situations such as business, politics, war, etc.

**Strategy**, Greek word, combines *stratos* (army) and *ago* (leading): Leading Resources

*"La **Stratégie** est l'art de bien diriger"*

*Gen.Jomini, Précis de l'Art de la Guerre, 1838*

*"We need a philosophy of **Strategy** that contains the seeds of its constant rejuvenation, a way to chart strategy in an unstable environment"*

&

*Von Clausewitz, Vom Kriege, 1832*

*"**Strategy** is a system of expedients"*

*"No plan of operations extends with any certainty beyond the first contact with the main hostile force"*

*Von Moltke, Militarische Werke, 1871*

*"Today, to be a great company, think about what **Social Problem** you could solve"*

*Ma Yun, Alibaba Executive Chair, in 2018: Personal Net Worth 42.2 GUSD; 23.8GUSD Alibaba Revenues 6.2GUSD Profits, 56% Net Revenues Growth, Stocks +15% in 1 month*



# STRATEGOS: Master Science in Engineering

A new Educational Degree in  
Engineering Technologies for Strategy in Defense,  
Industry, Government & Homeland Security in Companies



- **STRATEGOS** is the new International MSc (Master Science) in Strategic Engineering (Laurea Magistrale in Italia, 2 anni)
- **STRATEGOS** promotes Quantitative Modeling to Support Decisions by developing a new generation of Engineers able to deal with Strategic Thinking & Decision Makers
- **STRATEGOS** prepares Engineers for Decision Making providing strong foundation in Modeling, Simulation, Scenario Analysis as well as in Enabling Technologies



[www.itim.unige.it/strategos](http://www.itim.unige.it/strategos)



# Some new way to... Perish!



- 1995 Mercedes from Munich to Denmark, 1600 km
- 1996 Parma University follow lane marks, 1900 km
- 1997 NAHSC, 20 vehicles in I7 San Diego
- 2004 DARPA, failure on running in the Desert
- 2005 Parkshuffle near Rotterdam
- 2007 DARPA, urban challenge won by Chevy CMU
- 
- 2014 Vislab 20' in Rush Time →30M\$ by Ambarella
- 2016 Daimler AG smart parking in Stuttgart HQs
- 2016 Tesla first Casualty
- 2016 Nutonomy in Singapore, Self Taxi Service
- 2016 Uber testing in Pittsburgh
- 2017 Uber banned in London after Vancouver & Austin

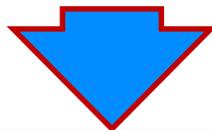
18 millions of Taxi Drivers Worldwide



900'000 Truck Drivers In Italy



200'000 Uber Drivers Worldwide



CMU  
DARPA  
NAHS

Carnegie Mellon University  
Defense Advanced research Projects Agency  
National Automated Highway System Consortium  
2015 Statistics



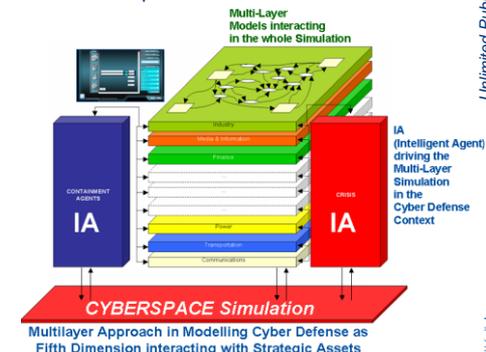
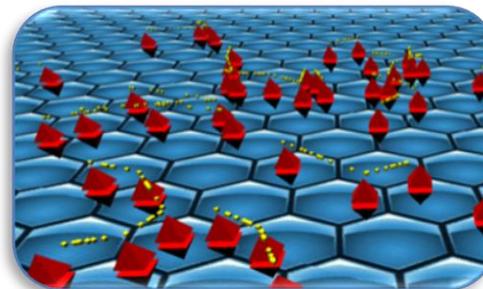
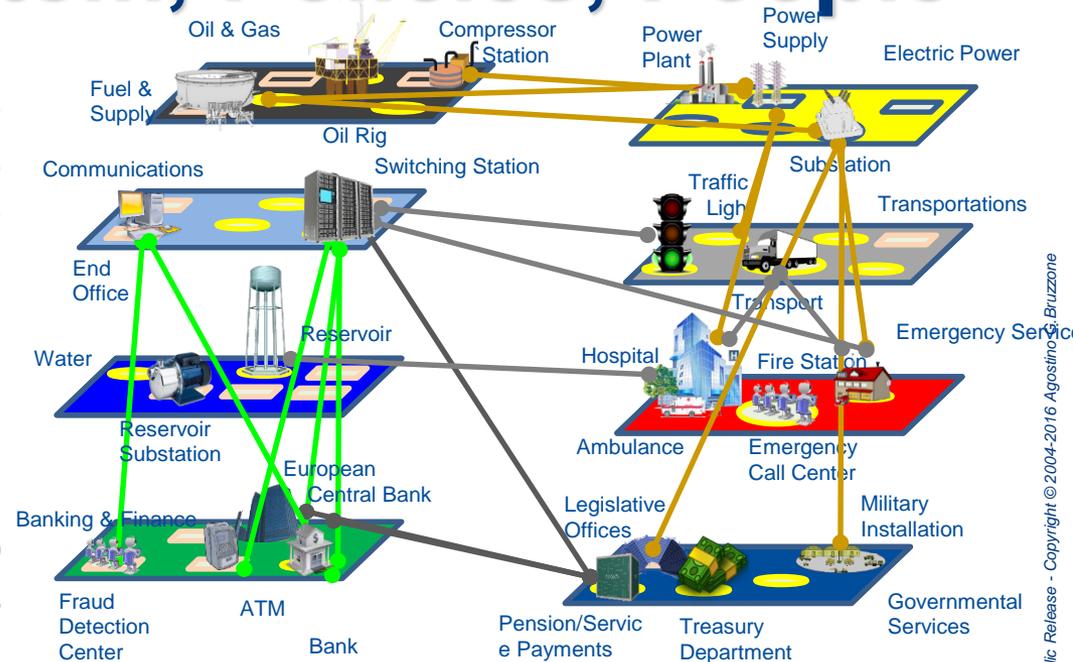


# Multi-Layer Simulation for New System, Policies, People

The Modern Systems are usually addressing Multiple Layers and requires to consider multiple aspects for developing

- New System Design
- New Policies & Procedures
- New Technologies and Processes
- Table Top Exercise in order to understand and raise awareness by Human and Machine Learning
- Education & Training Programs for Multiple Players

The use of AI & Intelligent Agent is crucial to automate Smart Simulation



Multilayer Approach in Modelling Cyber Defense as Fifth Dimension interacting with Strategic Assets

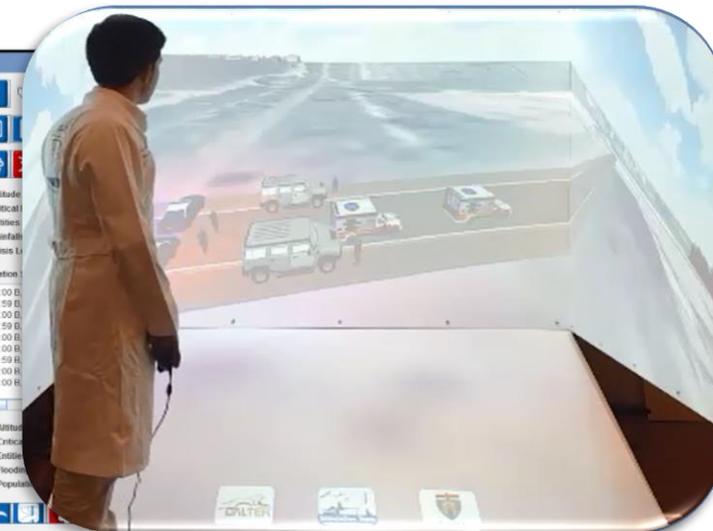
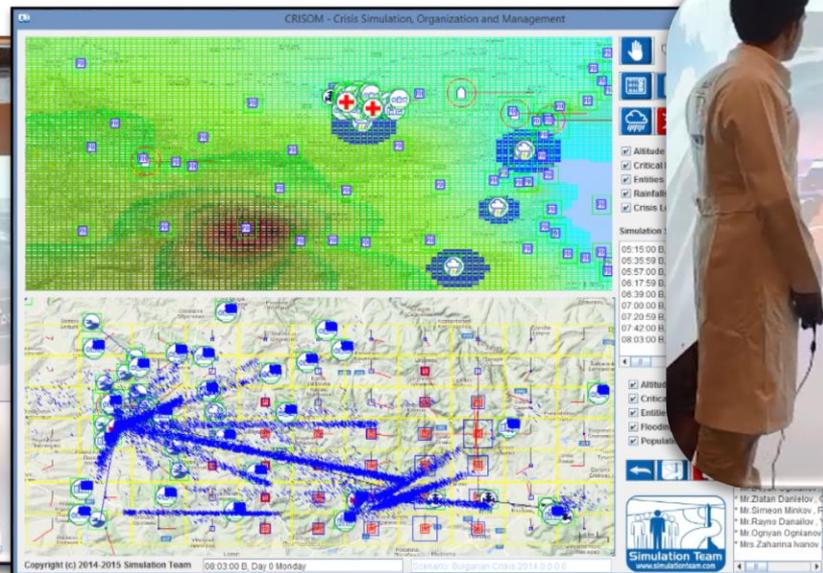
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## MS2G and IA-CGF

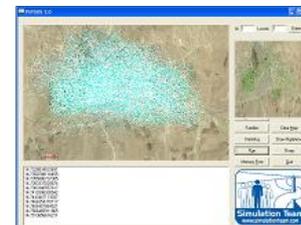
The MS2G (Modeling, interoperable Simulation and Serious Games) could be combined with use of IA (Intelligent Agent such as IA-CGF by Simulation Team). The Intelligent Agents simulate concurrently many actors, people and actions enabling to recreate and study very complex scenarios to improve trainee engagement





# Agent Directed Simulation Benefits

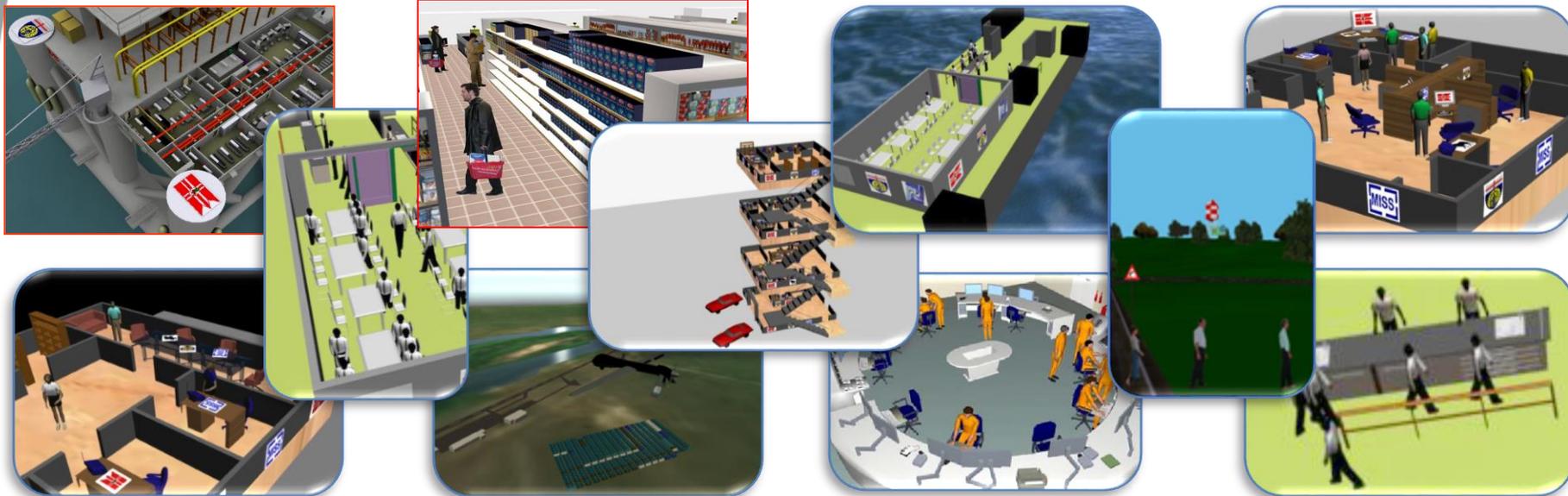
- Simulation of Complex Behaviors related to People, Organizations, Entities and Resources
- Experimentation with a reduced workload thanks to the agents autonomous behavior able to replace man-in-the-loop and help in scenario setup
- Execution of large number of simulation runs and replications  
Allow collective training with limited Personnel
- Investigation of New Policies and Regulations on the Simulation
- 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 Expert Contributions and Creativity by operating over Realistic and Reactive Simulation Frameworks





# Intelligence to Simulate Humans as well as to Interact

The data flows, business processes are usual crucial in systems. The Human Behavior Models (HBM) are required to enable Smart Simulation in order to reproduce people, organizations, companies, cities,, so it is very important to use Intelligent Agents to reproduce these elements & their interactions





# Benefits from *IA-CGF*

*Intelligent Agent Computer Generated Forces*



- Introduction of Composable Elements in the Simulation Environment
- Reduction of Workload for Experimentation
- Speeding Up Scenario Preparation
- Supporting Data Farming and Experimental Analysis
- Simulate Complex Non-Conventional Asymmetric Scenarios
- New Capabilities to evaluate Impact of Second Effects
- New Sparring Partners







# Conclusions



**Strategic engineering results a new discipline arising from the necessity to combine different enabling technologies in decision making.**

**The use of MS2G paradigms in the Strategic Engineering is promising and have a great potential to educate a new generation of engineers**

**Future challenges will strong rely on Simulation, Data Science and AI to be solved by experts in strategic quantitative sciences devoted to model and investigate complex systems.**

**Seeral critical issues, opportunities and requirements have been identified and address by this research in different sectors**

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Università di Genova



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# New Frontiers &... ...New Engineers



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