

# System of Systems Engineering Workshop



# Welcome



Liophant  
Simulation



McLeod Institute of  
Simulation Science



University  
of Genoa



Orizzonte  
Sistemi Navali

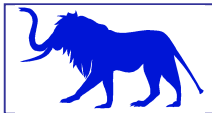


DIPTM  
Università di Genova

Unclassified



# Complex Systems & System of Systems Engineering



Liophant Simulation



M&S Net



McLeod Institute of Simulation Science  
Genoa Center

**Agostino G. Bruzzone**

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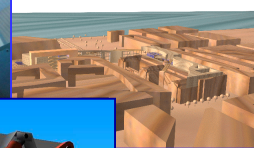
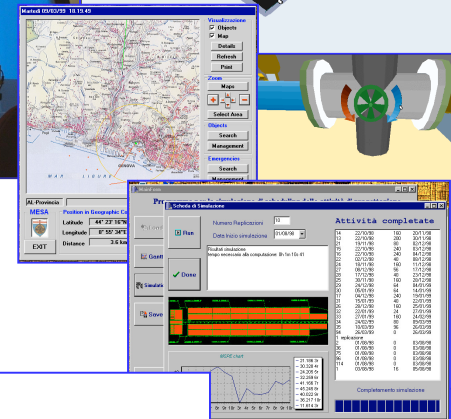
*www.simulationteam.com*

*www.mcleodinstitutue.org*

*www.liophant.org*

*www.itim.unige.it*

*www.ms-net.org*





## Who We Are?

Universities, Research Centers and Companies operating worldwide in synergy for developing Innovative Solutions with a particular focus in Modelling and Simulation



DIPTM  
Università  
di Genova



Genoa



CentraLabs  
Cagliari



CSU  
Australia



CIREM  
Università di Cagliari



MSC-LES



Mik  
Riga TU



DIPMEC  
Università Calabria



MISS Universitat  
Autònoma de Barcelona



MISS  
Università di Perugia



LSIS  
Marseille



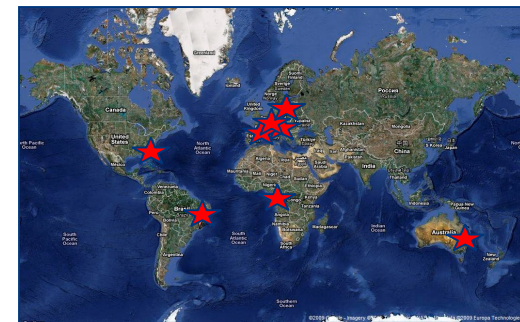
Rio de Janeiro  
Brazil



McLeod Institute of  
Simulation Science  
Genoa



IMS-LAPS  
Univ. Bordeaux



DIPTM  
Università di Genova



## McLeod Institute Simulation Science M&S Net Genoa Center

Email: [agostino@itim.unige.it](mailto:agostino@itim.unige.it)

URL: [www.itim.unige.it/mcleod](http://www.itim.unige.it/mcleod)  
[www.simulationscience.org](http://www.simulationscience.org)

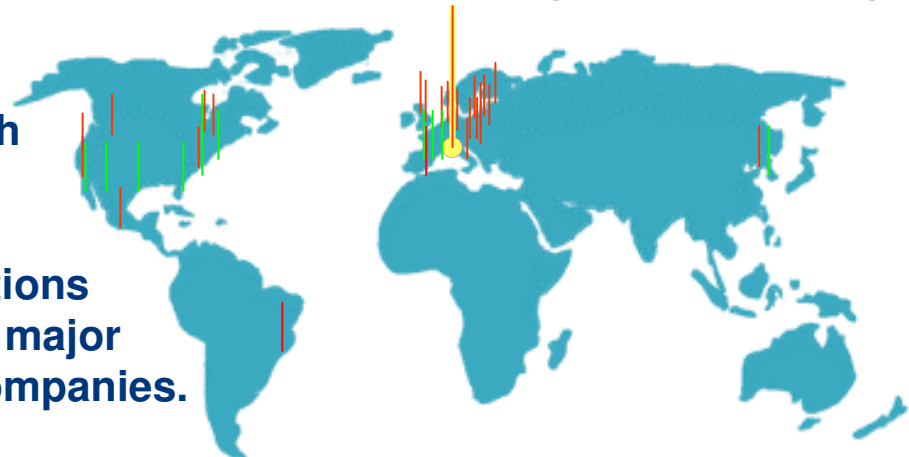


The research group of DIPTM of *Genoa University* is active from '60 in Simulation applied to Industrial Engineering and is part of MISS and M&S Net. The activities involve modeling, simulation, VV&A and analysis of Industrial Applications and Services (design, re-engineering, management, training etc.)

as:

Chemical Facilities	Power Plants	PM
Harbor Terminals	Public Services Environment	
Manufacturing	Assembling	Logistics
Public Transportation		

The Department staff is in touch world-wide with the simulation community and is present actively to conferences, exhibitions and working meetings with the major Associations, Agencies and Companies.



28 MISS Centers, 34 M&S Net Centers World-Wide





# Simulation Team

# Simulation Team MISS DIPTM

The Simulation Team - DIPTM of *Genoa University* carries out many industrial simulation projects in cooperation with the large corporations and small and medium sized Enterprises; some example of recent industrial simulation project are following:



**Polimeri Europa ENI**



**Fleet Management Planning & Scheduling  
Chemical Plant Logistics Optmization**



**ADtranz**



**Ansaldo**

**Service and Optimization  
for Power Plant Design**



**Cetena**



**Fincantieri**

**Simulation & Virtual Project Management  
of Car Deck Construction for Fast Ferry**



**COOP**

**Simulation for Re-Engineering Supply Chain  
in a Large Chain of Grocery Stores**



Members of MISS are appointed in several positions in simulation community such as:

- General Director M&S Net (34 M&S Centers worldwide)
- Associate Vice President of SCS and Chairman of Technical Chapter
- Member of NATO SAS and NIAG
- Italian Point of Contact of ISAG (International Simulation Advisory Group)



# DIPTeM - University of Genoa

DIPTeM was founded in 1997 as evolution of the Institute of Technology and Industrial Management (ITIM) that was operative from '60. DIPTeM is composed by about 60 faculty members, 15 technicians and administrative, plus several PhD Students, external Researchers and Consultants. DIPTeM teachers are involved in Undergraduate, Postgraduate and Professional activities in Engineering, Management.

DIPTeM active in R&D Projects for major Institutions, Companies and Governmental Organisations. DIPTeM co-operates actively with major Excellence Centers World-Wide.





# University of Genoa: an Overview

The University of Genoa is one of the oldest in Italy and in the World (founded in 1471 AD), it is located in middle of Italian Riviera.

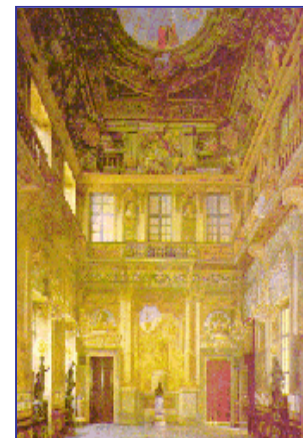
The students are about 40,000 (about 8,000 new entries), and the engineering departments has about 7,500 students (12% in Savona Branch Departments); in effect the Savona Campus Savona holds about 1,000 Engineering Students.

That campus is located about 2 km from Savona Downtown, in an old complex of barracks recently converted into new University Buildings (over an area of 200,000 m<sup>2</sup>).

For further Information about  
the University of Genoa:

<http://st.itim.unige.it>

<http://www.unige.it>



# Savona Campus & Facilities



The University of Genoa includes a new campus in Savona about 2 km outside Downtown; bus services and large parking areas guarantee easy access.

That structure has been obtained transforming Army barracks; today the campus includes a big park with facilities such as tennis courts and sport grounds.

The campus holds Depts on Engineering, Economy and Education; new laboratories have been realised by Simulation Team (Cybersar Mobile Lab, HLA Lab).

Facilities for Professional Congress Centres are available in the surroundings



*Savona Campus*



*Simulation Team Labs*



*Congress Centre*





## Partners & Spin-Off

Former Students and Researchers from MISS DIPTM Simulation Team created over the years spin off and companies that currently cooperate in M&S. MAST srl (**M**anagement of **A**dvanced **S**olutions and **T**echnologies) is devoted to drive Innovation to Success in a wide spectrum of Application for different Business Sectors, Companies, Corporations, Agencies, Societies and Governmental Services.



MAST puts *Modeling and Simulation* to work by creating Outstanding Solutions Essential to a Better, Safer, Healthier and Wealthier Life operating worldwide.

MAST offers a wide range of innovative products and services for markets including:

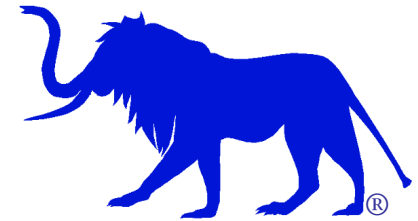
- Aerospace
- Defense
- Electronics
- Engineering
- Safety and Security
- Retail
- Environment
- Logistics
- Service to the Society (nutrition, health care)
- Petrochemical
- Energy and Power
- Shipping & Transportation





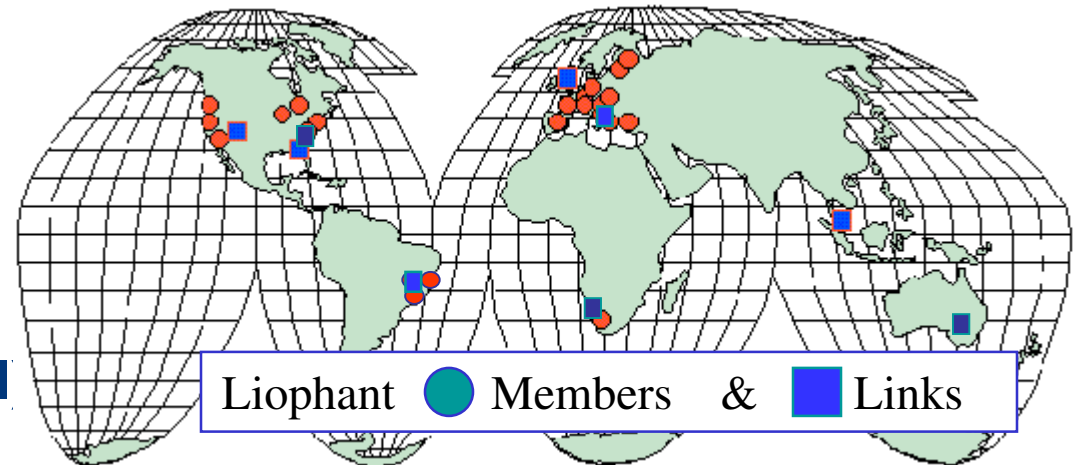
# Liophant Simulation

Email [info@liophant.org](mailto:info@liophant.org)



The *Liophant Simulation* involves World-Wide over 120 Scientists and Technicians working in Companies and Academia. The *Liophant* develops Advanced R&D Projects for Real Applications:

The *Liophant Simulation* promotes international Cooperations and exchanges with Excellence Centers World-Wide (i.e. NCS, KSC, VMASC, KPI)



[www.liophant.org](http://www.liophant.org)



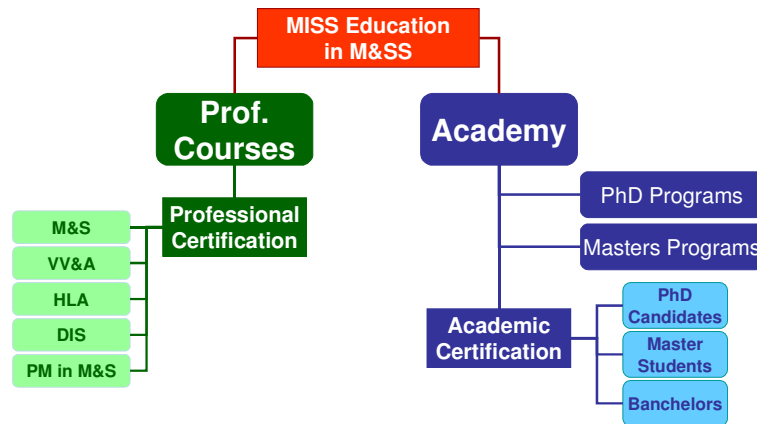
# The International Activity of Liophant Simulation





# Simulation Technology Transfer

Since 2000 Simulation Team - DIPTeM support Professional and Academic MISS International M&S Certification Program:



Course Location



Lecturing



Team Working & Exercises

The Lecturers included experts from major excellence centres (i.e. Boston College, Genoa University, NASA, DMSO, National Center for Simulation, SAIC, Aegis, CSY., Riga TU, UCF , McLeod Institute of Simulation Science).

The Professional course attendance (PM >100, M&S 60, HLA 40, VV&A 20) included Companies (i.e. Piaggio Aero Industries, Alenia Aeronautica, Alenia Marconi, SIA, Fincantieri, COOP), Academia (Pol.Torino, TU Delft, Univ.Marseille, Pol.Milano, Univ.Firenze, Univ.Bari, Univ.L'Aquila, etc.)

and National and International Services (i.e. Army, Navy, Air Force, Joint Forces)



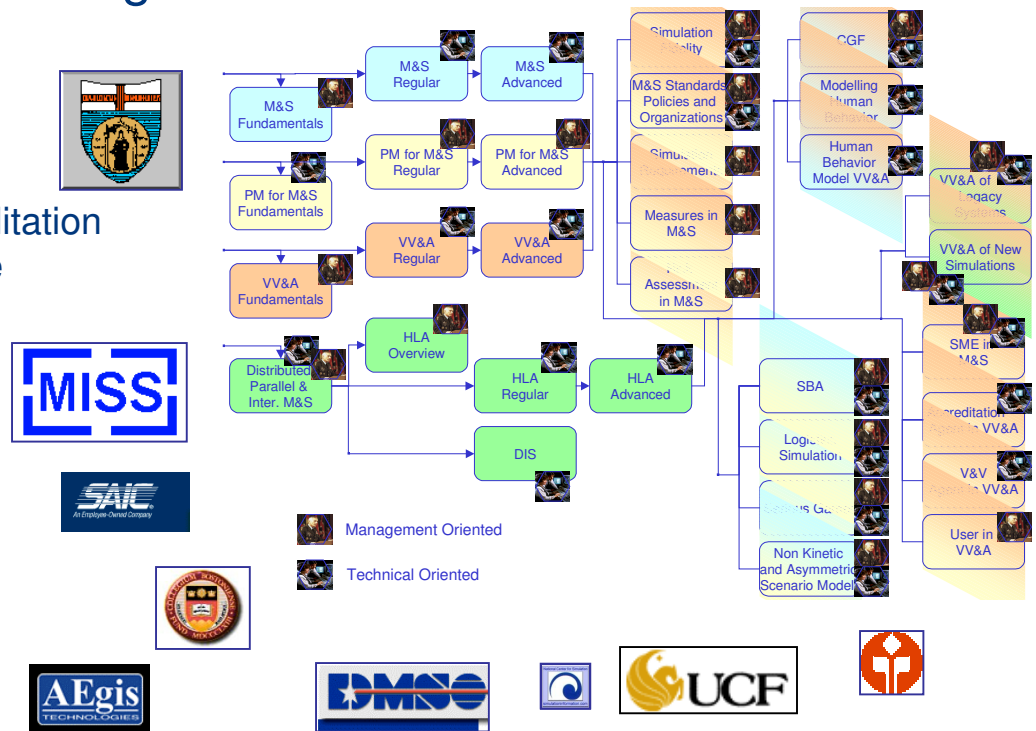
# Project: SIREN Professional Courses



The professional courses have been organized since 2000 for World-Wide professional experts and technicians, in English, Italian and French, including:

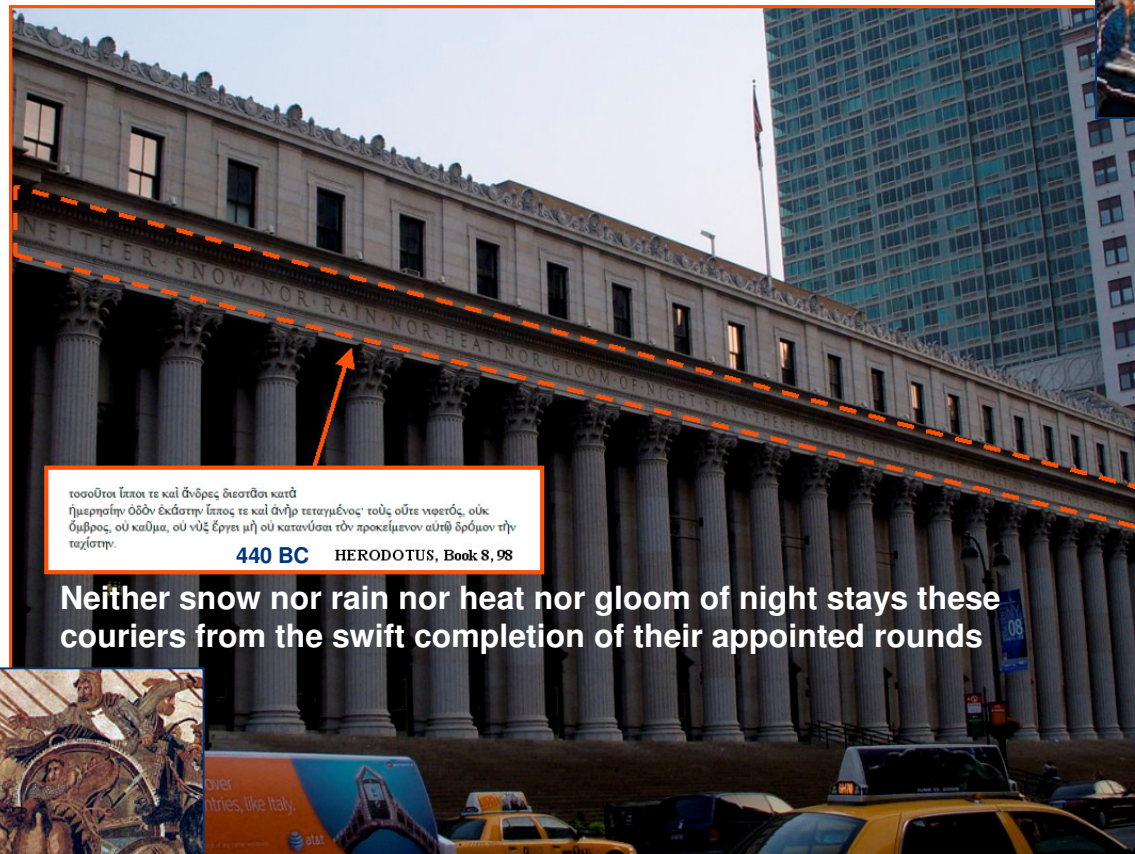
- PM: Project Management for M&S
- M&S: Modeling & Simulation
- Interoperability M&S
- HLA: High Level Architecture
- VV&A: Verification, Validation & Accreditation
- RCM: Reliability Centered Maintenance

The courses include lecturing and exercises; teachers are usually world wide experts from major excellence centers (i.e. Boston College, MISS, Genoa University, NASA, DMSO, National Center for Simulation, SAIC, Aegis Technologies, CSU, Riga TU, UCF, McLeod Institute of Simulation Science, etc.).





# System of Systems Engineering along Millennia



τοσοῦτοι ἵπποι τε καὶ ἄνδρες διεστίθαι κατὰ  
 ἡμερησίην ὁδὸν ἑκάστην ἵππος τε καὶ ἄνθρωπος τεταγμένοι· τοὺς οὔτε νηθεὶς, οὐκ  
 ὄμβρος, οὐ καύμα, οὐ νύξ ἐργεῖ μὴ οὐ καταλύσαι τὸν προκειμένον αὐτῶ ἄρῳμον τῆν  
 ταχίστην.

**440 BC** 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





# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?







# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?





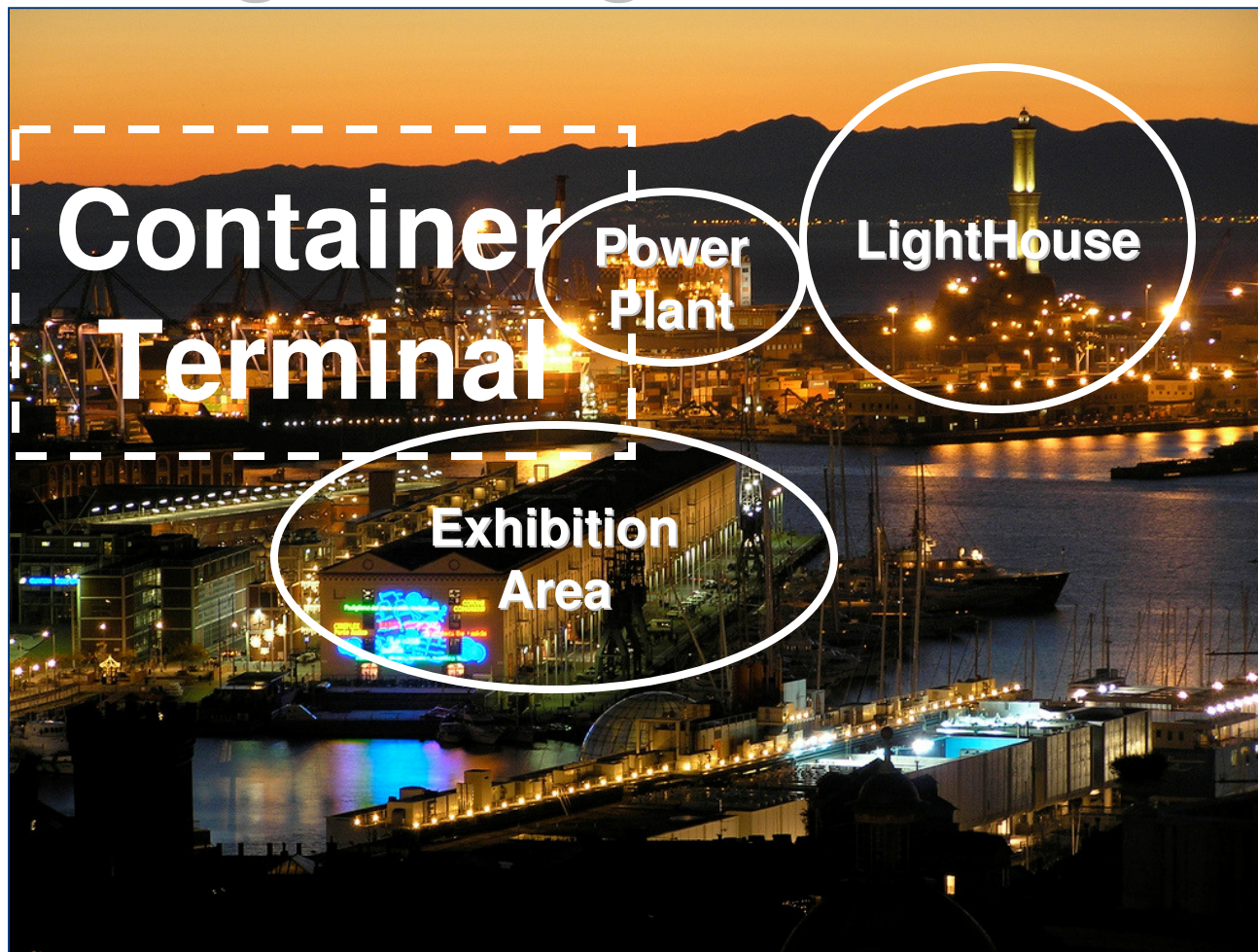
# System of Systems Engineering: Where is it?





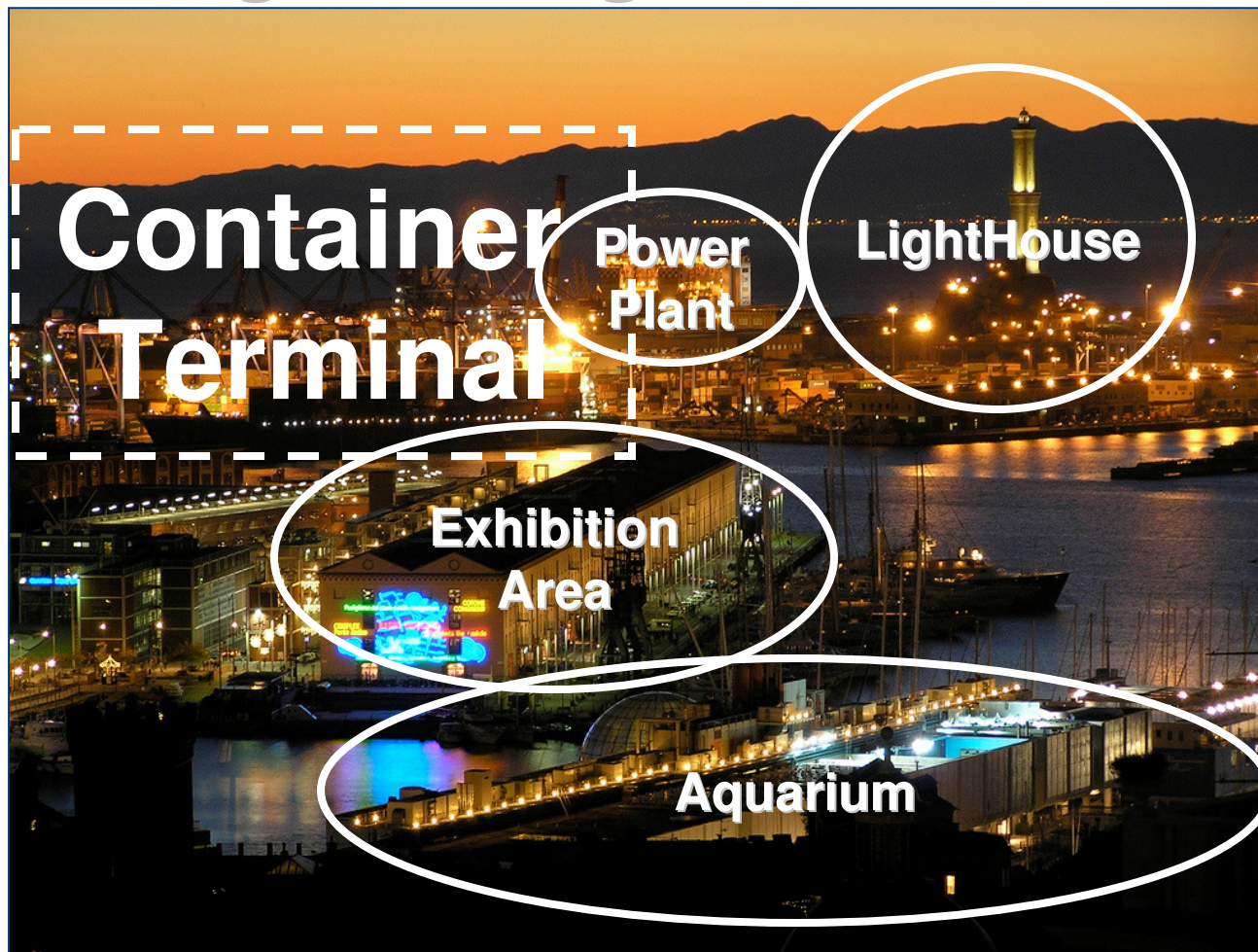


# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?



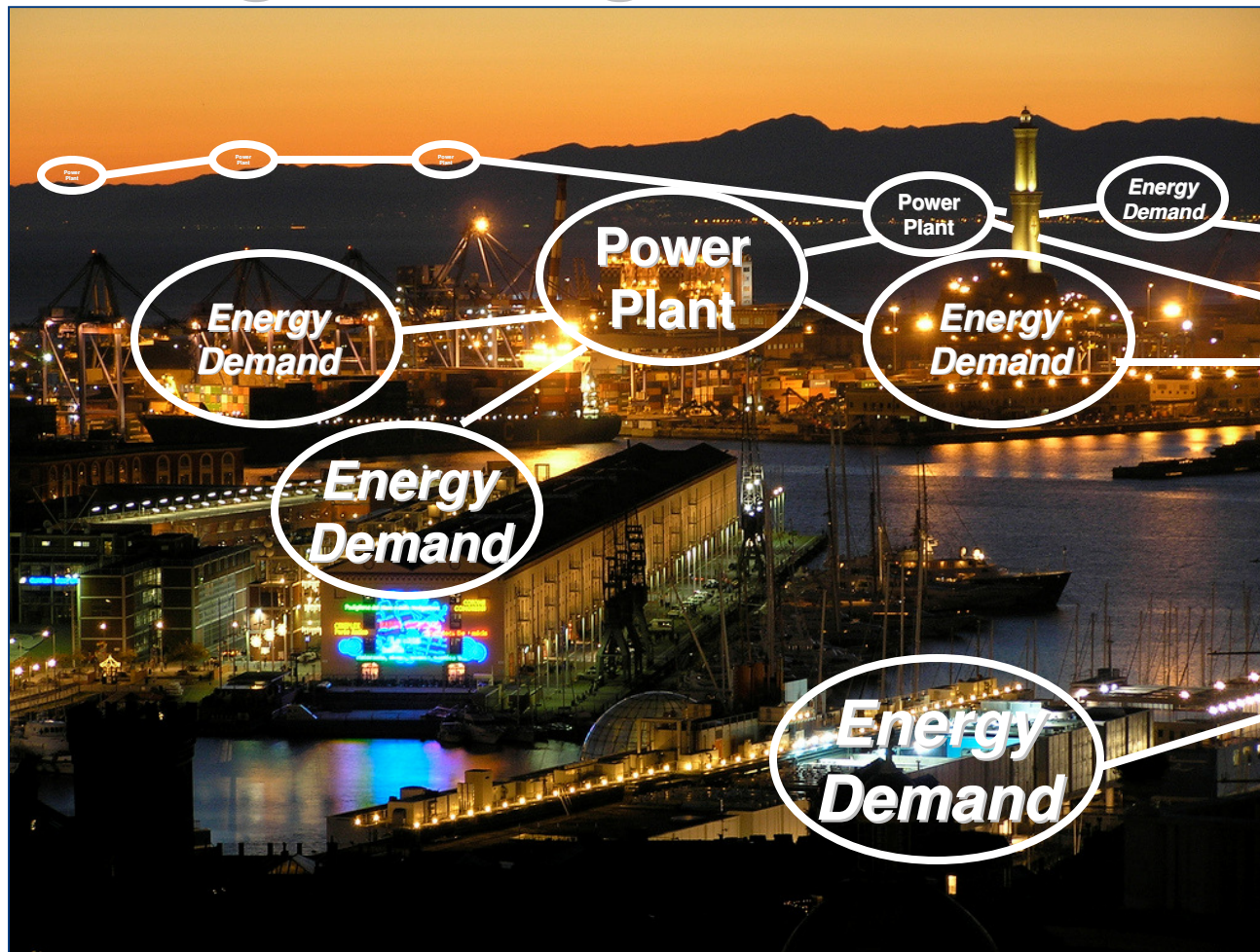


# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?





# System of Systems Engineering: Where is it?







# System of Systems Engineering Why Engineering?

Because these are very  
*Engineering Intense Systems*

...and their Combination is  
very Complex ...

so we need a lot of  
*Ingenium*  
*to illuminate us on these SoS*





# Complex Systems

A Complex System is an entity obtained as composition of interconnected elements, able to exhibit one or more properties and or behaviors not obviously deriving from the properties of its individual parts.





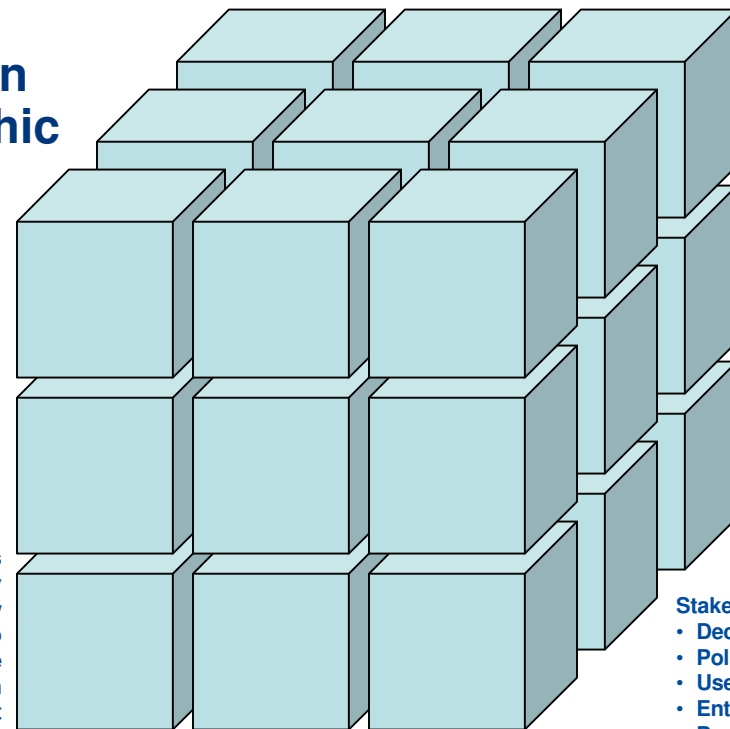
# System of Systems

The principal differences between a very large, complex, but monolithic System and a System of Systems is related to the following issues:

- A System of Systems is expression of many Systems that have their own capability to operate technically independently
- Managerial Independence of each System
- Geographically Distributed Systems
- Evolutionary Development
- Emergent Behaviors

#### Interrogatives

- Why
- How
- Who
- Where
- When
- What



#### SoS Levels

- System of Systems
- System
- Subsystem
- Component
- Part

#### Stakeholders

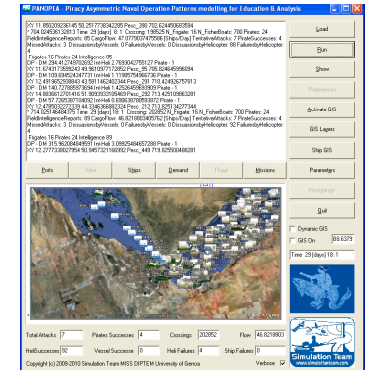
- Decision Makers
- Policy Makers
- Users
- Enterprises
- Project Managers
- Product Managers
- Engineers/Architects
- Developers Builders
- Suppliers
- External Parties

***Most Contemporary Challenging Issues on SoS are Human Components***  
***SoS Characteristics are Very close to those of a Complex Systems***





# System of Systems as Challenging Framework



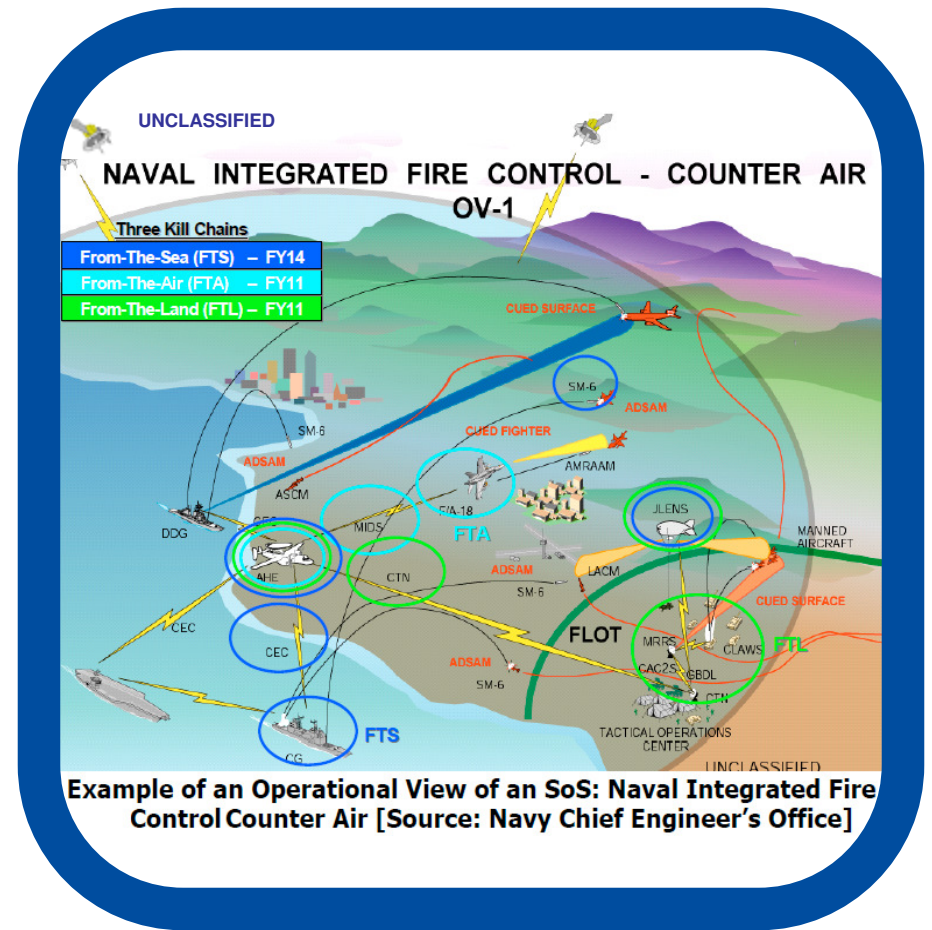
To succeed in applying SoS Engineering it is necessary to deal with challenges such as

- Clearly Defining SoS Boundaries, Ranges of Validity and Requirements
- Keeping under Control the SoS development environment to guarantee that the requirements are satisfied in optimal way considering technical, economic and operative issues
- Considering the Constraints related to the use of Legacy Systems as SoS Components and their possible impact in term of functional and implementation inefficiencies and inconsistencies
- Defining SoS solution considering that the Component Systems have independent ownership, funding, and development processes in addition to the operational and technical elements
- Paying attention to Emergent Behavior and Development Changes and on their possible overriding effect on SoS Capabilities





# SoS SE as guideline for DoD Acquisitions

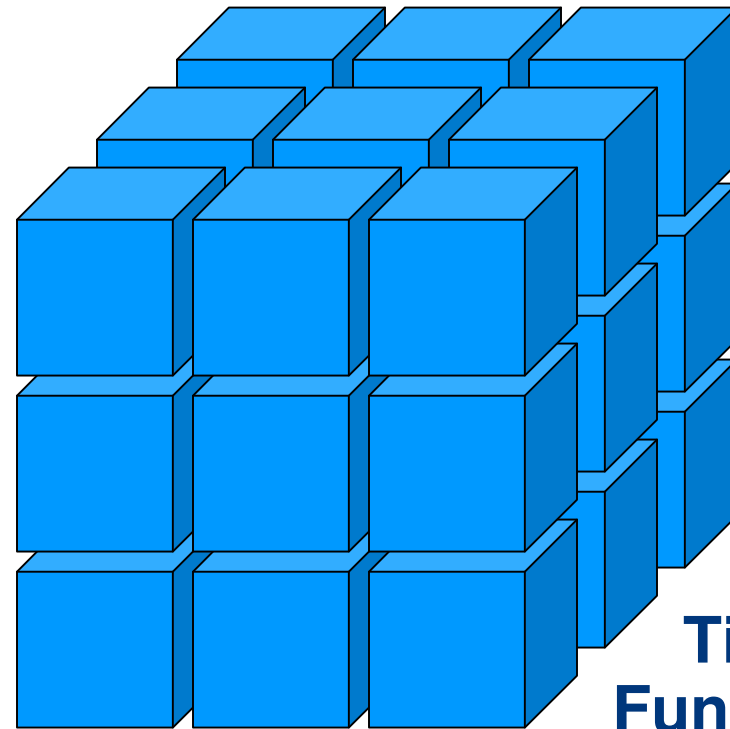


Example of an Operational View of an SoS: Naval Integrated Fire Control Counter Air [Source: Navy Chief Engineer's Office]



# Engineering in SoS as a Paradigm

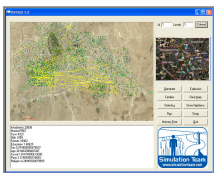
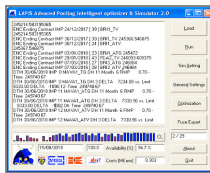
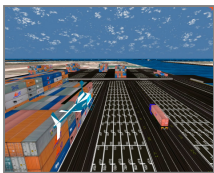
*System of System Engineering is an approach able to be applied to SoS created in multidimensional environments*



**Disciplines & Areas**

**Time & Functions**

**Space and Configuration**



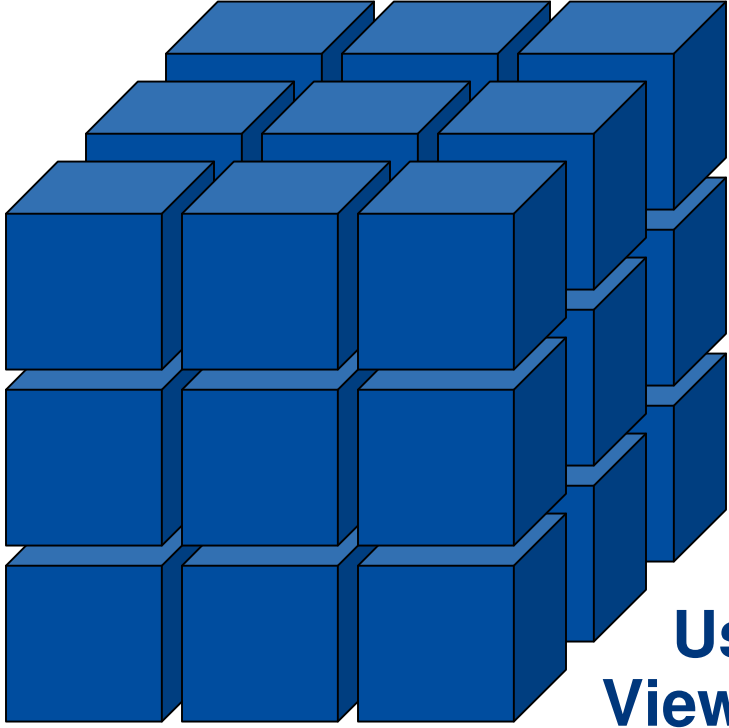
**Strong need to combine Social and Technical Networks**

Unclassified



# Engineering in SoS as a Paradigm

*System of System Engineering is an approach able to be applied to SoS created in multidimensional environments*



**Acquisition View**

**User View**

**Technical View**



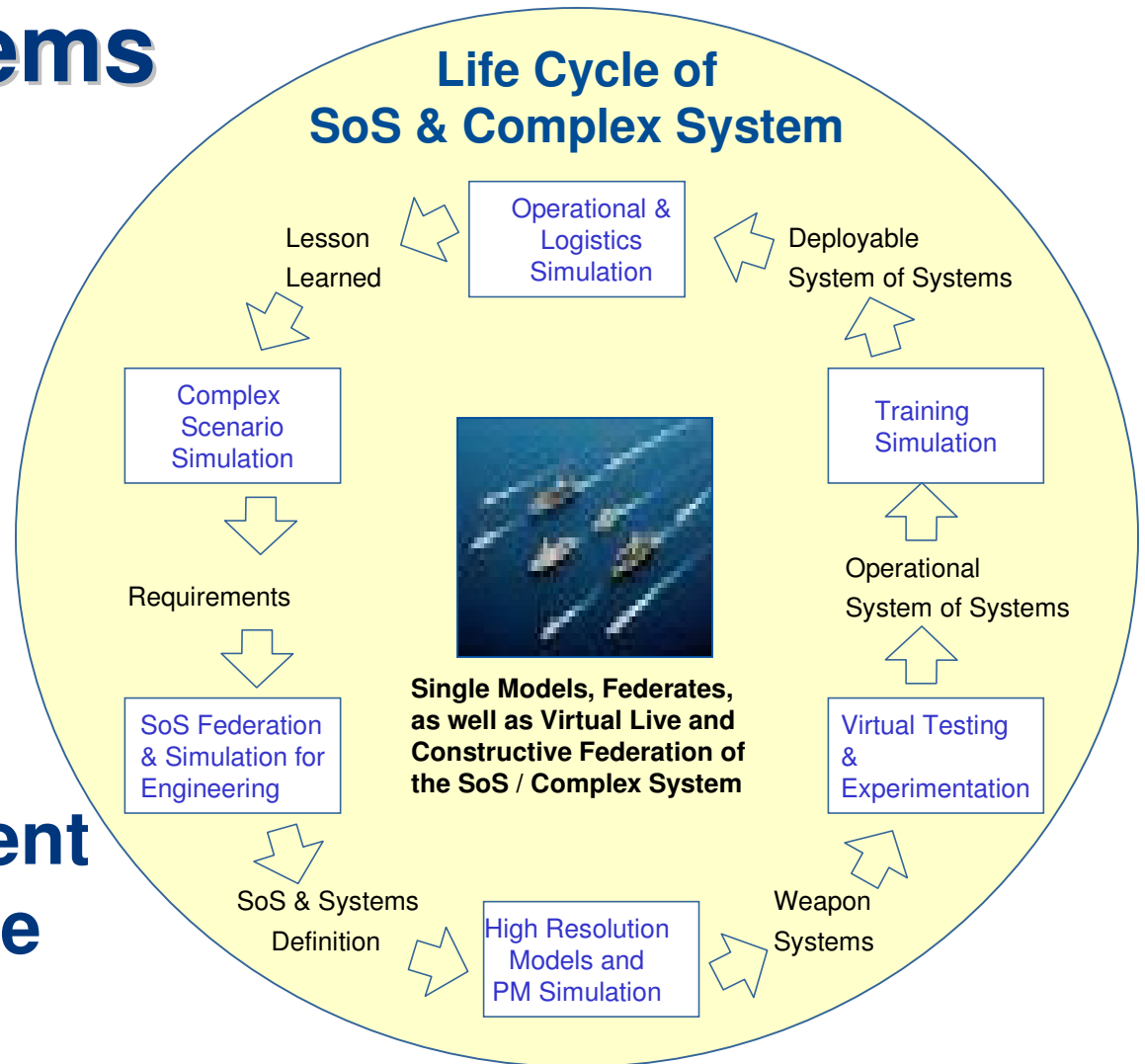
**Strong need to combine Social and Technical Networks**

Unclassified



# Simulation, SoS and Complex Systems

To support the whole Life Cycle of a System of Systems we need simulators able to federate the different aspects and to take care of Humans







# LAPIS

*Lean Advanced Pooling Intelligent optimizer & Simulator*

LAPIS is an intelligent decision support system for Service Division of Construction and Engineering Companies. LAPIS combines different modules:

- Service Model
- Inventory Optimizer
- Scheduling Optimizer
- Overall Resource Optimizer
- Metrics & Key Performance Indexes

**LAPIS Advanced Pooling Intelligent optimizer & Simulator 2.0**

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 ENC Ending Contract IMP 24/12/2017 [ 39 ] BR11\_TV  
 245214.583195365  
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 DTM 30/06/2018 IMP 0 MAV1\_TG DH 11 Month 6 FIMP 0.70 -  
 Time 249740.67  
 DTH 30/06/2018 IMP 0 MAV1\_TG DH 3 DELTA 7234.88 vs. Limit  
 8333.00 DELTA -1098.12- Time 249740.67  
 DTM 30/06/2018 IMP 11 MAV1\_ATG DH 11 Month 6 FIMP 0.70 -  
 Time 249740.67  
 DTH 30/06/2018 IMP 11 MAV1\_ATG DH 3 DELTA 7330.96 vs. Limit  
 8333.00 DELTA -1002.04- Time 249740.67  
 DTM 30/06/2018 IMP 12 MAV1\_ATV DH 11 Month 6 FIMP 0.70 -  
 Time 249740.67  
 DTH 30/06/2018 IMP 12 MAV1\_ATV DH 3 DELTA 7330.96 vs. Limit

**LAPIS Simulation Settings**

Starting Date: 18/09/2008 Random Seed: 1  
 Simulation Duration (years): 12 Runs: 1  
 Delta Stat (h): 168 Puage

Filename Root: [ ]

GOM Subset:  1  
 File Log:  TG Code: TG  
 File Temporal Evolution:  TV Code: TV  
 File Consumptions:  ATG Code: ATG  
 Files on Final Reports:  ATV Code: ATV  
 Files about Item Path:  Basic Verbose:   
 File Optimization:  Medium Verbose:   
 \*CD 1 ITEM 0 CONS Very Verbose:   
 INVENTORY: 2.00 Graphics:

Refresh Factor: 3  
 FUSE: C:\var\2006\lapis\_ansaldo\Fuse\_inf\lapis\_fuse.exe  
 Gui on: CONSUMABLESV94.36

Buttons: Load Config, Save Config, Close

**LAPIS Inventory**

Inventory 0 / 1] 0 CON  
 0 = 1 0.4 vs opt 4.0 0  
 0 = 2 0.3 vs opt 3.0 0  
 0 = 3 0.2 vs opt 2.0 0  
 0 = 4 1.1 vs opt 2.0 2  
 0 = 5 2.3 vs opt 2.0 0  
 \*CD 1 ITEM 0 CONS  
 INVENTORY: 2.00

**LAPIS General Setting**

Enable Interchange Regular GOM:   
 Enable Interchange Reliability GOM:   
 Enable Failure and Emergency Stop:   
 Enable Trust in Last Update EDH and Date:   
 Enable Contract Duration Limits:   
 Enable Expanding for Extra Steps:   
 Expanding Factor: Costs (Days): 2.0 Time Factor: 2.0

Opt. Most Prob. Pers.

Inspection Duration (days): 2 4 7  
 Partial Revision Duration (days): 28 33 40  
 General Revision Duration (days): 30 37 42  
 Failure Duration (days): 1 5 30

Importance Factor DH1: 1  
 Importance Factor DH2: 18  
 Importance Factor DHS: 0.1  
 Importance Factor DH4: 0.05  
 Importance Factor D1  
 Importance Factor D2  
 Importance Factor D3  
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 Importance Factor D8  
 Importance Factor D9  
 Importance Factor D10

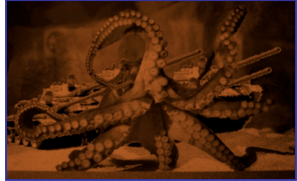
Tolerance on Part Rev  
 Tolerance on DH EDH





# PIOVRA

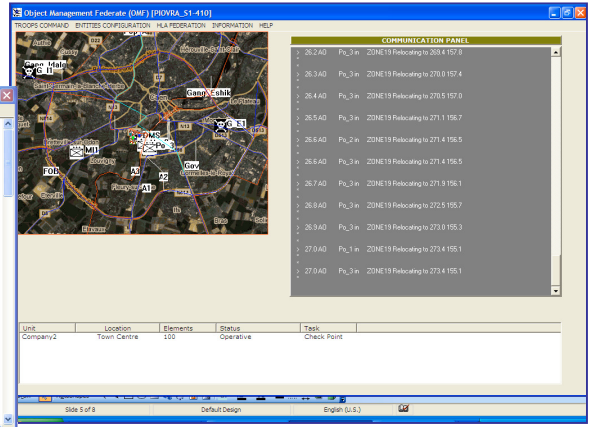
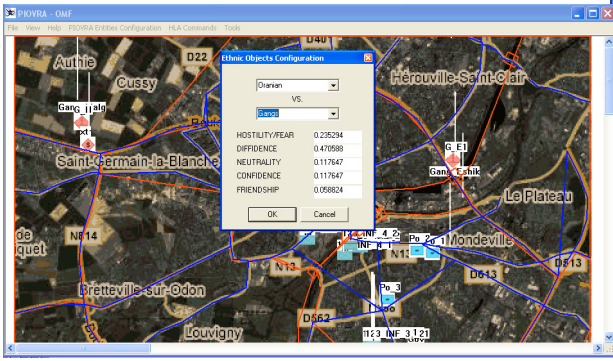
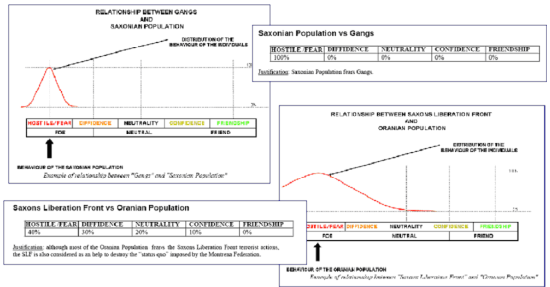
*Polyfunctional Intelligent Operational Virtual Reality Agents*



PIOVRA was an EDA Project developed in cooperation with Italian and French MoDs in partnership between MISS 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*

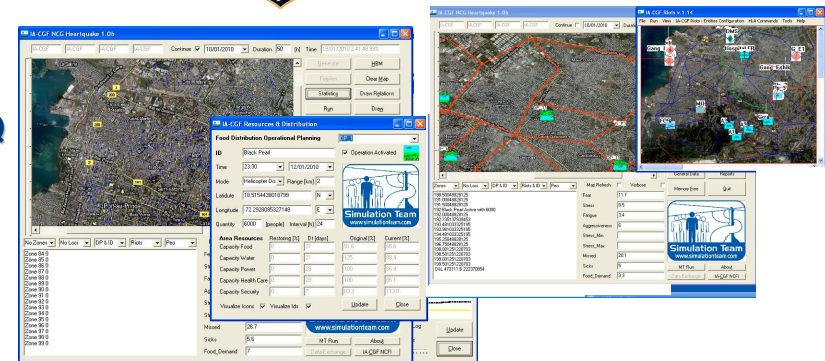
The collage displays various components of the RATS simulation interface:

- Map:** A satellite-style map showing an urban area with various markers and labels.
- Message Browser:** A window displaying a list of system messages, such as "03:00:01 DMG IN\_ZONE1 DETECTED DMG" and "03:00:01 DMG IN\_ZONE2 DETECTED DMG".
- Data Table:** A table with columns for different entities and their status. The entities listed include CIMBRIAN POPULATION, BRAXES MINORITY, SAXONS MINORITY, SPOY'S LOCAL POLICE, MONTRENA FEDERAL POLICE, SAXONS LIBERATION FRONT, SPOY'S LIBERATION FRONT, GANGS, BLUE FORCES, and RED FORCES. The table contains status indicators like 'Neutral', 'Foil', and 'Foe'.
- Graphs:** Two line graphs showing the relationship between different groups. One graph is titled "RELATIONSHIP BETWEEN SAVOIR LIBERATION FRONT AND OKRAMIAN POPULATION" and the other is "RELATIONSHIP BETWEEN GANGS AND SAKSONIAN POPULATION". Both graphs show fluctuating lines representing different behavioral states.



# Haiti Case

IA-CGF NCF Riots & IA-CGF NCF EQ



The Demonstration was based Haiti Earthquake 2010 and presented by USJFCOM at ITEC2010.

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

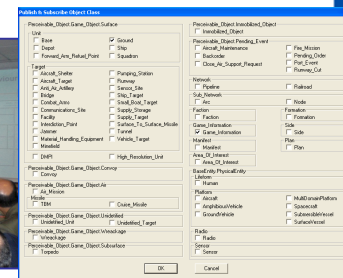
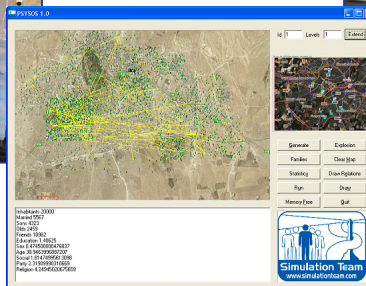




# CAPRICORN

*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)





## ***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.



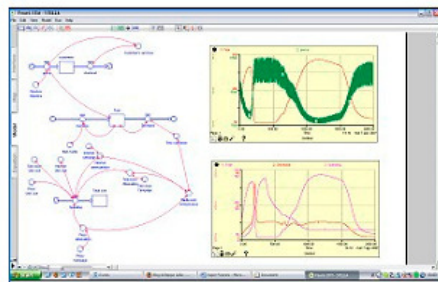
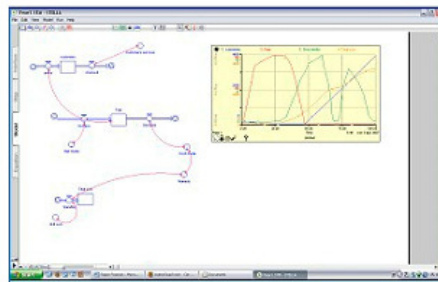


# MOSCA

MOdelling Supply Chain Attacks



MOSCA project is devoted to the development of Models for estimating the impact of attacks or disasters affecting supply chain of consumer goods; MOSCA includes dynamic impact of events on consumer emotions as well as effectiveness of countermeasures



Simulator of Attacks to Retail Chains.txt - Blocco note

File Modifica Formato Visualizza ?

Event: Contaminated fresh food    Bad media: Moderate Aggression

Fear perception: < 11 >

Store Code: 62    Division code: 6

Media Spending: Internet 34    Television 33    Press 25

Delay	Internet 20	Television 10	Press 30
Duration	90	00	30
Media Unit Cost	Internet 1	Television 2	Press 3

Average Arrives rate: 47    Average Checkout rate: 47

"Terrorism Attack In Retail Buisness" Simulator

GO!    Load

Simulatore / Codici / Historical / Matrix / Fear / Arriving / Badmedia / Mediums / Spending / Timecardown / Old-Data / data /



# ASPID

*Advanced Supply chain Protection & Integrated Decision support System*



This research is focused on the development of innovative tools for analyzing and optimizing the risk related to the evolution of the elements in the supply chain. ASPID proposes an innovative use of modeling for evaluating the impact on the supply chain of different aspects such as international competition, know-how diffusion in new areas, critical events and disasters



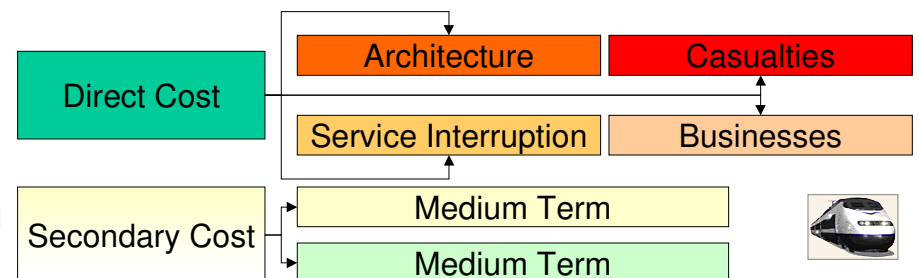
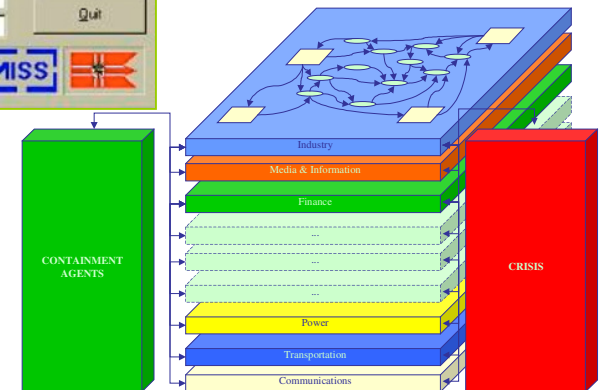


# RAILSEC

*Railways Security*

The project concentrated in developing models for Risk Analysis related to Security in Rail Environments. The project develop emergency management and event simulators as well as model devoted to identify medium and long term effects in term of costs, resources and impact on the overall environment.

The project was developed in cooperation with Institutes in North America and focused on terrorist attack issues





# SESISEP

Security Simulation of Sea Port

The project concentrated in developing simulation models to support Security in Ports in term of Risk Assessment, Training, Security Solution Analysis, etc. The initiative is modeling ports, terminals, operative procedures, regulations & policies.

The model was successfully applied to evaluate the impact of ISPS, MTSA and SCI evolution in large container terminals. A demonstrator is available on:

[www.liophant.org/projects/secsim](http://www.liophant.org/projects/secsim)



**GRAPHIC USER INTERFACE**

**Ship Characteristics**

Min. Container Number to unload: 0, Max. Container Number to unload: 1500

**Ships Arrival**

Mean Inter Arrival Time (h): 12

**Technical Equipment**

Tugboats Number: 4, Mean TugBoat speed (m/s): 1,667

Min. Unloading Time per container: 0,5, Max. Unloading Time per container: 1,5

Forklifts Number per Berth: 12, Mean Forklift speed: 13,2

**External Truck Characteristics**

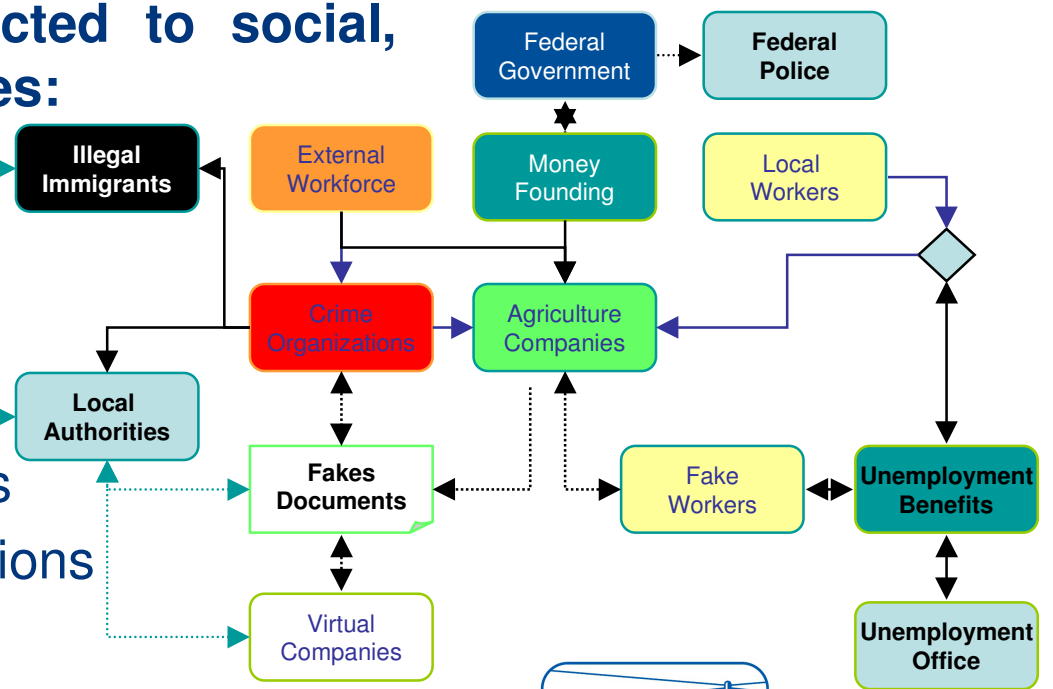
Trucks Number: 35, Mean Truck speed: 18



# 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





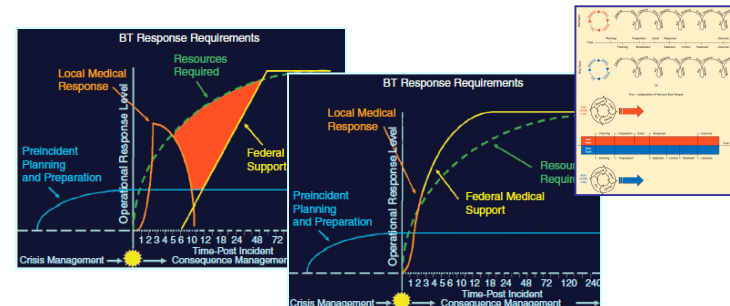
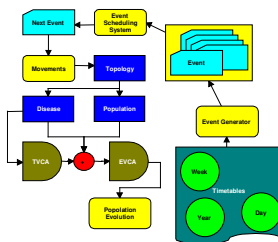
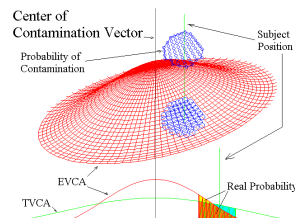
# PANDORA

*PANdemic Dynamic Objects Reactive Agents*



**CRiCS**  
CENTRE FOR RESEARCH  
IN COMPLEX SYSTEMS

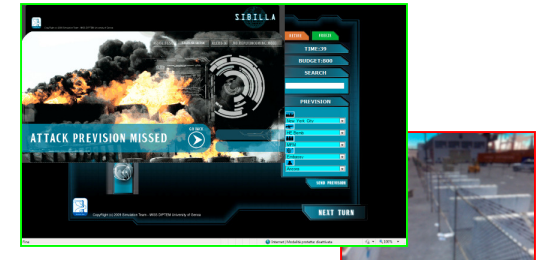
- PANDORA addresses the dynamics of the spreading of a Pandemic and experiments are on-going on H1N1 influenza A virus by a joint simulation project involving USA, European and Australian R&D Centers (MISS DIPTM, Dartmouth College, CRiCS).
- PANDORA proposes to use an evidence-based approach whereby 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.





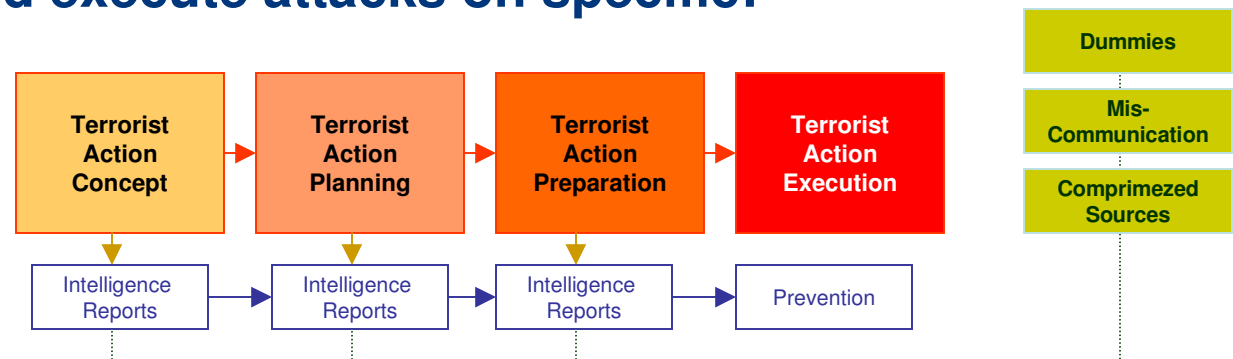
# SIBILLA

*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





# CUMANA

*Cooperative/Competitive Utility for Management  
and Advanced Networking skill Acquisition*

**CUMANA is a Web Multiplayer Game that provides the opportunity to play interactively a cooperative/competitive game, in a distributed environment where different “Managers” operate concurrently with benefits and penalties connected to both common and individual objective achievements related to their role in their Corporation.**

**The main goal is to share information in order to support Decisions Making in a Corporation Framework based on market reports affected by risks**

**The Identification of the market event in time is the key for individual success of each player as well as the overall corporation, while risks not properly addressed generate losses for the whole players**

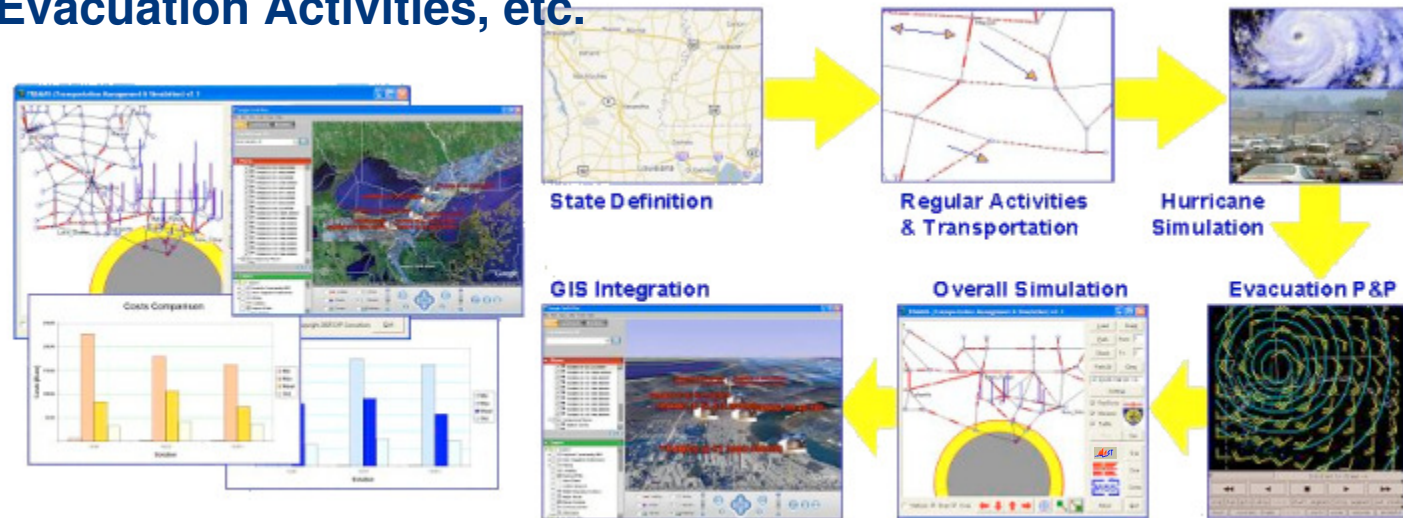
## Simulation Team





# KATRINA LIKE

**KATRINA LIKE** was a Joint Venture that Demonstrated the possibility to Model a National Crisis and to Simulate a Wide Emergency; the Project successful demonstrated the Simulation of an Hurricane Impact on the Transportation Layers of Louisiana State Considering Traffic Cargo, Evacuation Activities, etc.





# CIPROS

*CIVIL Protection Simulator*

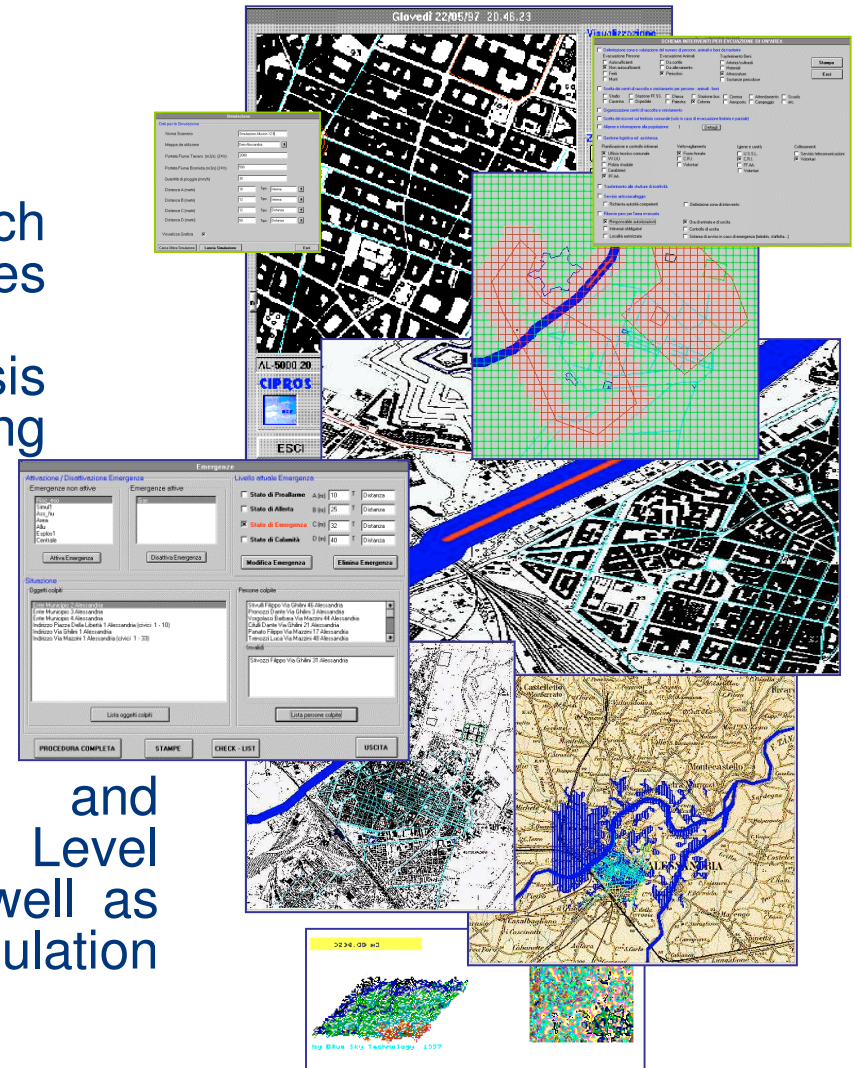
CIPROS is a modular approach for Civil Protection that integrates GIS and Simulation.

CIPROS generates Crisis Dynamic Web Sites for supporting training and information share

CIPROS includes simulation of:

- Explosions
- Hazardous Material Fallout
- Flooding

CIPROS support definition and management of different Alert Level and Threats Classification as well as evacuation Procedures for Population and people with impediments





# MESA

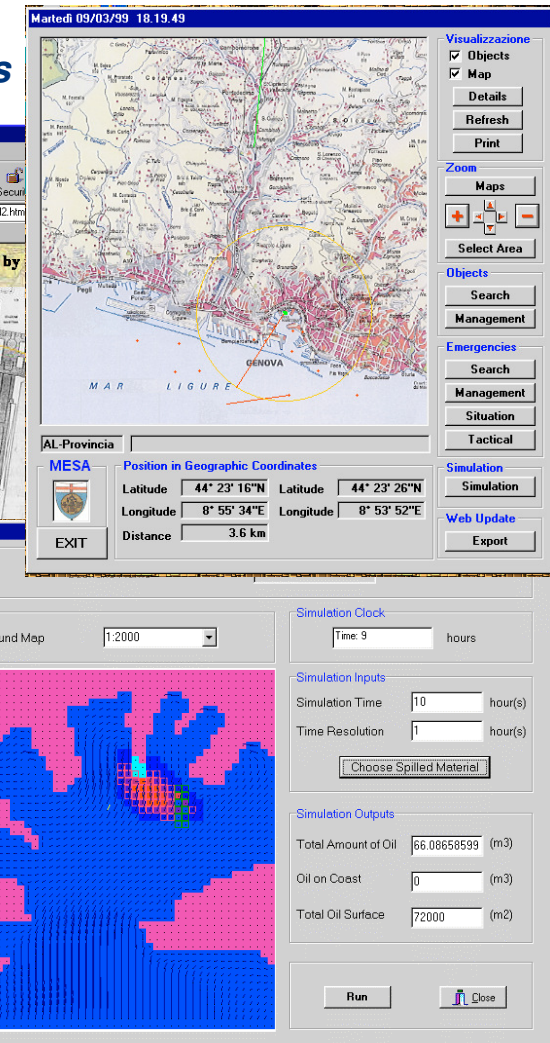
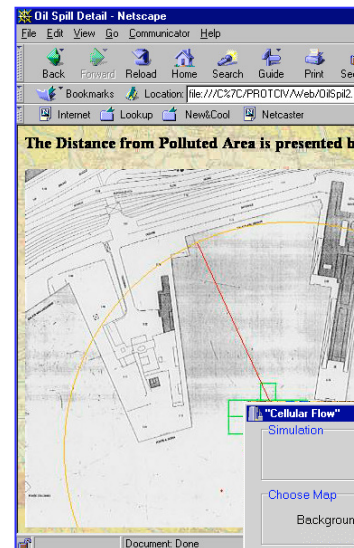
*Maritime Environment for Simulation & Analysis*

MESA is an integrated environment to perform simulation and risk analysis in ports and maritime sector.

MESA is devoted to support port organizations, entities and operators in Emergency & Environmental

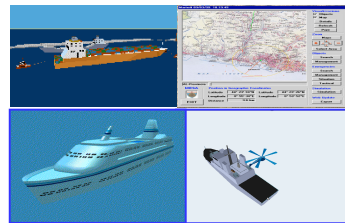
Management.

MESA is a modular system based on combined simulators running on PC and providing direct output also on WWW servers.





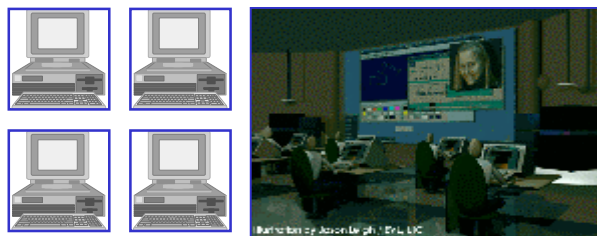
# Distributed Virtual Maritime Environment



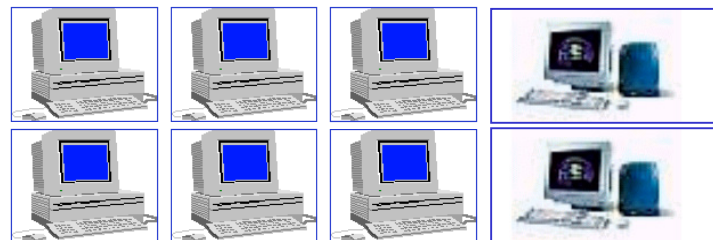
Procedure Design, Risk Analysis , Re-Engineering

C/C++  
Java

DIS  
HLA



Distributed , Cooperative Planning and Management



Distributed Operation Control

A Platform Independent Distributed Environment for Maritime Applications



# MARLON

MARitime LOGistic Network

MARLON is a model that allows the evaluation of costs related to different marine logistics scenarios. MARLON has innovative features like interoperability, Interactivity and Integration with GIS so companies have demonstrated interest about these; MARLON is a critical support for organizing distributed Meetings concerning tactical and strategic decisions on logistics and production (investments and budget) as well as Videoconferences to evaluate critical operations and scheduling decisions. MARLON is an integrated solution combining Simulation and Optimization, so MARLON is a DSS that improves planning and management of resources for liquid bulk transportation reducing the total cost for transportation and related risks. MARLON also allows to put in contact logistics with production and make their integration in the company's context easier. MARLON simulator has been tested and validated giving output compatibles with other models and with Real Industrial Case.

**Marlon Parameters**

- Ports
- Flows
- Paths
- Ships
- Save on File
- Verbose Reports
- Dynamic Update
- Random Seeds: -1
- Duration: 1
- Regular Fuel Cost [%]: 1
- Port Fuel Cost [%]: 1
- Increasing Tanks Capacity [%]: 1
- Increasing Piping Flow Capacity [%]: 1
- Production Increase [%]: 1

**Marlon - Maritime Logistics Networks**

34	Bitessa2	36.7167	20.8500
35	Bitessa3	35.9500	23.1167
36	Bitessa4	37.6667	24.1933
37	Bitessa5	38.2167	24.8333
38	Bitessa6	39.2667	24.0167
39	Bitessa7	40.4333	22.7500
40	path4sottosicilia	36.2500	16.8333
41	path4sardagnacorsicaest	41.2833	9.7666
42	manica	50.8833	1.6167
43	nordhamburg	54.7167	6.4833
44	imboccaregibiliteraaest	36.3500	-1.4000
45	daravennaamarghera	44.9333	12.6833

Flows

1	flow1	4	Priolo_C4	Ravenna_C4	2795.3462
2	flow2	4	Porto_Marghera_C4	Ravenna_C4	1867.7693
3	flow3	5	Porto_Marghera_Etilene	Omisali_Etilene	1487.9423
4	flow4	5	Priolo_Etilene	Vada_Etilene	1406.2693
5	flow5	3	Brindisi_Butadiene	Ravenna_Butadiene	1335.8269
6	flow6	1	Priolo_Propilene	Brindisi_Propilene	1159.8654
7	flow7	1	Porto_Torres_Propilene	Brindisi_Propilene	1010.2692

Simulation Team  
www.simulationteam.com

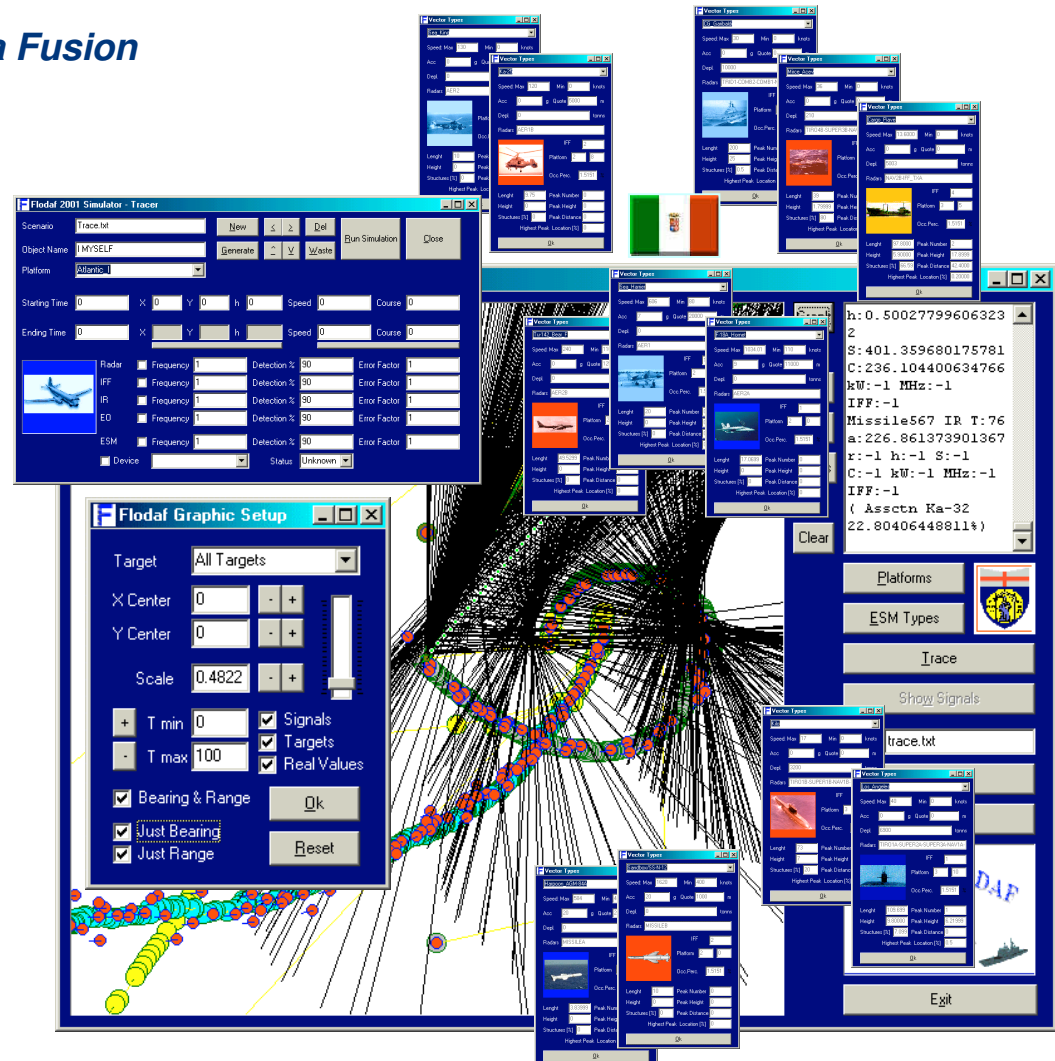
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# FLODAF

*Fuzzy Logic Data Fusion*

FLODAF is an tools to support engineering and performance estimation of Data Fusion Solution; this suite includes a Scenario Generator and a Simulator for analyzing the Data Fusion performances over complex Air-Naval scenarios including ships, submarines, missiles, airplanes and helicopters.





# PANOPEA

*Piracy Asymmetric Naval Operation  
Patterns modeling for Education & Analysis*

- PANOPEA is a simulator for reproduction of Piracy activities and for evaluating different strategies in NEC C2 M2 (Netcentric Command and Control Maturity Models).
- PANOPEA reproduces military vessels and helicopters, ground base, cargos as well as fisherman and yachts traffic as well as Pirates
- Pirates are directed by Intelligent Agents and apply strategies for succeeding

**PANOPEA - Piracy Asymmetric Naval Operation Patterns modeling**

```

XY 11.8500292361 45.502617738342285 Pecc_390 702.62445065394
* 704.024536132813 Time: 29 [days] 8 1 Crossing: 19825 N_Figale 16 N_FishBo
FieldIntelligenceReports: 65 CargoFlow: 47.8779337475596 [Ship/Day] TentativeAlta
MissedAttacks: 3 Discussions/Vessel: 0 Failures/Vessel: 0 Discussions/Helicopt
4
Figales: 15 Pirates: 24 Intelligence: 95
DP - DM 294.412749702832 In-Hel: 2.769942759127 Pirate - 1
XY 11.5743173591643 45.901097172952 Pecc_39 705.62464996204
DP - DM 193.694523427731 In-Hel: 1.1199754366736 Pirate - 1
XY 12.491962038843 45.581146240234 Pecc_391 710.424826757813
DP - DM 149.727895973694 In-Hel: 1.4252649563909 Pirate - 1
XY 14.889612701416 51.9053812105469 Pecc_392 713.425109663281
DP - DM 57.7252365104932 In-Hel: 0.538638789292592 Pirate - 1
XY 12.479602227239 44.3346363882324 Pecc_312 713.825134277344
* 714.02516484379 Time: 29 [days] 18 1 Crossing: 20282 N_Figale 16 N_FishBo
FieldIntelligenceReports: 59 CargoFlow: 46.8218803495762 [Ship/Day] TentativeAlta
MissedAttacks: 3 Discussions/Vessel: 0 Failures/Vessel: 0 Discussions/Helicopt
4
Figales: 15 Pirates: 24 Intelligence: 95
DP - DM 215.92388494591 In-Hel: 3.0992484657288 Pirate - 1
XY 12.2777338027954 50.9457321166392 Pecc_449 719.825500488281
  
```

Exports Sites Ships Demand

Total Attacks: 7 Pirates Successes: 4 Crossings: 20282 Flow: 46.8218803  
 HelSuccesses: 52 Vessel Successes: 0 Hel Failures: 4 Ship Failures: 0

Copyright (c) 2009-2010 Simulation Team MISS DIPTeM Università di Genova

**Helicopter** Average Setup Time [h]: 0.1  
 Radar max [Nm]: 45 Eye Max [Nm]: 12  
 Speed [Knots]: 135  
 Max Distance to Try [Nm]: 240

**Fisherman Boat/Pirates** Generate [boats]: 700  
 Pirates (%): 3  
 Attack Threshold [Nm]: 8  
 Attack Probability (%): 0.8  
 Fisher Speed [Knots]: 10  
 Pirate Speed [Knots]: 35  
 Cargo Ship Flow [ship/day]: [ ]  
 Intelligence Detection Probability: 0.1

Dynamic GIS:  GIS On: 88.6379  
 Time: 29 [days] 18 1

ships: 16  
 [Nm]: 8  
 Knots: 30  
 [Nm]: 50  
 r [Nm]: 5

Close

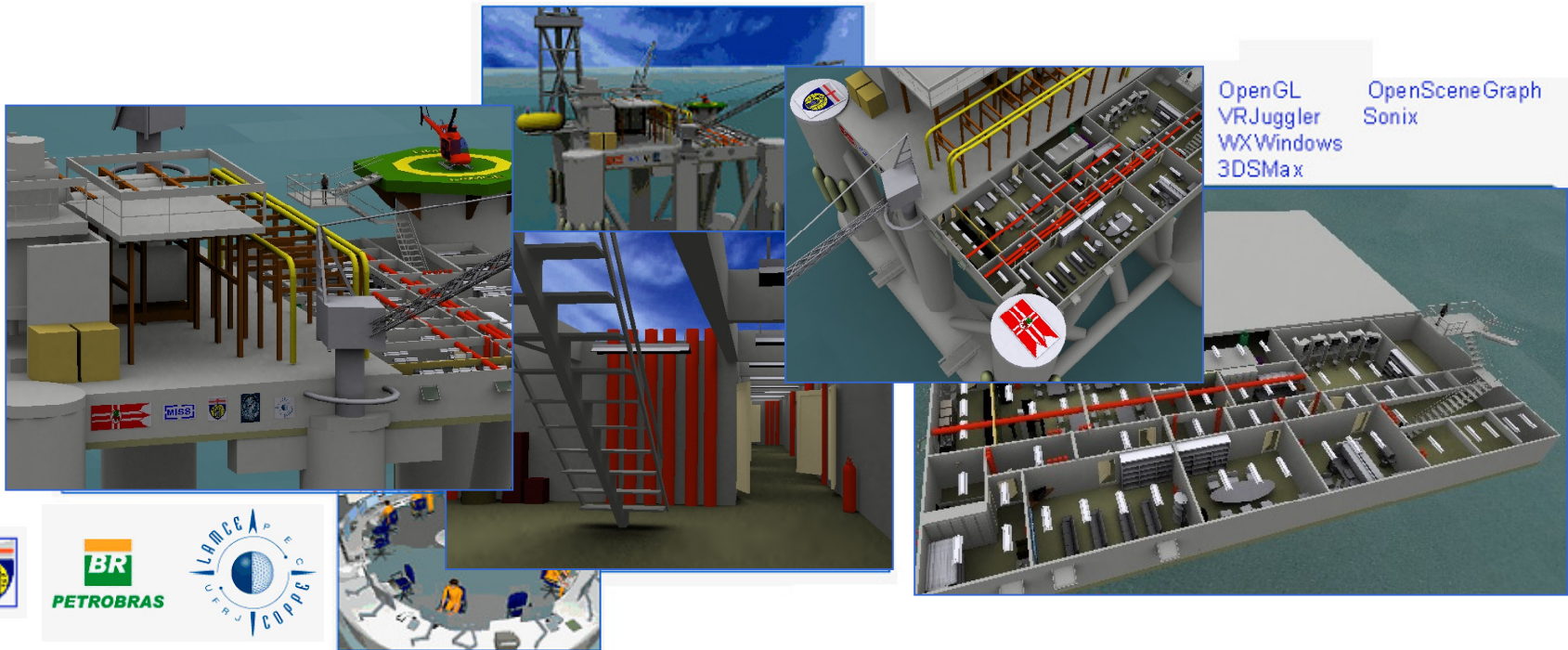




# Placra

Platform Crew Analyser

The Placra model was developed in order to reproduce the crew activities on Oil Platforms. Placra simulates crew activities



OpenGL  
VRJuggler  
WXWindows  
3DSMax  
OpenSceneGraph  
Sonix





# CALYPSO

Carrier Life cYcle Period Simulation & Optimization



CALYPSO project investigated methodologies and techniques devoted to analyze the Life Cycle of the New Italian Carrier Cavour. CALYPSO included development of Tools for comparing costs, operations and performances of different Carriers.

swbs	descrizione
	sistema piattaforma
	sistema combattimento
	sistema integrato di telecom
200	impianto di propulsione
300	gruppo impianto elettrico
400	gruppo comando e sorvegli
500	gruppo impianti ausiliari
45111	radar di scoperta navale
41211	sottosistema comando e c
41511	sottosistema data transfer
45112	sottosistema radar di navig
42511	sottosistema di navigazione
48412	sottosistema meteo ocean
440	sottosistema di comunicazi
430	sottosistema di comunicazi

CALYPSO - Carrier Life cYcle Period Simulation & Optimization  
PLANE EVALUATION

ACASO: Advanced Carrier Acquisition cost Simulation & Optimization

Indirect operating and support cost

Training coeff	N° personnel	0.313	Result indirect operating and support cost coeff
Fuel delivery	hp	0.421	
Other		1.000	

evaluating plane evaluation method

ES-3a Shadow hp

choose confront

F/A-18  AV-8B Harrier II

evaluation

ES-3a Shadow	6890 27
AV-8B Harrier II	4120 27

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# ACASO

## Advanced Carrier Acquisition and Operation cost Simulation & Optimization



ACASO is a system for design new Vessel by simulating their performances in relation to their operative profiles and maintenance policies. The system estimates the unknown characteristics of the new Vessel Systems by applying advanced AI techniques (genetic algorithms) and evaluating different hypotheses and scenarios

The software interface includes a flowchart on the left showing the process from 'SSM Stochastic Simulation Model' to 'Simulation Exp. Results' and 'SIO Smart Integrated Optimizer', which then feeds back into 'Estimated Data' and 'Detailed Data Scenario'. A central graph titled 'Fitness Comp' shows 'Fitness' on a logarithmic scale (1 to 10000) versus 'Runs' (1 to 10000). The graph displays several lines representing different optimization runs, with one line showing a sharp decline in fitness over time. The right side of the interface is a control panel with various parameters and buttons. A small window shows a 'Crew Stress/Relax' graph with a red line and a green line. At the bottom, there are buttons for 'Bath-Tube 1' and 'Bath-Tube 2' with numerical values and checkboxes for 'Sound' and 'Movie'.

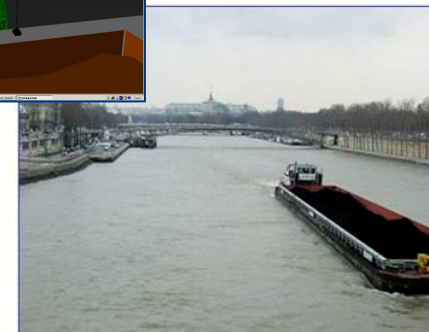
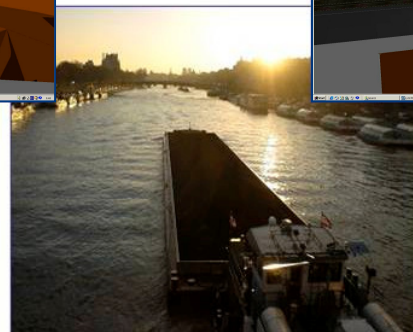
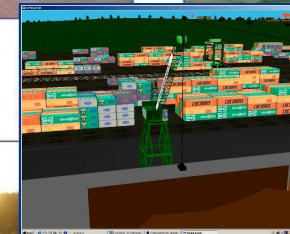
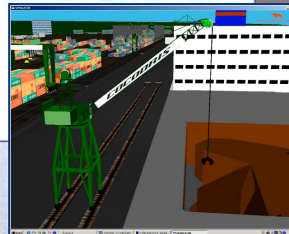
Run [h]	262800.0	[n]	5
Time [years]	29.9	[n]	4
Op. Treshold	0.75		311.676190
Stops	6	2	SJO
Maint. Cost	859.0		1158.21997
Availability	0.65		0.83734360
Type	Stochastic Adaptiv		
Coding	Log - 16 bits		
Rep. Rate	0	Pop.	20
Mut. Rate	0.1	Impact	0.2
Free Time	0.0		0
SMP	6.6		6.6
GM	6.22		13.2
Extra Down Time	17895.29		84.2
Availability			



# DESU-BUMATRAS

*Development Support for Front & Design in Bulk Material Transhipment System*

Support to the development of a Stochastic Discrete Event Simulator devoted to investigate Bulk Material Terminal and Transhipment Systems.





# VIP-STRALO

*Virtual Prototype by Simulation in Transportation and Logistics*

*VIP-STRALO* goal is the creation of innovative solutions based on Interoperable simulators for SBDVP (Simulation Based Design and Virtual Prototyping) applied to Logistics, Transportation and Automation Sectors.

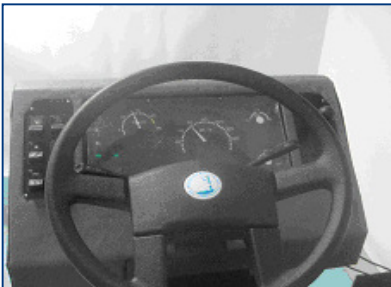
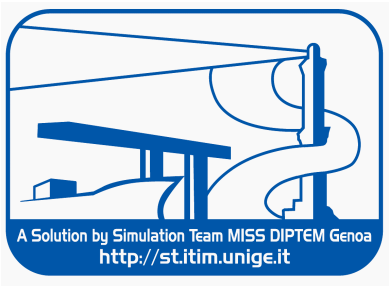
*VIP-STRALO* involves the creation of two interoperable demonstrators:

- **LOCRAS:** *Logistics Crane Simulator*
- **FEBO:** *Federation of Boats*





# ST\_PT & ST\_RS Simulators



This new generation of simulator is mobile, real-time, scalable and interoperable and compliant with state of art technology and standards

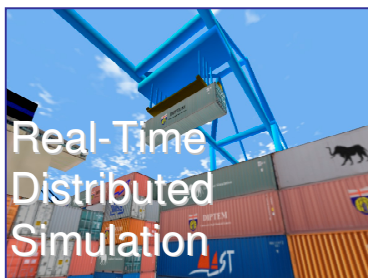
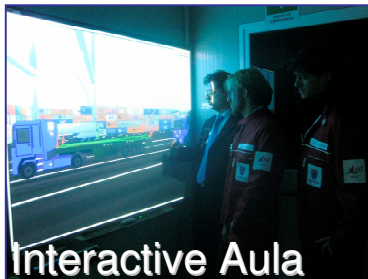
Shelter & Facilities

ST\_PT Crane Sim

ST\_PT Truck Sim



# Atout of our Virtual Simulation





# ST\_VP: Virtual Port Simulation



The **ST-VP** is the ultimate Port Crane Simulator developed by Simulation Team and includes all the different crane types and New Solutions for Operator Training, Safety and Security, Procedure Definition, Equipment Design and Virtual Prototyping



**ST-VP** is fully containerized real-time distributed HLA Simulator reproducing Port Operations. ST-VP is integrated in a 40' High Cube Container ready to be used on site immediately after arrival.



**ST-VP** Simulator allows to operate all the different Port Cranes in a Virtual World by an immersive Cave (270 ° Horizontal and 150° Vertical), reproducing Sounds, Vibrations, Motion in all weather conditions

**ST-VP** includes a Full-Scope Simulation for Training Operations & Procedures, an Integrated Class Room, the Instructor Debriefing Room, and secondary Interoperable Simulators of all the Port Cranes and a Biomedical Module for Safety, Ergonomic and Posture Enhancement.

**ST-VP** World is customizable for each Port, Crane & Procedure and Equipment.





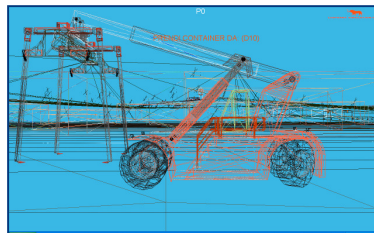
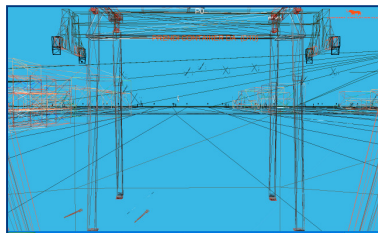


# Virtual Prototyping



The Simulation Team Solutions are very effective as support for Virtual Based Design and Prototyping measuring Real Overall Performances in the Virtual World by considering dynamic interactions among all the Elements and Entities.

Experience was carried out in Equipment, Control and Man-Machine Interface Re-Engineering

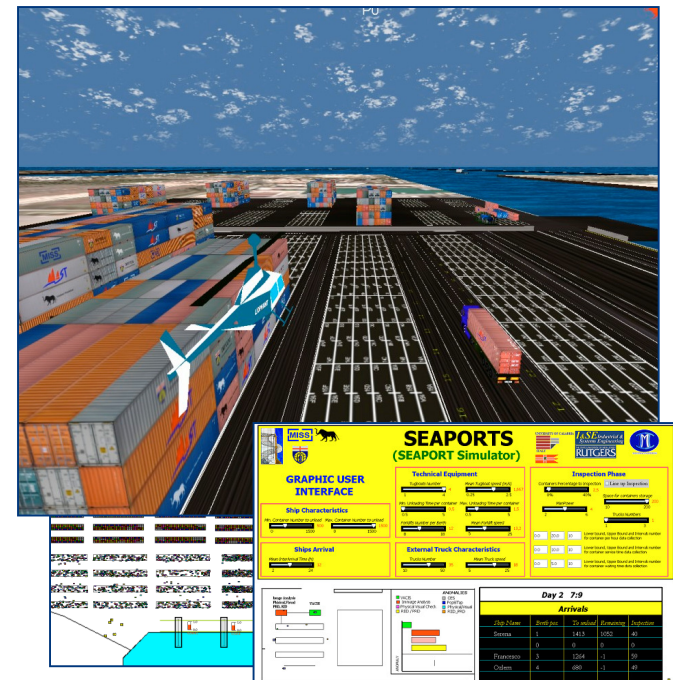




# Virtual Security Assessment and Training

**VISAT (Virtual Security Assessment and Training) allows to Simulate Security Issues in Complex Framework such as that one related to Port Environments.**

**VISAT includes Constructive Sim of organizations and layouts as well as Synthetic Environment for Virtual Sim supporting Distributed Cooperative Training among different Actors (i.e. Port Authority, Coast Guard, Custom Resources, Terminal Operators, Public Urban Authorities) within different Scenarios**

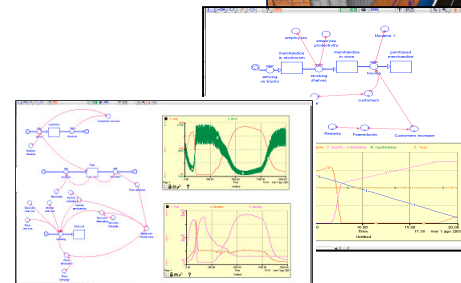




# Port/Terminal Security Simulation

Simulation Team is active in Modelling & Simulation for Guaranteeing Security in Maritime Environment especially in reference to Ports and Terminals

A major goal in this context it is to create solutions that support the Definition of operative and training procedures for security and safety harbours operations with strong emphasis on common standards and multi user framework





# LEM

Logistics Evaluation Model

LEM Project is a joint venture among Ford, Boston College, LSC & Genoa University for Developing a Web Based Support System for Supply Chain management.

Tests using LEM beta\_modules have been carried out successfully on over 70 logistics centers.



**LEM MAIN** Menu

Cars

SUPPLIERS: Products, Capacity

PRODUCTION: Sites, Lines

Production Supplies

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**Production Lines** Menu

Line ID	Line DAE1	Line DAE2	Line B&S	Line A1	Line A2
Car Type	Luxury	Compact	Luxury	Compact	Compact
Site	PS_01	PS_01	PS_02	PS_03	PS_04
Location	Pittsburgh	Pittsburgh	Clinton	Pocahontas	Florissant
Initial Max Capacity	600,000	400,000	500,000	750,000	750,000
Productivity Increase					
Theoretical Productivity	600,000	400,000	500,000	750,000	750,000
Current Production	400,000	250,000	200,000	650,000	400,000
Productivity	80%	63%	40%	87%	53%

Overall Efficiency: 97%, 97%, 88%, 94%, 97%

MTBF: 19.0, 16.0, 19.0, 31.0, 31.0

MTTR: 1.4, 1.2, 1.4, 2.2, 2.0

Cost for Improving Productivity: 9.78, 8.8, 9.78, 8.8, 8.7

Cost for Enabling new Cars same type: 150,000, 100,000, 160,000, 140,000, 140,000

**Production Supply Chain**

Production Site: PS\_01 Pittsburgh

Car Model: CA\_02 Car Mage

Chassis	Tires
Supplier SUP_18 Sp	SUP_14 To
Production Frequency 100000	274, 1,370
Warehousing	
Calculate Distance	233, 2
Transport No.	12

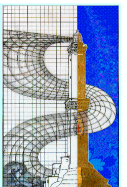
**Car already Enabled**

Car	Line DAE1	Line DAE2	Line B&S	Line A1	Line A2
CA_01	Yes	Impossible	Yes	Impossible	Impossible
CA_02	Yes	Impossible	Yes	Impossible	Impossible
CA_03	Impossible	Yes	Impossible	Yes	Yes
CA_04	Impossible	Yes	Impossible	Impossible	Impossible
CA_05	Yes	Impossible	Yes	Impossible	Impossible
CA_06	Impossible	Yes	Impossible	Yes	Yes
CA_07	Impossible	Impossible	Yes	Impossible	Impossible
CA_08	Impossible	Impossible	Impossible	Yes	Impossible



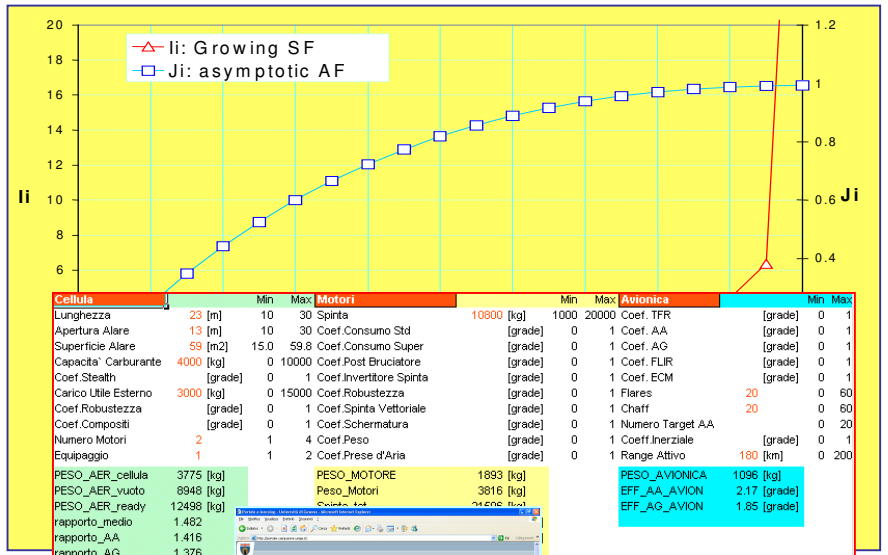
# J20 Experience

## E-Learning Concurrent/Cooperative Project Game



J20 allows to experience in a Web Based Environment a New Product Development by working in Cooperative Teams (Engine, Avionics Cell) representing different Joint Ventures competing for the Project a New Advanced Fighter.

The Exercise has been extensively tested in Distributed Environment for Professional and Academic Courses



**NIG-29**

Raggio d'Azione	229 km
Speed_Hi	2343 km/h
Speed_Low	1252 km/h
Alt	13 m
Altitude	6 m
Angle	3 [grade]
Angle	7 [grade]
Weight	7 M USD



# RIO

*Renovating Intelligent Operations*

**RIO is an innovative solution develop in Web Framework for Operation Control in Wide Supermarket Networks RIO allows both to control store and department performances (sales, customers, goods, productivity, workload) as well as to predict their behavior for improving the performances**





# GreenLog Simulators

Simulation Team developed GreenLog Simulators for Analyzing Production, Logistics and Supply Chain.

GreenLog is a Web Based Simulation Engine devoted to evaluate Costs and Environmental Impacts of Productive, Logistics and Transportation Elements of the Supply Chain and Specific Modules have been developed for focusing on specific aspects:

- GreenLog Port
- GreenLog Ship
- GreenLog Crane
- GreenLog Warehouse





# GREENLOG

*Green Logistics Simulator*

Greenlog is a web framework combining simulation and analysis techniques for self evaluating the Supply Chain Environmental Impact. The GreenLog models have been developed by DIPTeM for supporting its Joint Venture on Green Logistics under coordinated by Assologica and involving several major production, logistics and distribution companies in Italy



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## Simulation Team



# Conclusions

The Simulation Team is acting at international level as a reference point between users and providers in simulation area.

The integration of experts, technicians is providing very good results on real case studies and complex projects.

An active area of development is related to distributed simulation and web-based modeling for extending the impact and exploitation of these proposed systems.

Every year Simulation Team - MISS DIPTM and Liophant organize major Conferences and International Workshops focusing on application of Modelling & Simulation.

For instance the I3M2011 will be Rome, SummerSim in The Hague, WAMS2010 in Rio & Buzios.

There is a constant interest in fostering joint cooperation and exchanges with international Excellence Centers working on simulation.

In 2010 Prof. Bruzzone served as General Chair of WAMS in Brazil WAMS2010 as well as of Summersim in Canada and I3M in Morocco: these last two conferences represent 2 of the 4 major scientific events worldwide in simulation



Boston



The Hague



IMAACA



Rome



## Simulation Team



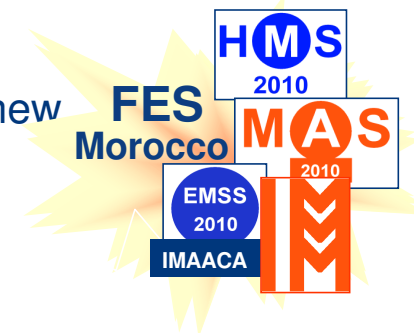
Rio de Janeiro &amp; Buzios



# Potential Cooperations

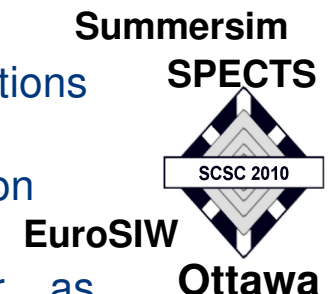
## Simulation Team provides R&D/Scientific Opportunities such as:

- Conferences and Track Organization in event where the Simulation is Strongly Involved (i.e. SummerSim, I3M, WAMS, AMS, ect)
- Exchanges for Senior and Young Scientists
- Opportunity for Scientific Cooperations devoted to promote new developments in M&S
- Developing new Standards and Procedures in M&S
- Promoting M&S in Service of the Society
- Development of Networks of Excellence in M&S



## Simulation Team is looking for Opportunities including:

- Activation of Innovative Simulation Projects
- Combining Simulation Team Solutions with Partner's Models as Options to be proposed to Sponsors during the Proposal Phase
- Include in Simulation Team Solutions Add-In from Partners as Option for Sponsors during the Proposal Phase
- Supporting Partners in future Proposal acting directly or as subcontractor and viceversa
- Receiving Support by Partner in future Proposal acting directly or as subcontractor





# ADSL & Prof. Dimitri Mavris



**Systems-of-Systems Engineering in ASDL**

**Prof. Dimitri Mavris**

*Director of the Aerospace Systems Design Laboratory (ASDL)  
Guggenheim School of Aerospace Engineering, Georgia Institute of Technology*



Liophant  
Simulation



McLeod Institute of  
Simulation Science



University  
of Genoa



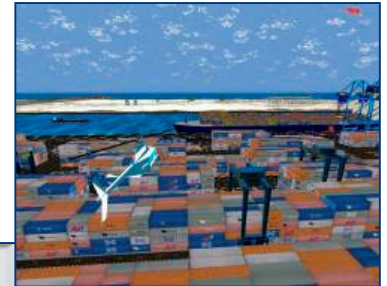
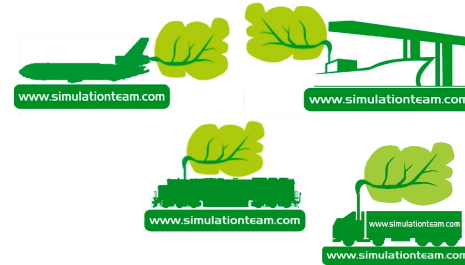
Orizzonte  
Sistemi Navali



# Simulation Team

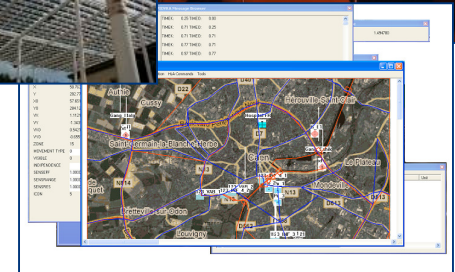
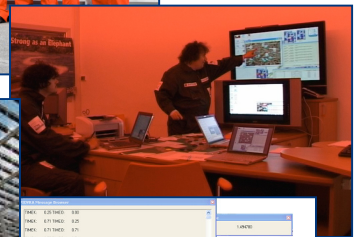


## References



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DIPTM  
Università di Genova

Unclassified