Logistics Enhanced by Simulation Nowadays: New Opportunities, Challenges & Capabilities



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University of Genoa: an Overview

The University of Genoa is one of the oldest in Italy and in the World (founded in <u>1471 AD</u>), 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 m²).

For further Information about the University of Genoa:



www.itim.unige.it www.unige.it





Who Are We?

Simulation Team is a non profit Excellence Network including Universities, Research Centers and Startup Companies operating worldwide in synergy for developing Innovative Solutions with a particular focus in Modeling and Simulation



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PETROBRAS

Simulation Team Genoa

The Simulation Team - MITIM DIME of Genoa University carries out many industrial projects in cooperation with the large corporations and Small and Medium sized Enterprises; some example of recent industrial simulation project are following:1 LOCKHEED MARTIN BR

ENI Fleet Management Planning & Scheduling Group Ansaldo OII PNNT) LAMCE SOLVAY TELECOM **Petrobras EDA** Ford Motor

AMPARI

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Logistics: Meanings

Λογιστικος

Greek word for Art of Calculus

Logisticus

Logistique

Medieval Latin:Calculation

Introduced by General A.H. de Jomini

Translated in English by Cap. A.T.Mahan

Marechal General de Logis

Established during Napolean Wars

Logistics



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Logistique: l'application pratique de l'art de mouvoir les armées

Antoine Henri de Jomini, General





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The Art for Winning Competition



L'Art de la Guerre se divise en cinq branches						
puremen	t militaires;	la st	ratégie,	la g	rande	
tactique,	la logistique	l'art	de l'ingé	énieur,	et la	
tactique o	de détail.					

Antoine Henri Jomini, Precis de l'Art de Guerre

1836 AC





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Exporting "Logistics" in New World & English



...between Strategy and Grand Tactics comes logically Logistics. Strategy decides where to act; Logistics is the act of moving armies.

Alfred T. Mahan, Objects of the U.S. Naval War College. An Address 1888 AC



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Military & Logistics



The Care for the Subsistence of the troops comes therefore into reciprocal action chiefly Strategy, and there is nothing with more common than for the Leading Strategic Features of a Campaign and War to be traced out in connection with a view to this Supply.

Carl & Marie von Clausevitz, Vom Kriege, II-1

1832





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Supplying Lines & Military Operations



... de expugnatione desperavit, de obsessione non prius agendum constituit, quam rem frumentariam expedisset. *

Caesar, De Bello Gallico

52 BC



Gentlemen, the officer who doesn't know his communications and supply as well as his tactics

is totally useless.

George S. Patton, USA

1944 AC





* [...] despairing to be able to take [Gergovia] by storm, he decided not to hold a siege before addressing grain stocks. 2010-2018 © Copyright Agostino G. Bruzzone, Simulation Team



Sun

Simulation Team



Origins in Military Manouevring

軍爭簄



軍政曰:「言不相聞,故爲金鼓;視而不見,故爲旌旗。」夫 金鼓旌旗者,所以一人之耳目也;人既專一, 則勇者不得獨進 怯者不得獨退,此用眾之法也。故夜戰多火鼓 書戰多旌旗,所以變人之耳目也。

故三軍可奪氣,將軍可奪心。是故朝氣銳,書氣惰,暮氣歸。故善用 兵者,避其銳氣,擊其惰歸,此治氣者也。以治待亂,以靜待嘩,此 治心者也。以近待遠,以佚待勞,以飽待飢,此治力者也。無邀正正 之旗,無整堂堂之陣,此治戀者也

故用兵之法,高陵勿向,背丘勿逆,佯北勿從,鋭卒勿攻,餌兵勿食 ,歸師勿遏,圍師遺闕,窮寇勿迫,此用兵之法也。

We may take it then that an army without its baggage-train ĬS *lost;*

without provisions it is lost; without bases of supply it is lost

Sun Tzu, Art of War, Art of Manoeuvring -11

500 BC









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Industrial Competition: It is a Game or it is War?

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。



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



Simulation Origin? Simulator





Ovid's Metamorphoses, 11, 634, 8 AD



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Challenges along Millennia...

τοσοῦτοι Ιπποι τε καὶ ἄνδρες διεστᾶσι κατὰ ἡμερησίην όδὂν ἑκάστην Ιππος τε καὶ ἀνῆρ τεταγμένος· τοὺς οῦτε νιφετός, οὐκ ὅμβρος, οὐ καῦμα, οὐ νὺξ ἕργει μὴ οὐ κατανύσαι τὸν προκείμενον 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





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00 times

an that!

0 Space

huttles!



... Corresponding Today to...

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

....Science

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than

the

Gross World Product!

full



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 Retalier

We are far from being experts at managing inventory, even thought we turn our inventory faster then, 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, 2018:26th World Company, 135 GUSD Sales, 2'371 MUSD Profit)



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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 ($\exists \overline{x})$ 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 month)



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"Companies need to be considering logistics problems of the future, like delivering to space stations" 2010-2018 © Copyright Agostino G. Bruzzone, Simulation Team Unclassified, Unlimited Public Release

Today: Living in a Paradox In 2018:

2018: world's Largest Taxi Company

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

Facebook, the most popular media owner,...

Alibaba, the most valuable retailer,...



Airbnb, the largest accomodation provider,...

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owns no Vehicles





creates no content



has no inventory





owns no real estate





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New Locations...



Freetown, Sierra Leone



Asunction, Paraguay



Ashgabat, Turkmenistan



Macau, China

....within a Challenging World



Kiev





Kobane



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

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

- New System Design
- New Policy Definition
- Table Top Exercise in order to raise Top Management awareness
- Training in procedures and Operations
- Personnel Training and education

The use of Intelligent Agent is crucial to automate Simulation





Model Nature

Classification on the base of the Model Nature:

Deterministic Simulation

A Simulation based on models where statistical distribution are not in use, including just deterministic behaviors

Stochastic Simulation

A Simulation reproducing a system with variables regulated by not known statistical phenomena by implementing pseudorandom variables





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The Future as Opportunity based on Innovation

Breakthrough Technologies are the opportunity to guarantee competitiveness and needs strong support from M&S







Why Modeling & Simulation?

Internal Complexity

Complex Behaviors



Simulation:

More Efforts More Capabilities Reusable Models Not Linear Systems Not valid Simplification Hypotheses Boundary Conditions are Critical No Generalization

External Complexity -

Many Interaction





Looking Forward for new decade Technologies

Some of major issues arising will be focused on following issues:

- Serious Games & Simulation for Training
- Mobile Solutions
- Virtual Worlds & Augmented Reality
- Cloud Technologies
- New Industrial Paradigms







M&S Resources Allocation and Logistics Planing

Simulation is able to supports Logistics in term of Operation Planning, Resource Management and Optimization

In addition Hybrid Simulation (intended as integration of Simulation with Intelligent Agents and Artificial Intelligence) supports scenarios evaluation and the identification of effective solutions in terms of costs, efficiency, productivity, robustness, etc.





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Simulation Team Looking Really for M&S? Yes!



... but you should be... smart... flexible... quick... solid... relying on SME... professional... reliable... etc.

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MS2G Paradigm as new Enabler



The innovative concept of <u>MS2G</u> (<u>Modeling, interoperable Simulation</u> <u>and Serious Games</u>) 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





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Yesterday Challenges

Logistics as evolving and crucial sector is younger than other areas in Industrial Processes and it was often quartered among other company divisions Among critical issues it was possible to Rank among the others the following aspects:

- Not to trivalize Logistics even Now
- Working Conditions of Logistics operators
- Globalization
- Supply Chain Management Optimization
- Outsourcing









Current Logistics Shortfalls

Today shortfalls in Logistics included several issues such as:

- Need of Talents and Skills in Logistics
- Last mile & last km
- Safety and Security
- Sustainability



There are also interesting opportunities:



- New Routes such as Panama Canal, Polar Routes, Amazonia
- Price and Service Balance
- Service Evolution (i.e. freight bill payment (freight bill audit and payment firms)



Tomorrow Challenges

- Urbanization and the increasing number of "Mega Cities"
- World Evolution
- Technological advances (e.g. "additive manufacturing")
- Cyber Attacks to logistics networks
- Harnessing of "big data" to improve supply chain efficiency
- Adaptation to Global climate change.











Logistics as *Periodic* Source of Risks and Opportunities

The Logistics exploded during the last 20 years due to globalization, therefore due to the market evolution this situation is characterized by periodic behaviors with very challenges oscillations, where M&S could support decision making:

~10 kUSD/Day 2006 >100 kUSD/Day 2007 ~4 kUSD/Day 2008 5-60 kUSD/Day 2010



Dry Bulk (Cape Ship) Rates along Shipping Containers Europe to China from - 2'000 Euro/TEU + 20 USD/TEU to





Complexity evolve along Life Cycle: Logistics should be there

A Product, or System, *Life Cycle* is the cycle through which it goes from its initial introduction to the withdrawal, or decommissioning, and includes among others:

Requirements DefinitionSystem DefinitionDevelopmentCommissioning

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Operation & Service

Deployment Decommissioning



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Production

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High Level

Orders

<u>Assign</u>

Tasks

Enabling

Engagement

Man on the Loop vs. Man in the Loop Leading

	Driving	Single Unit Control	
	Venicies	Acting in	
(Low	Coordinate Mode	
	Level		Y
	Orders	Direct	25 3 50
De Conflicting		Engagement	
	Actions		



Role

Responsibilities

Assign

Goals

Humans could assign tasks, missions, high level orders and supervise the whole scenario involving Complex Operations.

Different solutions need to be to developed with alternative interface solutions (e.g. an immersive interactive cave composed by an interactive whiteboard in a cubic solution such as the SPIDERTM)

Man-machine interfaces for collaborative distributed work need to be taken into account in order to improve immersive capabilities as well as Simulation Support




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Autonomy **Big Data Data Analytics Robotic Process Automation Supply Chain Management**

Container Self Organize their Supply Chain and Global **Network**

Mixed Reality Internet of Everything **Machine Learning**

AGV & Robotics interact in Swarms

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Bins present what to pick

Global Plant & SCM

IoE & Autonomy

Cloud

Trucks Deliver Goods

Autonomously





Credits to Thorsten Hülsmann, Logistics 4.0, IML, Fraunhofer 2010-2018 © Copyright Agostino G. Bruzzone, Simulation Team



Supervision, Fixing & Control by People

Each Shelf organizes its own Refurbishment

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Data Opportunities: Big Data & Data Farming Data Dominance requires to be able to: Mine Data **Extract & Process Information**

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Complete Analysis & Draw Conclusions





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Smart Simulation is allowing to develop new Models based on Big Data and to **Investigators** feed by Data Farming and enabling the use of Crowdsourcing

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Enhanced Simulation to Validate Data & Look Forward

On-Line Simulation Concept could evolve into Data Enhanced Simulation through approaches



Pattern of Life for Commercial Traffics



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Simulation is already Available









A Megacity is commonly defined as a City with over 10 million people and it is usually affected by management

and development problems similar to a small States. Megacity Model, by Simulation Team, allows to check how to address:

- Environment
- Energy
- Transport

Security







The creation of a Virtual Model of a Megacity allows to

visualize & to Quantify dynamically the Dynamics of the Town Demands

Area Required by Local Node Warehouse to support population based on dynamic demand







Experimental Synthesis

දු 1

⁵¹ 0,8

Evaluation Method Comparison on Participation Rate respect Shared Resou



- <u>Case A</u>: Conservative Approach on the Costs of people using CM Platform first Time
- <u>Case B</u>: Dynamic Approach with initial reduction of Cost to attract customers

CM: Cloud Manufacturing

0,6 0,4 02 Evaluation Method Comparison on Frequency Rate respect Original Registration Time

Evaluation Method Comparison on

Frequency Rate respect on Task Numbers











Simulation, Virtual Reality & Augmented Reality

Simulation, AR/VR and Serious Games Reality provide very crucial support to Industrial Safety :

During Process Development

- Identify & Quantify Risks & Critical Issues
- Support Safety Engineering
- Defining Safety Procedures
- Support Development of Training Equipment
- Involve Users in Engineering Processes

During Operations

- Evaluate Impact of Changes
- Develop Training Programs
- Preventive Support in Dangerous
 Situations
- Support during Crisis & Emergencies
- Accident Causes Identification









M&S: Simulation use computers to recreate real systems on computers, to experiment them within such

& Enabling

Technologies

virtual environment, to conduct experiments and tests even before the new industrial system is realized

Industry 4.0

- Virtual & Augmented : is the combined use of Computer Solutions to Immerse the user into a Virtual Framework and to add info to reality; currently MR is flexible, working with multiple platforms & I/O (e.g.Smartphohes, CAVEs, Laptops, CAVE, HDM , Hololens[™] , etc.)
- AI & IA: Artificial Intelligence, Intelligent Agents and Machine Learning allow to elaborate big data collected by industrial systems and to identify correlations able to create smart supports to users that evolve dynamically





W-Artemys

Wearable augmented reality for employee safety in manufacturing systems

Simulation Team supports W-Artemys by its Labs & Tools (e.g. Cave SPIDER, ST Applications, etc.). The Focus of Genoa

group will be on the conceptual modeling and definition of the general architecture, Integration of new Interactive & Intelligent Mixed



Reality Solutions, Development of Intelligent Elements, Smart Solutions design and implementation, W-Artemys Demonstration construction, Integration of W-Artemys based on Industry 4.0 and Smart Manufacturing

concepts





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Working on Real & Virtual Worlds

Cooperative Remote Supervision for Operations & Service



Mixed Reality integrating VR & AR for improving Safety & Productivity



Training and Troubleshooting over the whole **Production** Line by SPIDER Cave, Tablets & Hololens™



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The Future as Opportunity based on Innovation

Breakthrough Technologies are the opportunity to guarantee competitiveness and needs strong support from M&S





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M&S Trouble Shooting, Training & Remote Assistance



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Simulation Practical Immersive Dynamic Environment for Reengineering

The SPIDER (Simulation Practical Immersive Dynamic

Environment for Reengineering) is an innovative Interactive and Interoperable CAVE (Cave Automatic Virtual Environment) developed by Simulation Team. The basic configuration is compact (2m x 2m x 2.6m) and could be embedded within a standard

Container and integrated in any interoperable simulator. The SPIDER is interactive through touch screen technologies. The SPIDER is fully Immersive including sound and motion.







Why putting Virtual & Augment Reality Everywhere?

Today technology is available for improving Efficiency through Virtual Environments, Augmented Reality & Phenomena Simulation the decision process so we need to use it for developing :

New Understandings
New Operational Supports
New Training Solutions



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A new Approach to Enhance Education and Training

Augmented Solutions for E&T that combines Simulation, AR & VR are able today, especially on new Generations to enhance Efficiency and Effectiveness of Education Programs. In particular it becomes possible to <u>Engage and Motivate</u> in new ways the Trainees as well as to provide them a <u>Realistic</u> <u>Virtual Labs</u> where to <u>Test</u> and <u>Experience</u> the studied

theories and procedures, as well as to <u>Exercise</u> on <u>Complex Simulated</u> <u>Scenarios</u>. MR is further reinforcing these concepts. It is evident the necessity to tailor and integrate these technologies in the whole E&T process.





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







"Tell me and I will forget. Teach me and I will remember. Involve me and I will learn", Confucius

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... Serious Games Evolve into Simulation Team Roadmap





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MMOC Massively Multiplayer Online Game MMORPG massively Multiplayer Online Role-play Game 2010-2018 © Copyright Agostino G. Bruzzone, Simulation Team

AR

Future Use and Innovative Interface

The architecture is designed to incorporate future technologies for continuous development. This R&D addresses especially:

- Monitoring & Tracking
- Remote Test & Troubleshooting
- Supervision
- Decision Support
- Remote Service Support
- Mobile Service Support
- Availability Improvements
- Reduction of Losses









Collaborative Remote Supervision & Service

The Central Subject Matter Experts (SMEs) become available to check remotely the Status of Different **Distributed Assets without** leaving the HQs. It becomes possible to Track them as well as to conduct Supervised Service Operation with the Service Operator or, directly, with final Users





Many Different Solutions: Glasses & Goggles

In facts there are many different solutions that could be adopted to support VR and AR implementations. Some ones are mostly useful for Training and Supervisions such as Head Mounted Displays.

The Oculus Rift is a basic and valuable commercial example of VR while the Hololens represents a new product for MR



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Tablets as Intuitive & Simple Approach to AR

Indeed sometime it is more effective to use basic Hardware solutions that result reliable and intuitive for potential users. From this point of view the tablets provide an interesting Man Machine Interface for supporting Service and Maintenance of Equipment and being operated by basic

Operators.







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Simulator's Interoperability Feature

One of the innovative features of the simulator is its interoperability. It is possible to use this characteristic during:

 Meetings for tactical and strategic decisions on logistics and production (investments and budget)
 Videoconference to evaluate critical operations and scheduling decisions.

> It also allows to put in contact logistics with production and make their integration in the company's context easier.

Testing MARLON Simulator through Smartboards in different labs

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ST_VM: Virtual Marine 🏧



The ST-VM is the ultimate Marine Simulator developed by Simulation Team and includes many different Marine components, equipment and platforms as well as New Solutions for Terminal Design, Operator Training, TAITER Safety and Security, Procedure Definition, - S O **Equipment Design and Virtual Prototyping** <u>PARK</u>





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

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



ST-VM includes a Full-Scope Simulation for Training Operations & Procedures, an Integrated Class Room, the Instructor Debriefing Room, and secondary Interoperable Simulators of different Marine equipment with other modules (i.e. **Biomedical Module for Safety, Ergonomic** and Posture Enhancement).

ST-VM World is customizable for each Platform, Port, Crane, Procedure and Equipment.



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Simulation Team Ergonomics & Improving People Capabilities

Quay Crane Unloading Sequence from Ship to Truck





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Performance Evolution over Time



Crane operators performance curves along the four time shifts (6h each) are decreasing by a parabolic trend





Interoperable Virtual Simulators

The Simulators developed by Simulation Team are an important support in Training **both Operative Resources and Decision** Makers. The Interoperability of our simulators is based on state of art standards (i.e. HLA High Level Architecture) and emphasize in addition to traditional stand-alone training in Operating, even **Concurrent Cooperative Training in Operations and Policies; Simulation Team** collect long experience in Professional and Executive Training.









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ST_PT & ST_RS Simulators



















Shelter & Facilities



ST_PT Crane Sim



ST_PT Truck Sim

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

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Atout of our Virtual Simulation









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Training & R&D

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ST_VM Federates





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Green Log: a Web Based SONY **Approach to Green Logistics**

Dependence

Dipendente

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Q Riferimento

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MARS

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DataLink Emission gas... Output kWh kWh Via Faia,9 Dipendente Emi particolato Input Dipendente 435 kWh kWh 345345 DataVector Dipendente 234 kWh kWh 234234 Faia .Nox Input 34534 kWh kWh 345 mi CO Dinendente Innut DataImpact 📕 GL - GreenLog Impact Node Measured impact: _ D X **Environmental Impacts** ПX 1.87 tCO2/anno 😹 Delete.. 35.000 Link 32,500 🖌 0.17 tTire/anno 30.000 27.500 33534.65 euro/anno ector 25.000 22,500 20,000 e 17.500 Vector to Link 15.000 12,500 Bilico 10.000 Treno 7.500 Bilico125 5.000 Piedi 2.500 Macchina GREEN Autobus scenarioA Molto Bassa Compare to. Impacts Molto Bassa 📕 tCO2 📕 tTire 📕 euro Molto Bassa Molto Rassa 🔆 CO2 0 CFP 0 tWater/anno 1.87 tCo2/anno 0 tCarta/anno 0 kWh/anno 33534.65 Euro/year Cancel 69 DIME Università di Genova T LI II

DataImpact

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InOur

Input

🕑 🛄

Questionnaire - Main

Green Logistics - Gestione

DataNode

Part 1/5 Part 2/5 Part 3/5 Part 4/5 Part 5/5

Simulation Team Automated Scenario Generation in GreenLog Sim

CAMPAR



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 Green Log allows to integrate automatically the data collected in the questionnaire in order to create a basic simulation scenario to provide an estimation of the company

File Data Strumenti Llala	ST ST	Questionnaire - Ma	ain		• ×
			Part 15 Part 25 Part 35 Part 45 Part 55		
SYLE:	CAMPAR	Dati Aziendali	1		
		Azienda			2
Maia	offStore	Indirizzo	Via Fala,9		it
http://st.itimunige.it/greenlogistics		Località	Faia		
		Provincia			2
	Perrone	Sito WEB	e		2 ••1
- North		Telefono	019887503		1.00
PICCON		Fax	none		·
		E-Muil	oTaro@hotmail.com		100
					2
		Settore			2
	SuperMarket	N° Dipendenti		9	
		Nº Stabilimenti			400
		Azienda	Locale		22
			Multinazionale		93
		Fatturato	0-100		
		<< Back	Next >> Model &	Reports Scenario:]
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MOSES MOdelling Sustainable Environment through Simulation

MOSES is a sustainability model based on dynamic simulator which has been used as a tool in a game based experience.

The goals of MOSES project are:



 To propose a quantitative method for modelling and integrating well-known sustainability issues

• To conduct a role play game experience through the use of a sustainability model implemented in a simulator

The model has been tailored on a city populated by about 95k inhabitants, facing the Tyrrhenian sea and with one commercial and military port hosting the arsenal of the Navy. The urban area extends over 52 km² and includes a power-plant.

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MOSES Simulation

MOSES (MOdelling Sustainable Environment through Simulation) is a sustainability model based on dynamic simulator which has been used as a tool in a game based experience during a MIPET class.

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Sustainability Simple Geo Representation

The simulator is equipped with a mapping tool which visualizes the use of the soil in terms of intended use, superimposed to a satellite picture







MOSES: a Game for Negotiation & Decision Making

The experience will subdive the students in two groups. All participants will be randomly assigned to their roles. In this experience students will supervised by professional engineers with professional background in the field. One group will play the role of the governmental authority of the region, and it will be equipped with MOSES environment. The second group will take care of the interests of a company which aims at building and operating a coal power plant in a specific virtualized area and economic scenario. These team members will act as the engineers who had to finalize the technical proposals and to draft the design document including the environmental impact assessment. This team will also use MOSES simulator, obviously with a prevailing interest in a subset of output variables which will be different from the one of the previous team and more profit-oriented, while the public authority will focus more on social indicators. The goal of the two groups is to finalize successful the negotiation on the offsets and to adopt winning

strategies





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Port & Cyber Security: MS2G in T-REX

The Cyber Security environment (T-REX) creation by Simulation Team allows to evaluate the impacts on operations and estimates the magnitude. The approach allows to considerate the Cyber Warfare Complexity and the impacts on ICT process and infrastructures.The MS2G (Modeling, interoperable Simulation & Serious Games) approach, make possible to raise users awareness and evaluating the efficiency and efficacy of the defensive actions against cyber attacks.







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The Cyber Security weaknesses are often in social Engineering instead in Cyber Space itself. But often the damage are not related to data.





Hybrid Warfare & Autonomous Systems



Autonomous Systems represent crucial elements in Hybrid Warfare both in terms of Defensive Resources and Threats Our T-REX Simulation includes patrols by UAV, as well as coordinated Cyber & Real Attacks using small UAVs



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The T-REX includes: Port, Oil Terminal, Tank Farm, Power Plant, Desalination Units, Security Systems, People, Threat Network, Media, Communications, Traditional Assets as well as Different **Autonomous Systems and Other Critical Infrastructures**

The Oil Terminal & Port is protected by Legacy Systems and UAV, USV, AUV in JISR from a threat network.

The cyber layer of T-REX includes computers, laptops and mobile IoTs (internet of Things) as well as firewalls and procedures.

The threat network includes terrorist agents able to adopt different operative modes such as "sleeping", "stand by", "planning action", "preparing action", "executing action" on different layers by using conventional attacks & drones. UAV

USV

AUV

JISR



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Unmanned Autonomous Vehicles **Unmanned Surface Vehicle** Autonomous Underwater Systems Joint Intelligence, Surveillance and Reconnaissance Unclassified, Unlimited Public Release





M&S (Modeling & Simulation) is a strategic enabler for investigating, experimenting & validating concepts, solutions & systems within complex multi domain scenarios:



- Reproducing a Complex Environments
- Reproducing joint interoperability among different Systems, Sub-Systems, Products & Services
- Simulating Entities, Objects, Units and their they interactions
 - Simulating different Aspects (e.g. demand , operations, etc.)







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.



Multidisciplinary Nature of the Complex Systems

















Complex systems are addressed by multiple competences, multiple backgrounds, multiple technical languages





Complexity Concepts in System Engineering

There are different kind of complexity affecting the Products and Systems to be addressed:



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Complex Systems/Products for Aerospace & Defence

 Logistics and Service represent examples of Complex Function that require to interoperate among all elements and features



SoSE & Simulation

 The increased level of complexity, interoperability and cost effectivness resulted in an increased focus on new Models considering the whole System of Systems Engineering



MISCHIEF Simulation





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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



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Previous Project Examples: 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 Sector. The approach allows to measure the benefits of engineering changes on the operations VIP-STRALO involves the creation of interoperable demonstrators:

- LOCARS: Logistics Crane Simulator
- FEBO: Federation of Boats





ARTEM (Augmented Reality TErrain interoperable Module) is a Module integrated through High Level Architecture with MS2G (Modeling, interoperable Simulation & Serious Game) systems.

ARTEM allows to present over smartphone and other mobile device the situation in real-time geo-referenced dynamically respect the on going simulation.

ARTEM provides the opportunity to train personnel directly on the field using details models and simulator that interact dynamically with personnel and assets during the exercises. The system allows to visualize

real and virtual assets as well as different effects on the terrain.



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Simulation Solutions based on virtual & augmented reality for Maintenance

SISOM is a Solution based on Virtual and Augmented Reality for Maintenance in Vessels and Plants. SISOM uses simple Tablets, mobiles and/or laptop to represent the real skid/system with augmented information; by this approach, SISOM guarantees safe and intuitive procedural instruction interactively overlapped to the real equipment (e.g. trouble shooting,

dismounting, emergency shutdown, etc.), as well as training procedures, remote dynamic supervision and testing. Indeed SISOM could be integrated with HLA Simulation to support training. SISOM supports both predictive, preventive and corrective maintenance.

SISOM





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Distributed Assets & IoT: New Distributed Systems



Distributed Assets & IoT: New Distributed Systems



Distributed Assets & IoT: New Distributed Systems Individual Production **Industries Patients** Service Warehouses Maintenance Service Nursery Transportation Homes Hospitals

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Distributed Assets & IoT: New Distributed Systems





Distributed Assets & IoT: New Distributed Systems



Example of Architecture





Example of Architecture



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The Placra model was developed in order to reproduce the crew and logistics activities on Oil Platforms at Sea

OpenGL Op VRJuggler So WXWindows 3DSMax

OpenSceneGraph Sonix







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Rethinking Health Care

New Technologies and New Solutions *Provide t*oday many opportunities to rethink the Health Care as well as the Long Term Care

It is evident that Simulation is Fundamental to investigate the new Possibilities and to design innovative Procedures &

Logistics Solutions for the Future





Slow Food & World Market with new Logistics

- Slow Food is a Concept spread worldwide that promotes an alternative to fast food based on preservation of Traditional and Regional Cuisine and promotion of Plants, Seeds and Livestock Farming that are specific of Local Ecosystems.
- Its final goal is Sustainable Foods and Promotion of Local Small Businesses in opposition to Globalization of Agricultural Products by using Cloud



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Carlo Petrini in Italy in 1986

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CM: Cloud Manufacturing applied to Slow Food



Slow Food Service within the Cloud

Cloud Central Service is a innovative service based on internet in which large amounts of servers are linked together in a network able to guarantee an unique virtual control of the Process, the Data, the Resources as well as online access to services and shared resources. M&S and Cloud

Central Service could support CM for Slow Food based on :

- Public Solution
- Private Solution
- Hybrid Solution

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CM: Cloud Manufacturing M&S: Modeling and Simulation



Direct

Supply

Cloud

Manufacturing

Platform

One

Step \ Supply Two

Steps Supply Local

Node

Local

Node

R,

Local

Node

Demanders

Enterprises

Bidder

CM Platform Management

Major Management Issues in using the Cloud

& Suppliers

Manufacturing Services

- Dynamic Resource
 Allocation
- Acquisition of Common Resources
- Selection of Required Services
- Creation of Specific management model

CM: Cloud Manufacturing M&S: Modeling and Simulation





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Resource Allocation



Due to the virtualization layer across the types of resources within the platform and high heterogeneity and distribution of resources, it is necessary to develop intelligent allocation system integrated with M&S Several optimization algorithms are under study and development by Principal Active Centers in this field as Beihang, Genoa & Tsiengtuo Universities

> CM: Cloud Manufacturing M&S: Modeling and Simulation

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Conclusions

Modeling and Simulation are Strategic Sciences to address the modern Industrial Challenges **Using M&S in Logistics provides** a Competitive Advantage for Industries dominating or introducing New Technologies. The Evolving Scenarios and their Dynamics today requires extensive use of Modeling and Simulation to Support Decision Making



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Simulation Team www.simulationteam.com

University of Genoa www.liophant.org/projects

Projects on Logistics www.itim.unige.it/logistics

Videos on Logistics & Simulation www.liophant.org/video

This Presentation

www.simulationteam.com/download_pdf/ago_st_logsim20180410_4.pdf

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