Simulation Team

ALACRES2 Project:
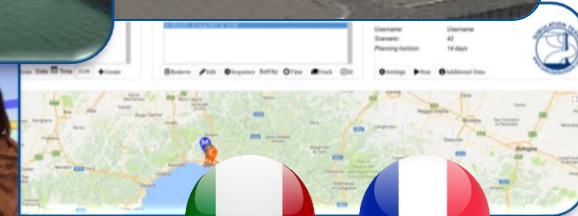# a Virtual Lab by M&S & AR

Servizio Avanzato di Laboratorio per Crisi ed Emergenze, in porto nello Spazio di cooperazione dell'alto tirreno, basato su Simulazione

service très Avancé de Laboratoire pour les CRises et les situations d'Émergence, en Situation portuaires dans l'espace de coopération de la haute mer Tyrrhénienne, basé sur la Simulation

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Port Plants as an Examples

Safety and Security are two major aspects to guarantee functionality and sustainability of Plants and Critical Infrastructures. We propose hereafter applications mostly in Port Plants, therefore the use of XR techniques such as VR, AR, MR could be in very similar way applied in any kind of Industrial Plant. It is evident that to protect and guarantee safe and efficient operations in Industrial Plant the possibility to use Immersive Interactive Synthetic Environments based on Virtual Reality allows to support training, education and design of safety and security technological & procedural solutions
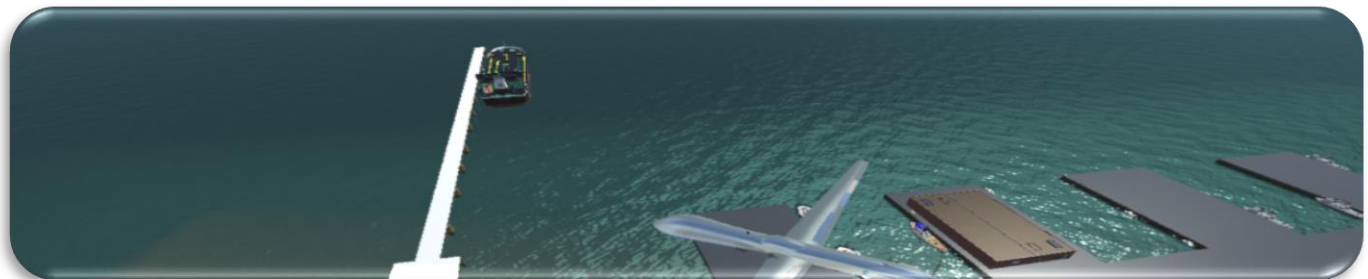
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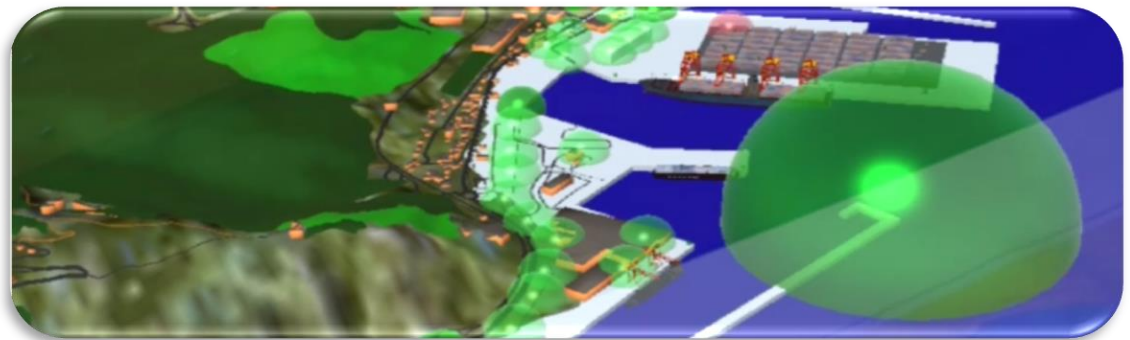
Port Traffic…

Top 10 ports of the World, 2018 - 2015

			2018	2017	2016	2015
1	Ningbo & Zhoushan	China	1080.0	1010.0	920	889.0
2	Shanghai	China	730.5	750.5	701.8	717.4
3	Tangshan	China	637.0	570.0	520.0	490.0
4	Singapore	Singapore	630.1	627.7	593.3	575.8
5	Guangzhou	China	613.0	590.0	543.6	519.9
6	Qingdao	China	540.0	510.0	510.0	500.0
7	Suzhou 1 (river port)	China	532.4	605.0	579.0	540.0
8	Port Hedland	Australia	519.4	500.9	460.4	452.9
9	Tianjin	China	508.0	501.0	551.0	541.0
10	Rotterdam	The Netherlands	469.0	467.4	461.2	466.4

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Port Traffic… new Issues…

Top 1

						593.3	575.8
5						543.6	519.9
6						510.0	500.0
7						579.0	540.0
8						460.4	452.9
9	Tianjin	China	508.0	501.0		551.0	541.0
10	Rotterdam	The Netherlands	469.0	467.4		461.2	466.4

10% more than first European Port

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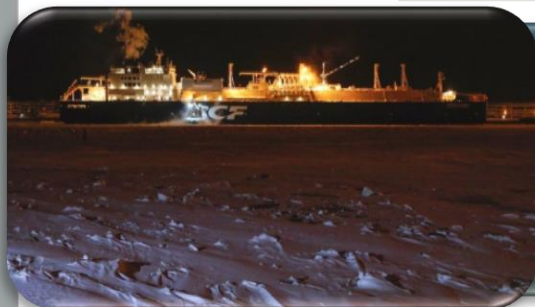
... and Safety and Security

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Town, Port and *Industry growth* created a intensive *dangerous Area*

Top 1

Just a Huge Accident caused by the Dangerous Materials present in the Port & Errors

Tianjin Explosion
August 12th, 2015
800 tons Ammonium Nitrate, 336 tons of TNT explosion equivalent
173 casualties, 2km range, 9bUSD Insurance Damages
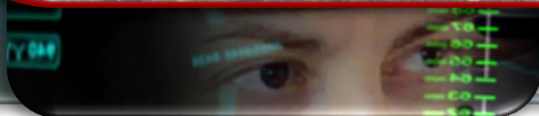
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ALACRES2

Servizio Avanzato di Laboratorio per Crisi ed Emergenze, in porto nello Spaziodi cooperazione dell'alto tirreno, basato su Simulazione

L'obiettivo di ALACRES2 è attivare un laboratorio permanente in grado di individuare, testare e validare procedure integrate di gestione delle emergenze nel caso di incidenti, crisi o sinistri rilevanti accaduti nelle fasi di carico e scarico in porto

ALACRES2 consente di individuare protocolli di gestione univoci di organizzazione e comportamento per assistere il miglioramento delle competenze dei lavoratori nelle emergenze di una fasi di estrema criticità della catena logistica

L'attività ha il compito quindi di indagare sui comportamenti delle diverse figure operative di gestione delle emergenze nel caso di incidenti andando a testare nuovi protocolli comportamentali, nuovi standard di operatività, nuove procedure di monitoraggio e controllo dell'emergenza, nuove tecnologie per l'infrastruttura e i sistemi di bordo.

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ALACRES2

service très Avancé de Laboratoire pour les Crises et les situations d'Émergence, en Situation portuaires dans l'espace de coopération de la haute mer Tyrrhénienne, basé sur la Simulation

L'objectif du projet ALACRES2 est d'activer un laboratoire virtuel permanent capable d'identifier, de tester et de valider des procédures intégrées de gestion des situations d'urgence en cas d'accident, de crise ou d'accident dans les ports.

ALACRES2 permet d'identifier le Protocoles de gestion et de comportement univoques pour aider à l'amélioration des compétences des travailleurs dans les situations d'urgence d'une phase extrêmement critique de la chaîne d'approvisionnement

L'activité a donc pour tâche d'enquêter sur le comportement des différentes figures opérationnelles de la gestion des urgences en cas d'accidents allant à l'essai de nouveaux protocoles comportementaux, de nouvelles normes d'exploitation, de nouvelles procédures de surveillance et de maîtrise de l'urgence, de nouvelles technologies pour le infrastructure et systèmes embarqués.

Approche ALACRES2
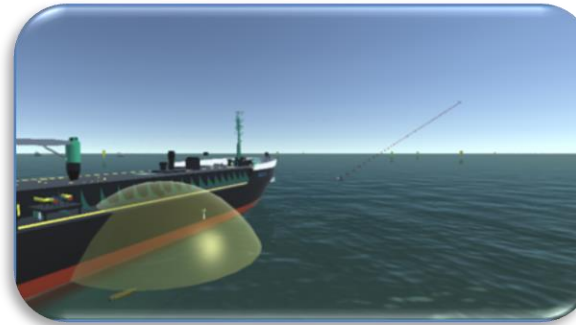
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Le laboratoire ALACRES2 étudie et analyse procédures et protocoles comportementaux pour:

- Les sommets de la chaîne de commandement et / ou des centres de gestion opérationnels, ou ceux qui sont chargés de gérer une situation d'urgence durable (incendie généralisé et prolongé, déversement dans de l'eau non contrôlée, évolution du nuage toxique, etc.)
- Les sujets opérationnels en charge des premières activités d'intervention visant à limiter l'urgence et / ou à réduire les causes qui ont généré l'indicateur (pompiers, travailleurs des urgences, etc.)

ALACRES2 est basé sur des techniques de simulation de comportements opérationnels et décisionnels visant à entraîner les différents sujets à effectuer leurs tâches respectives dans des conditions de stress mental et physique et de surcharge de travail, afin d'évaluer les processus incorrects, les méthodes d'envoi et / ou les envois incorrects. gestion de l'information, décisions non conformes aux conditions extérieures, etc. La simulation permet de reproduire l'évolution de la crise et son impact sur les structures, les systèmes, les personnes et les biens, en prenant en compte les aspects physiques et l'effet domino de son dynamisme.

ALACRES2 est en mesure d'évaluer de nouvelles solutions pour réduire la vulnérabilité, atténuer les dommages et prévenir les urgences. Le paradigme MS2G vien adopté (Modélisation, Simulation interopérable et Serious Games) pour pouvoir combiner différents modèles et garantir un haut niveau de fidélité et en même temps la simplicité d'utilisation, l'intuitivité et l'immersion
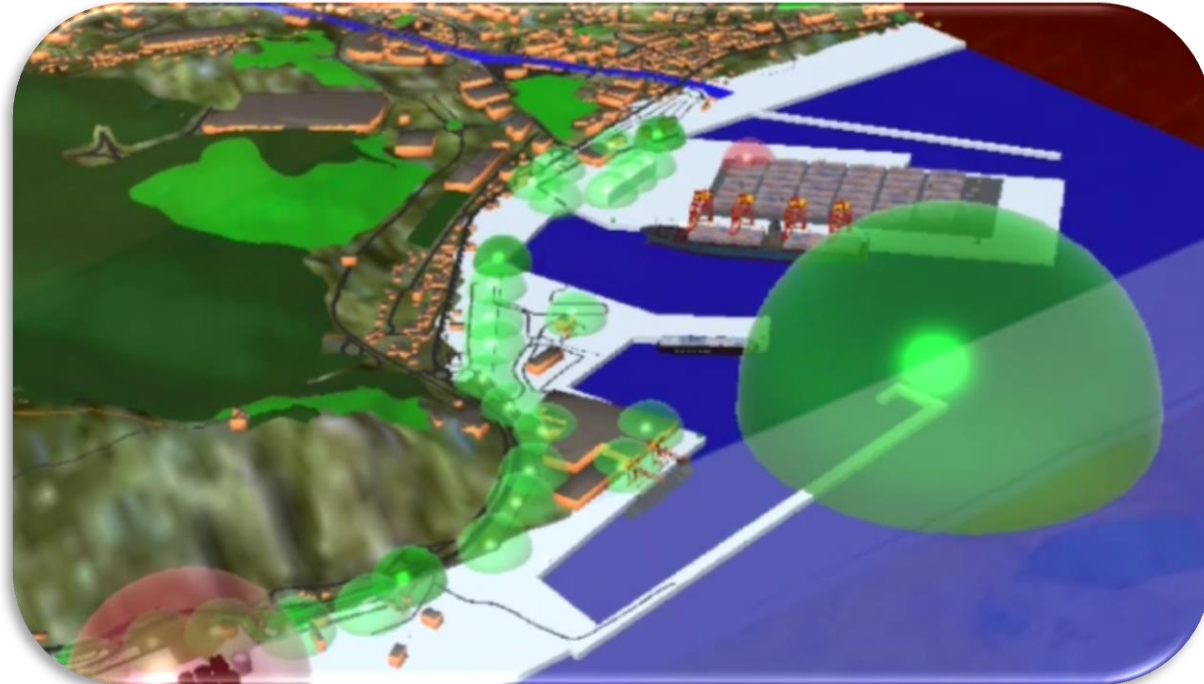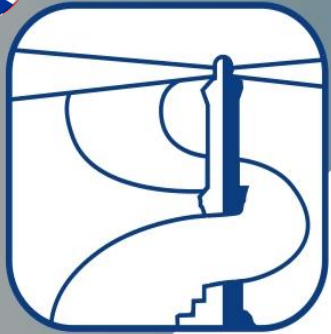
Virtual Lab for Ports

In virtual laboratory it is possible to test the effectiveness of new technological and infrastructural solutions to reduce vulnerability, mitigate damage and prevent emergencies. The simulation techniques adopt the new MS2G paradigm (Modeling, interoperable Simulation and Serious Games) to combine different

*Libya Es Sider Port, Oil Tank Fire (2014)*

*Virtual Port in Mixed Reality by Simulation Team with Risk Areas*

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AI & IA

Artificial Intelligence (AI) is based on techniques designed to reproduce intelligent processes. The M&S and AI are strongly connected because simulation often has to incorporate intelligence to control assets, virtual human beings, virtual organizations, planning activities. Intelligent Agents (IA) represent a crucial element for coupling complex scenarios with many entities that interact in a complex way. AI generally represent people, groups or units and reproduce the corresponding desired behaviors.

IAs allow an object to react to situation changes based on his perception. The use of AI-driven simulations reproducing the behavior human (HBM) is fundamental to recreate complex and extended scenarios which include the reactions of people and the population.

Port Protection
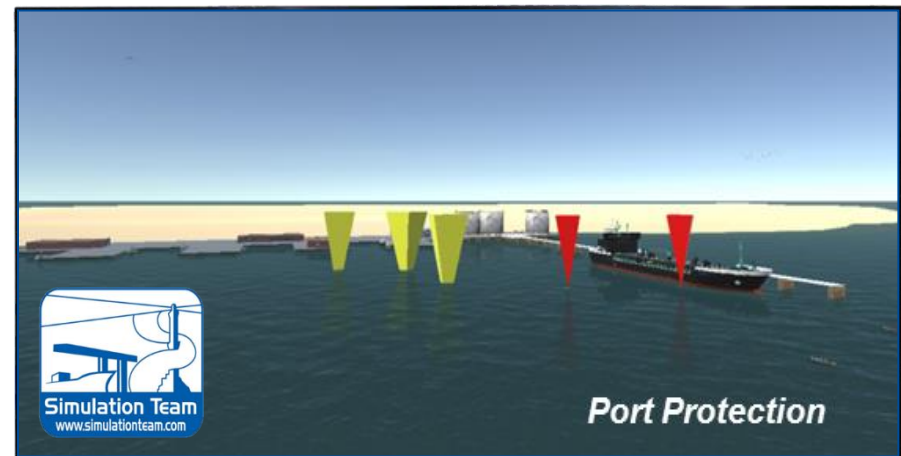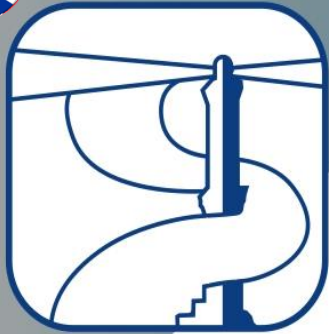
XR: AR plus VR Solutions

eXtended Reality combines ***Augmented & Virtual Reality*** to make intuitive and interactive to combine multiple data such as 3D terrain, Risks, Port Infrastructures & Plants over a real Nautical Map; this allows to extend information provided by "hardcopy" map adding information regarding hazardous materials, security, safety & adjacent zones
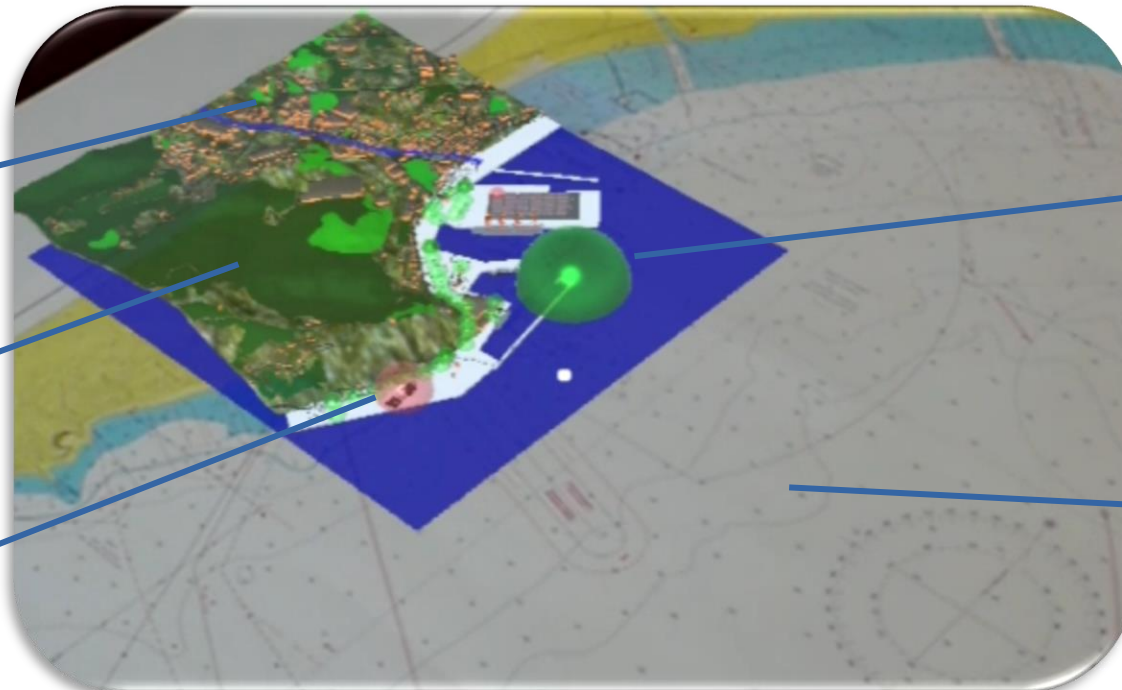
Adjacent zones

CCTV covered zone

3D terrain

Storage of Dangerous Materials

Nautical Map

Interactive 3D model of port overlapped with nautical map, view from Hololens

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Taste it
ALACRES2
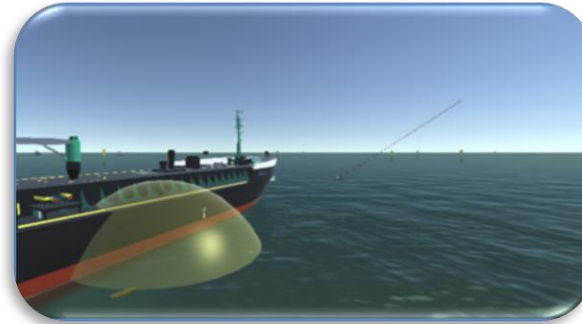
Please taste the feeling of Extended Reality on our App ALACRES2 Smartphone Demo that introduce it into an immersive world just using your mobile (Android 8.0 or more) with our basic ALACRES2 Headset getting it from our web sie

www.itim.unige.it/projects/alacres2/app

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AR & VR Live Demonstration

Thanks to **Augmented & Virtual Reality** it becomes possible to recreate the emergency scenario using immersive virtual reality technologies, allowing the operators to take actions and simulate their work in environment that reproduces the real emergency conditions and that guarantee to be involved in the crisis.

Cyber space simulation in SPIDER CAVE

Using Oculus Rift in maritime frmework
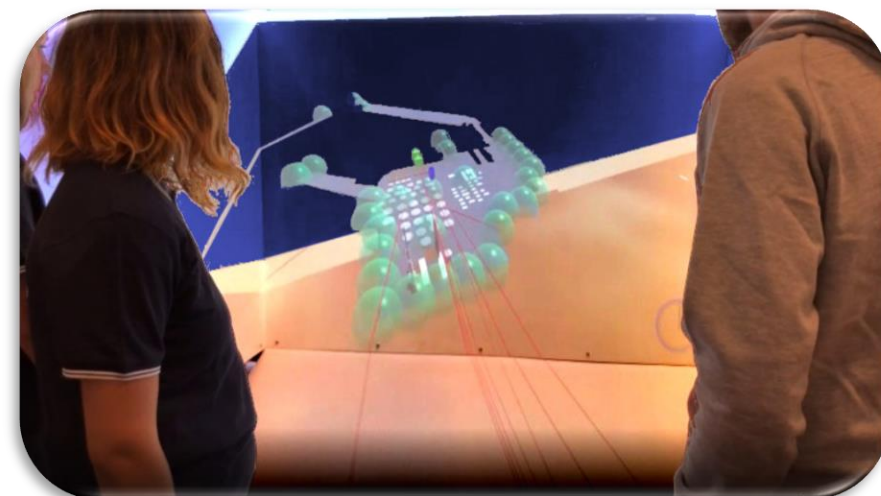
T-REX simulator in SPIDER CAVE

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Strategic Engineering as a New Way for Decision Making

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Strong potential synergy with STRATEGOS Initiative and partnter using Simulation, Data Analytics and AI for decision making

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HITACHI Inspire the Next
axpo
ANSALDO ENERGIA
accenture
MBDA
pass
PAUL WURTH SMS group
RINA
rulex
BearingPoint®
tenova
BRANDNEW
DITEN
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SiglaTech Business Energy
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ANTYCIP simulation
ICM
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Master of Science in Strategic Engineering

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Case Studies & Expected Results

After problem identification, it is possible to perform preliminary risk assessment and identify potential scenarios of interest, to be used for developing a simulation-based solution. In this case, it should be considered possibility of multiple types of accidents (e.g. fire with subsequent explosion) and causes. In the same time, the model should take into account the external conditions, such as presence of personnel, proximity of residential areas, meteorological conditions and configuration of the port.

As an example, possible scenario could include leakage of toxic material from tanks in the port while ferries are docked in proximity. In such case, analysis of the possible outcomes should include such factors as weather conditions (e.g. wind, fog, temperature, even time of the day) passengers' behavior (e.g. organized evacuation, panic) logic and actions of personnel and first responders, impact on port structures and nearby urban zones (domino effect, evacuation of urban areas).
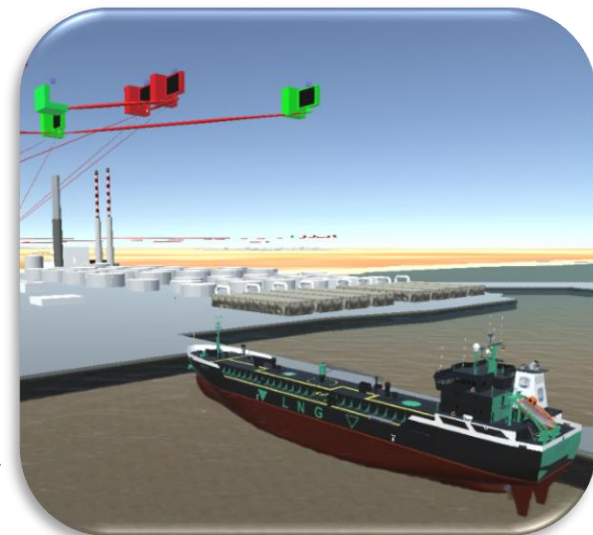
Screenshot T-REX

SPIDER

Simulation Practical Immersive Dynamic Environment for Reengineering
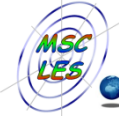
The SPIDER (Simulation Practical Immersive Dynamic Environment for Reengineering) is an innovative Interactive and Interoperable CAVE (Cave Automatic Virtual Environment) developed by Simulation Team. The basic configuration is compact (just 2m x 2m x 2.6m) and could be embedded within a standard Container and integrated in any interoperable simulator.
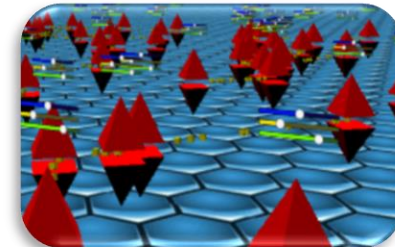
The SPIDER is interactive through touch screen technologies.
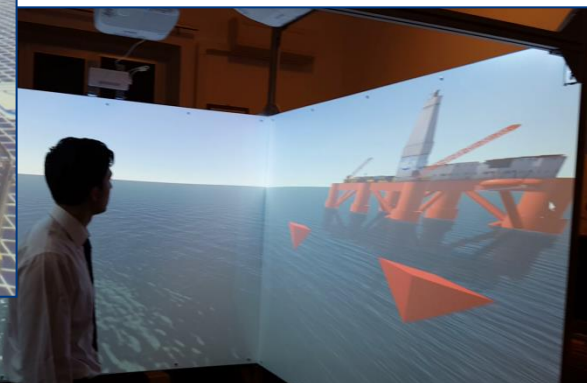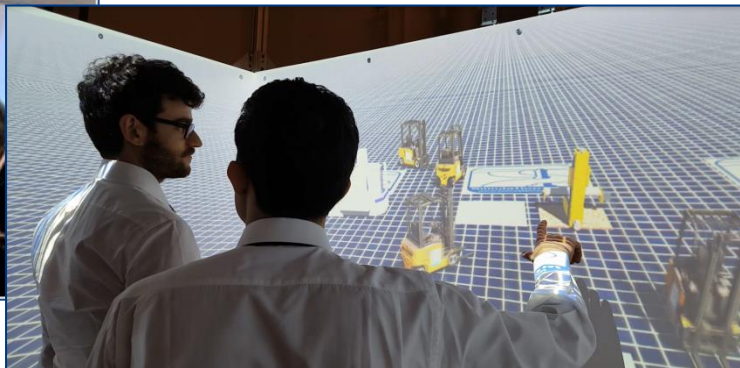
The SPIDER is fully Immersive including sound and motion.

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Hybrid Challenges & Autonomous Systems
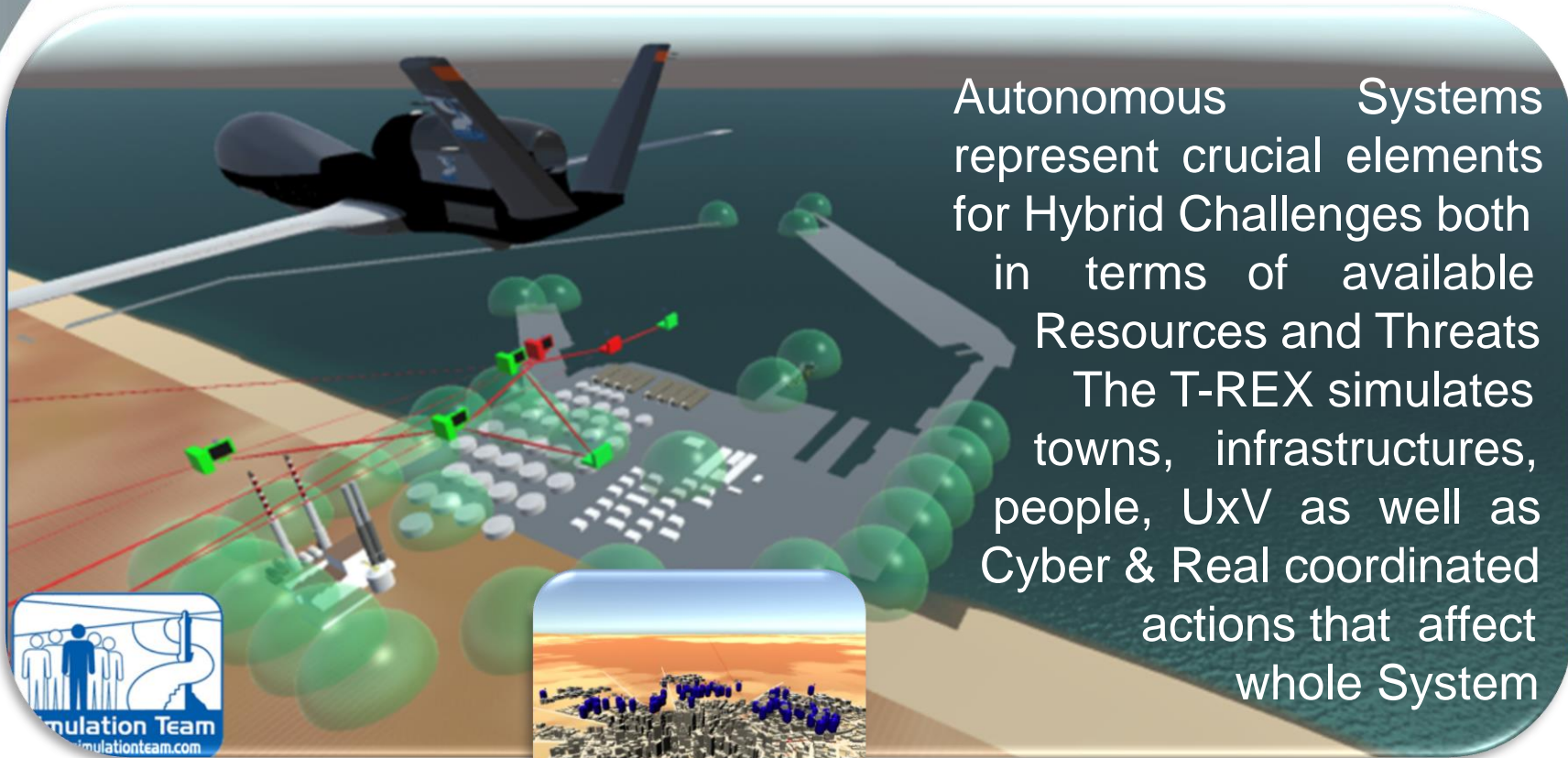
Autonomous Systems represent crucial elements for Hybrid Challenges both in terms of available Resources and Threats The T-REX simulates towns, infrastructures, people, UxV as well as Cyber & Real coordinated actions that affect whole System

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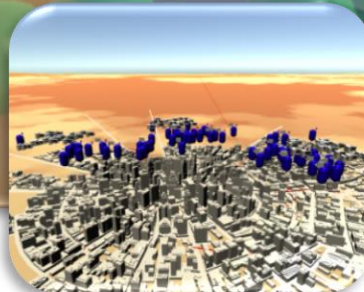
T-REX Cyber Layer

T-REX and IA-CGF (Intelligent Agents Computer Generated Forces) drive actions on the Cyber Layer where it is mapped the ICT domain and related levels of Confidentiality, Accessibility and Integrity for *each node and link*

Cyber Attack:
• Resources
• Responsiveness
• Efficiency
• Effectiveness
• Virus Dynamism
• Virus Initial Injection
• Virus Infectivity
• Virus Resilience
• Virus Level

Cyber Defense:
• Resources
• Responsiveness
• Efficiency
• Effectiveness
• Anti Virus Diffusion
• Anti Virus Resilience
• Anti Virus Level

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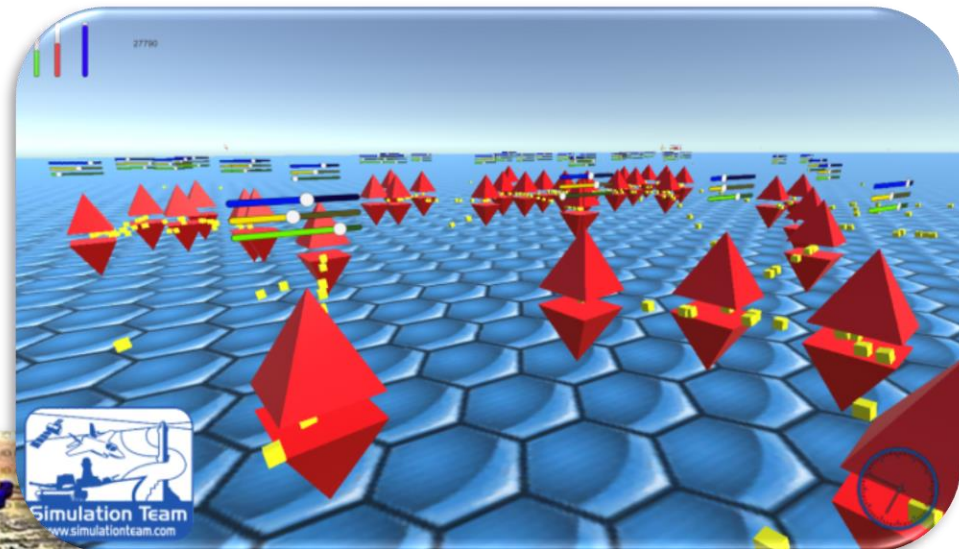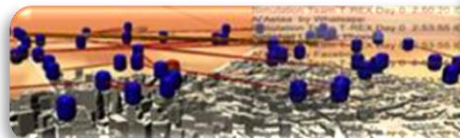
T-REX: Socials & Population

The Simulator reproduces the Social Network, Cyber Space and Population and how they react to their perception of the Scenario Evolution.
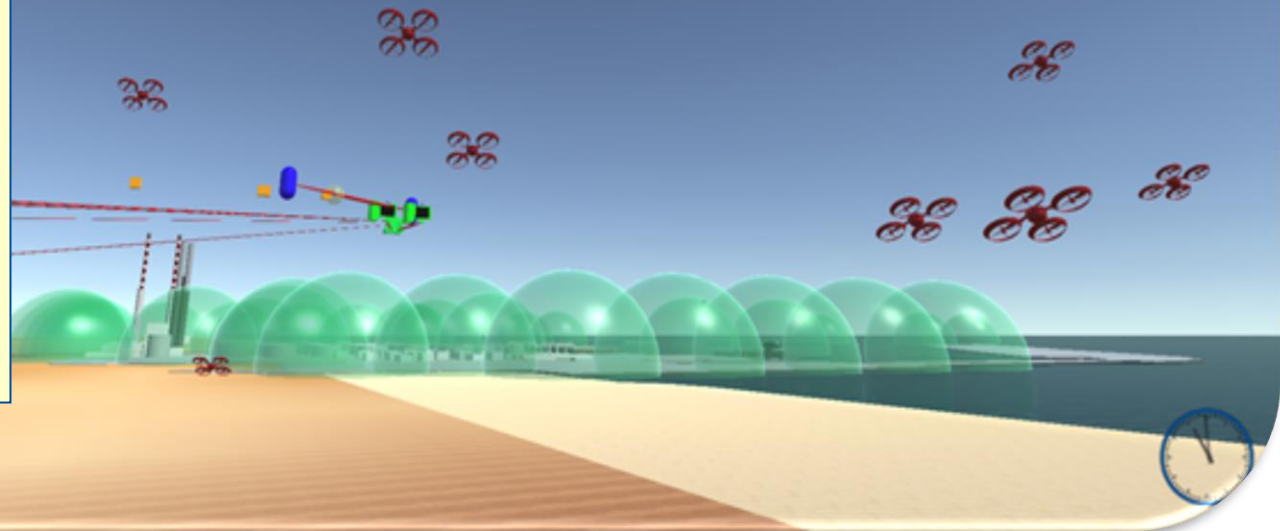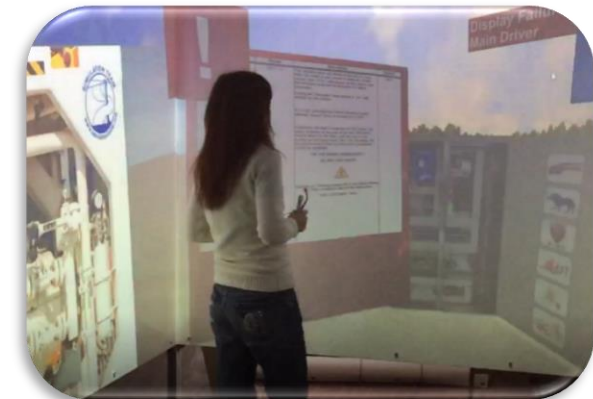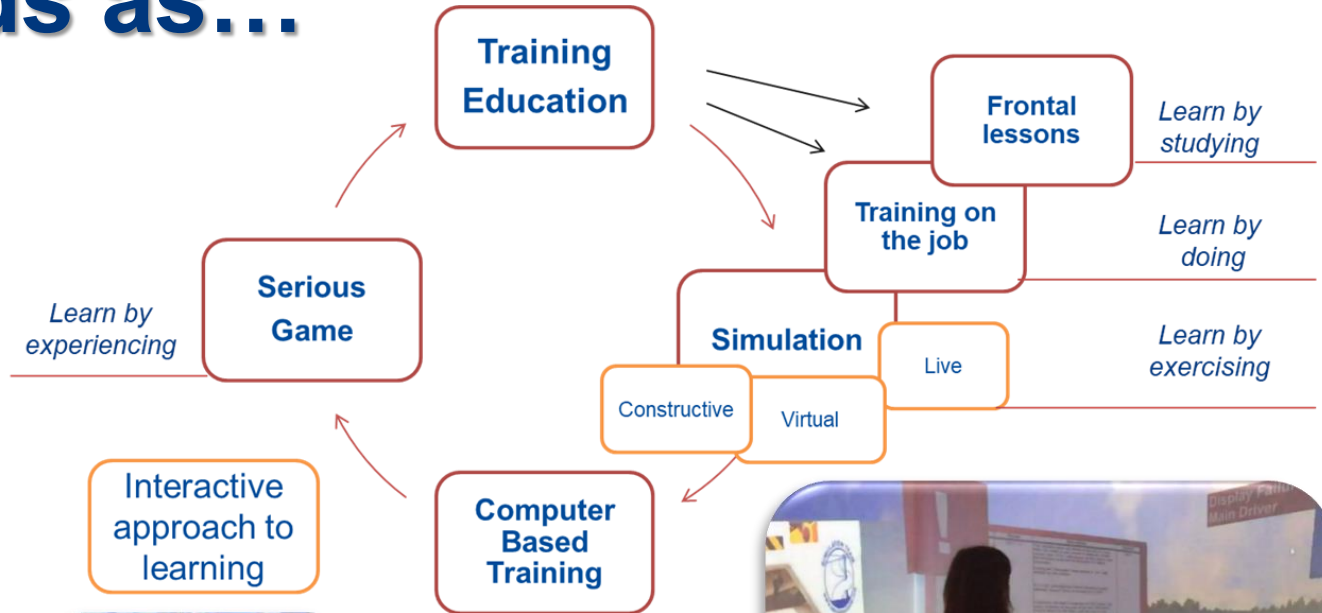
T-REX: Autonomous Systems

Autonomous Systems, on both sides, **are driven by Intelligent Agents and interact with traditional Assets. Coalition UxV (Umanned multidomain Vehicles) support JISR (**Joint Intelligence, Surveillance and Reconnaissance)**, while hostile UAV (Unmanned Aerial Vehicles) are conducting coordinated attacks**

Simulation Team demonstrated this attack in 2015… on September 14, 2019 an equivalent attack was successfully carried out by drones on Saudi Aramco's Abqaiq, the World Largest Oil Refinery
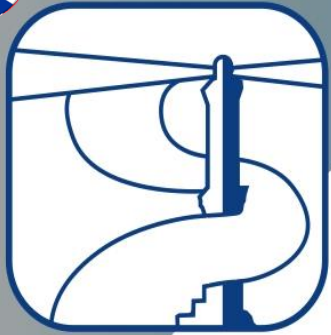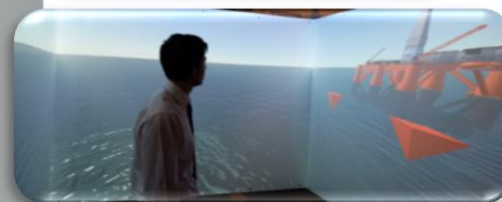

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Cyber Security & Training Aids as…

Training Education

→ Frontal lessons — *Learn by studying*

Training on the job — *Learn by doing*

Simulation — *Learn by exercising*

Constructive · Virtual · Live

Serious Game — *Learn by experiencing*

Interactive approach to learning

Computer Based Training

"*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

Training on the Job

Simulation for Training

Experimenting on the Simulator

Serious Games for Training

Playing while Learning

Experimenting on Games

Many Installations
Many More Users

New Education Modes
New Utilization Modes

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

MMO   *Massively Multiplayer Online Game*
MMORPG   *massively Multiplayer Online Role-play Game*

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Operational Drivers… for M&S

From Modeling Oil Platforms for Helicopter Landing, Operator Training, Crew Coordination
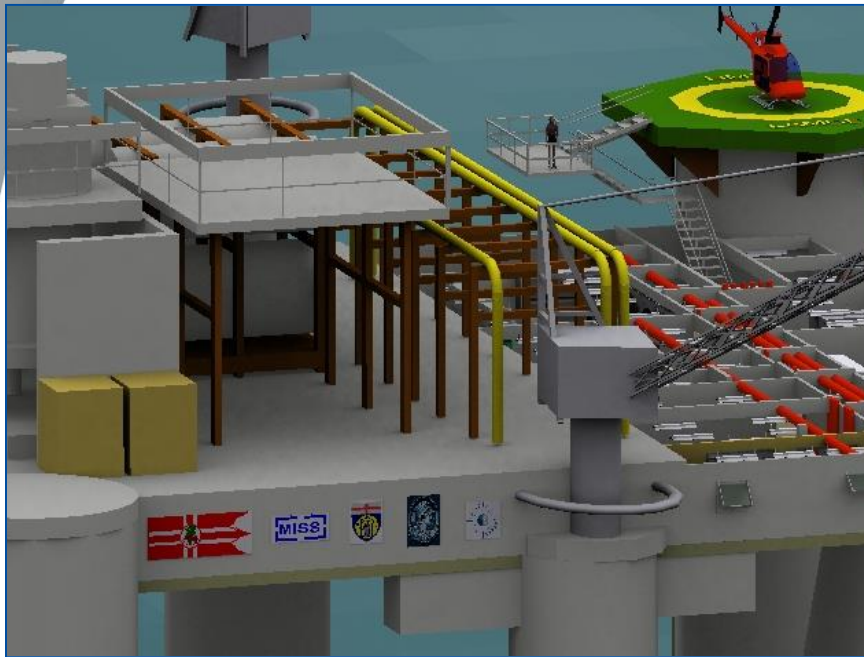
Extract from Bruzzone A.G., Gough E. (2012) "M&S in Maritime Environment: Challenges and Opportunities", Invited Speech at I3M2012, Wien, September

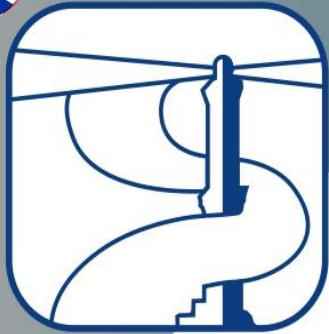**forward to <u>Eco-Mega-Crisis Management</u>**
(Economic/Ecological)

Interoperable Simulation to Address Real Challenges

All these Models were available, therefore no joint simulation was existing to address Deep Horizon Crisis in Mexican Gulf

The Criticalities in Safety and Security is related to the Interoperation among Systems!
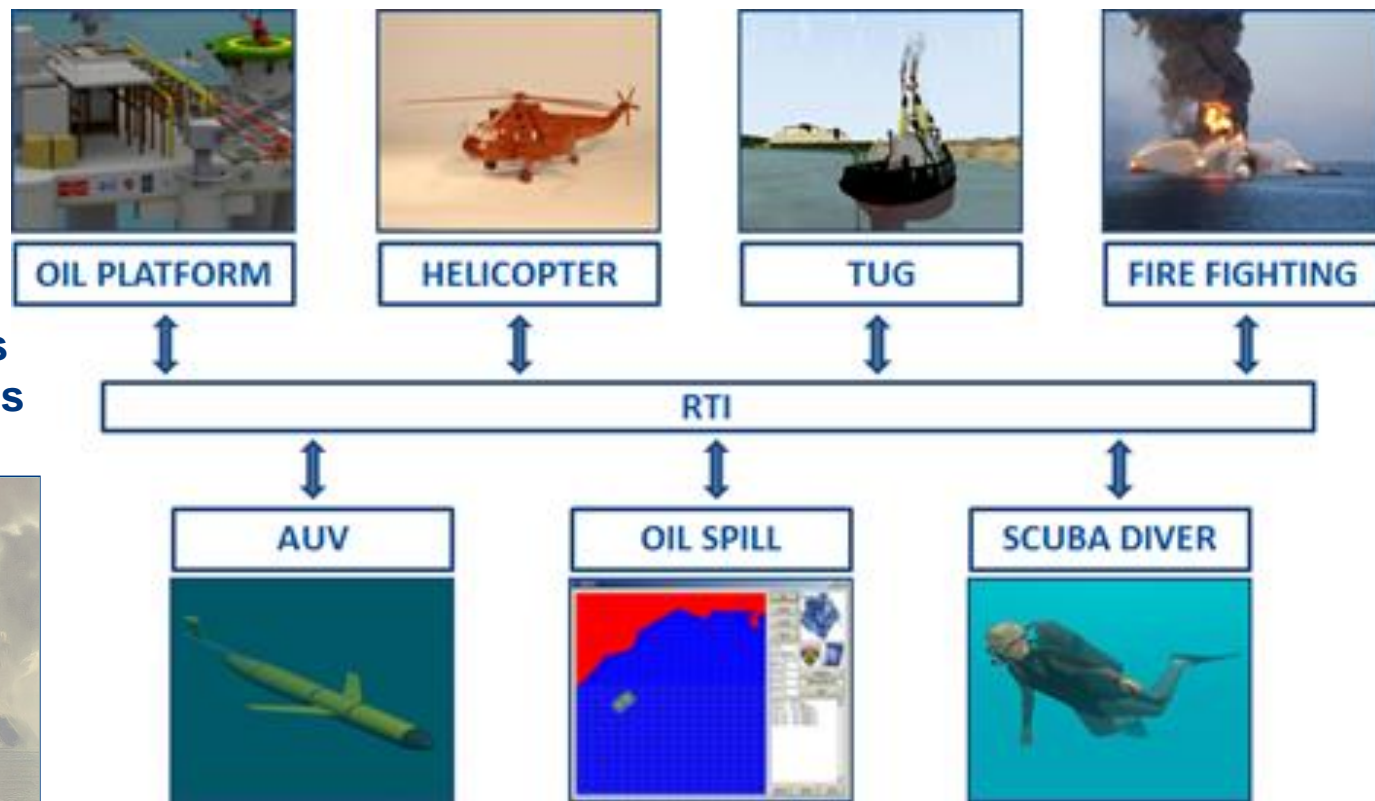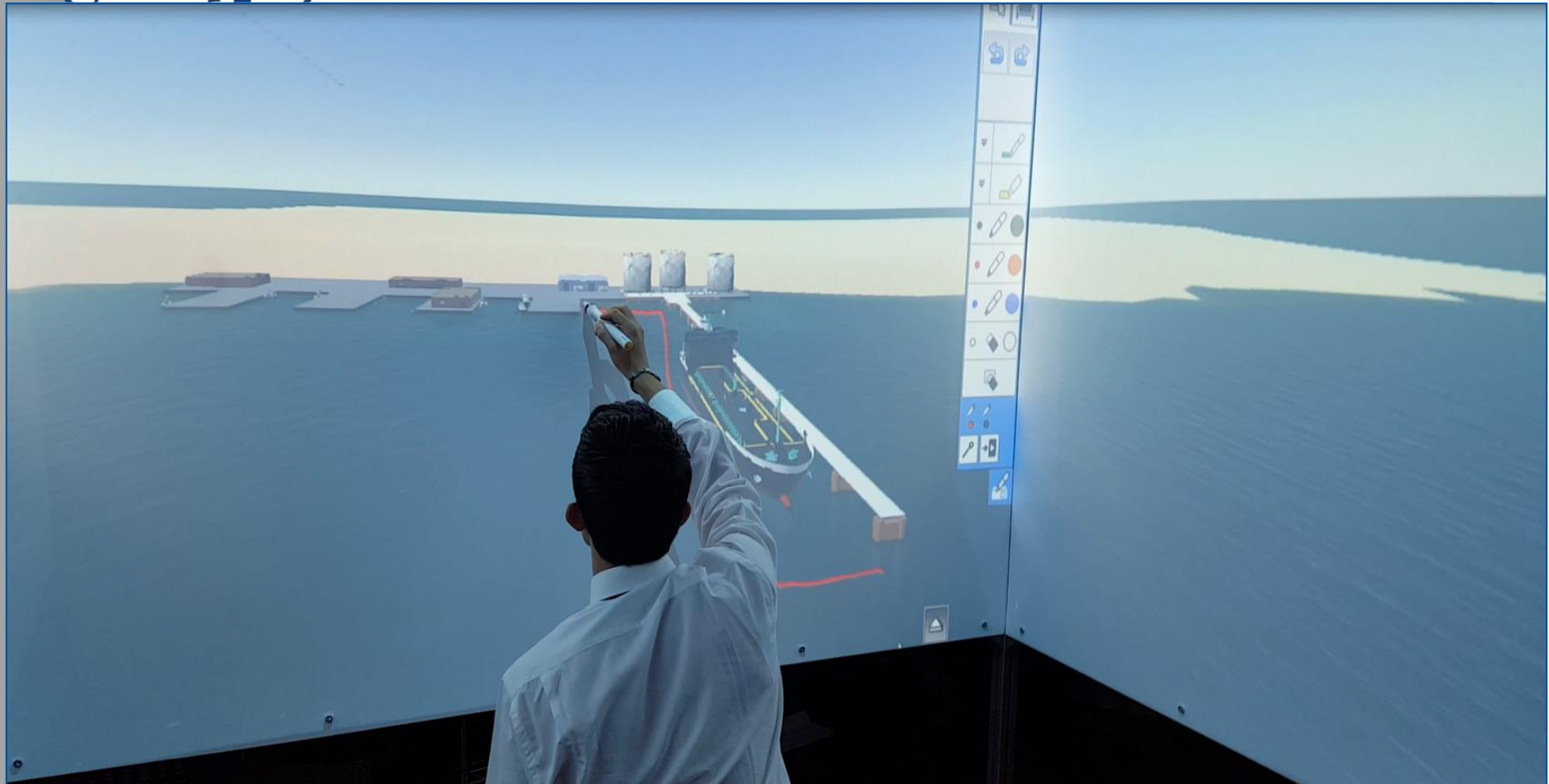
Usability vs. Fidelity in M&S

A model Output could be considered in relation to a credibility level. If correctness grows, development cost of the model grows; meanwhile usability of the model increases, but with a non-linear, and usually at decreasing, rate. So Verification, Validation and Accreditation are critical issues

Controlled Fidelity

Lean Simulation

Cost

Model Usability

Model Development Cost

Usability

Fidelity of the Model

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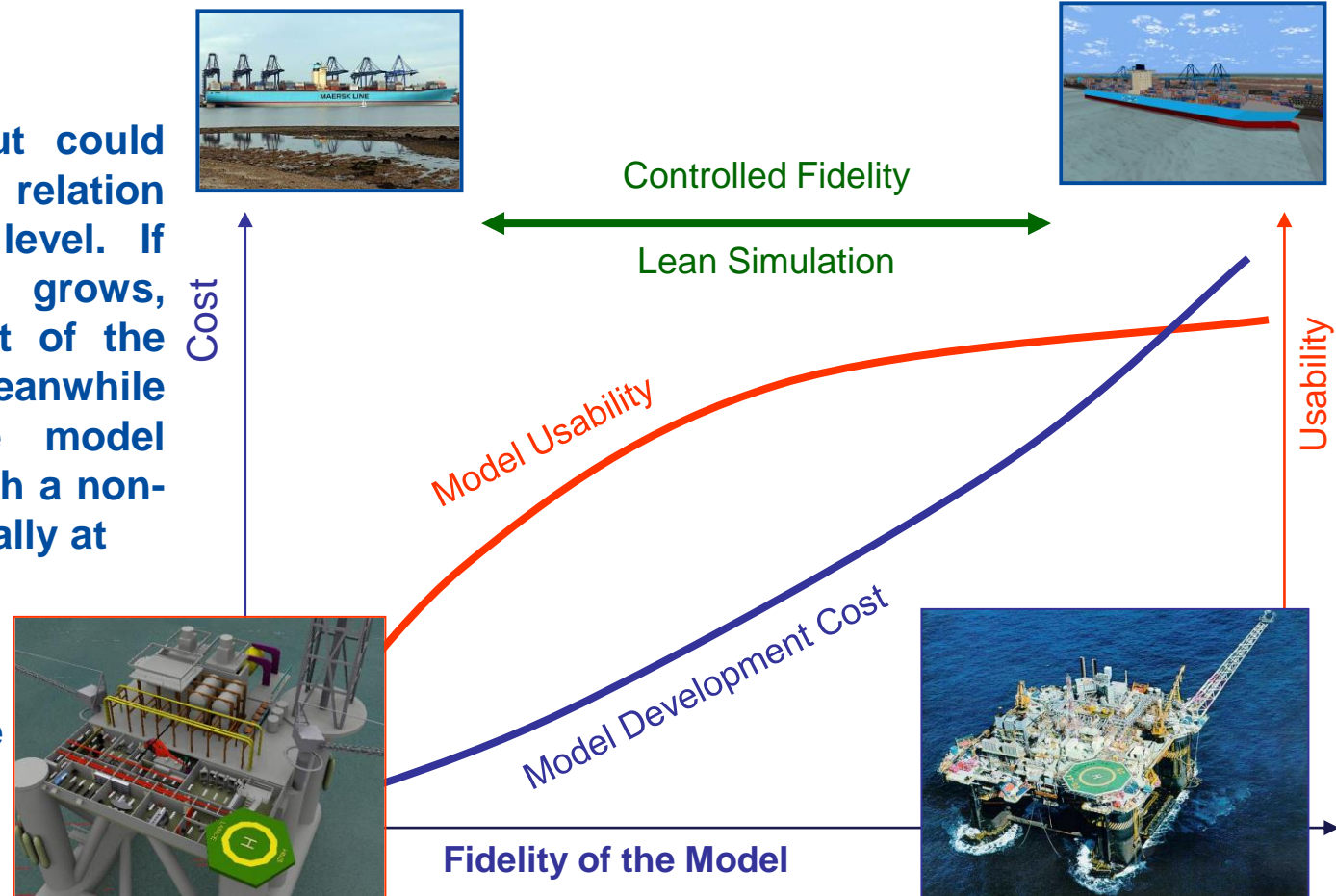
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Marine Domain and Complexity

Simulation Team

M&S and Experimentation

Simulation allows testing new standardized **components** without committing resources for their acquisition.

M&S explores and compares many options related to different **operating procedures** reducing risk and saving time and costs with respect to experimentation the real world context. Combining heterogeneous systems and remote human controllers is another important issue due to the implications on aspects such as engineering, use modes and training.
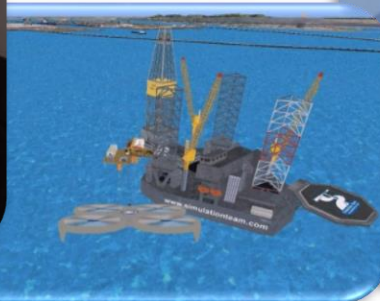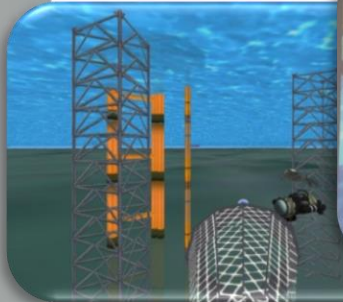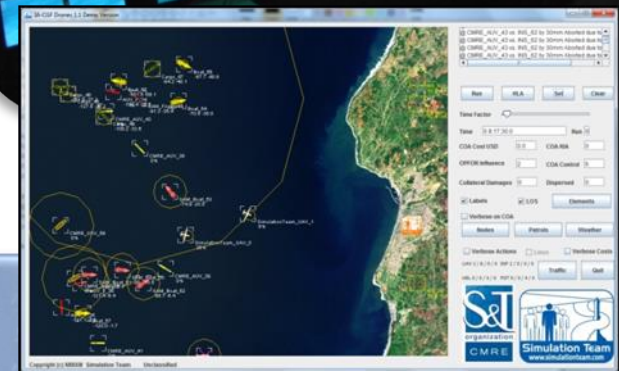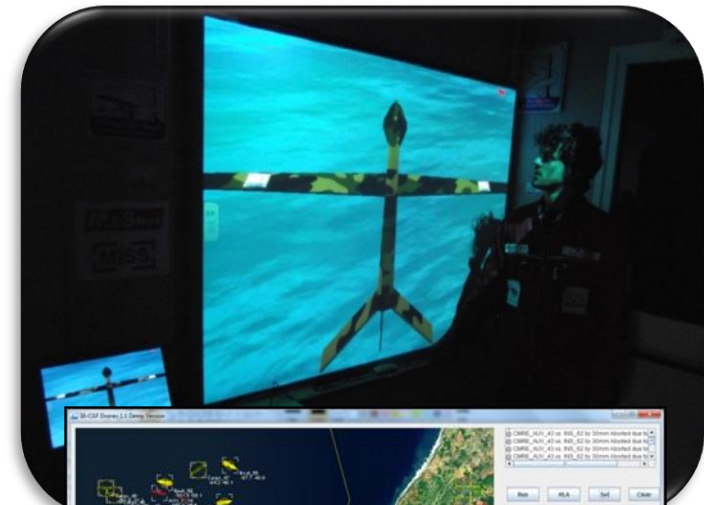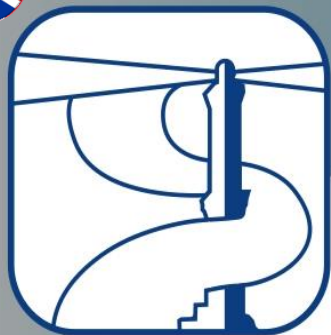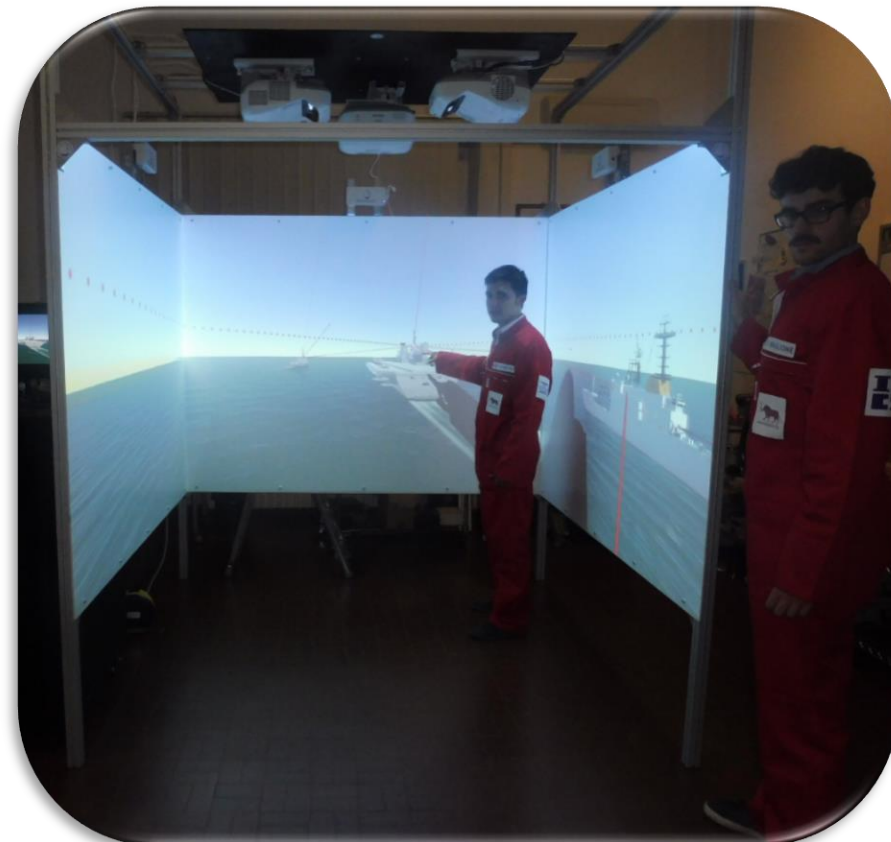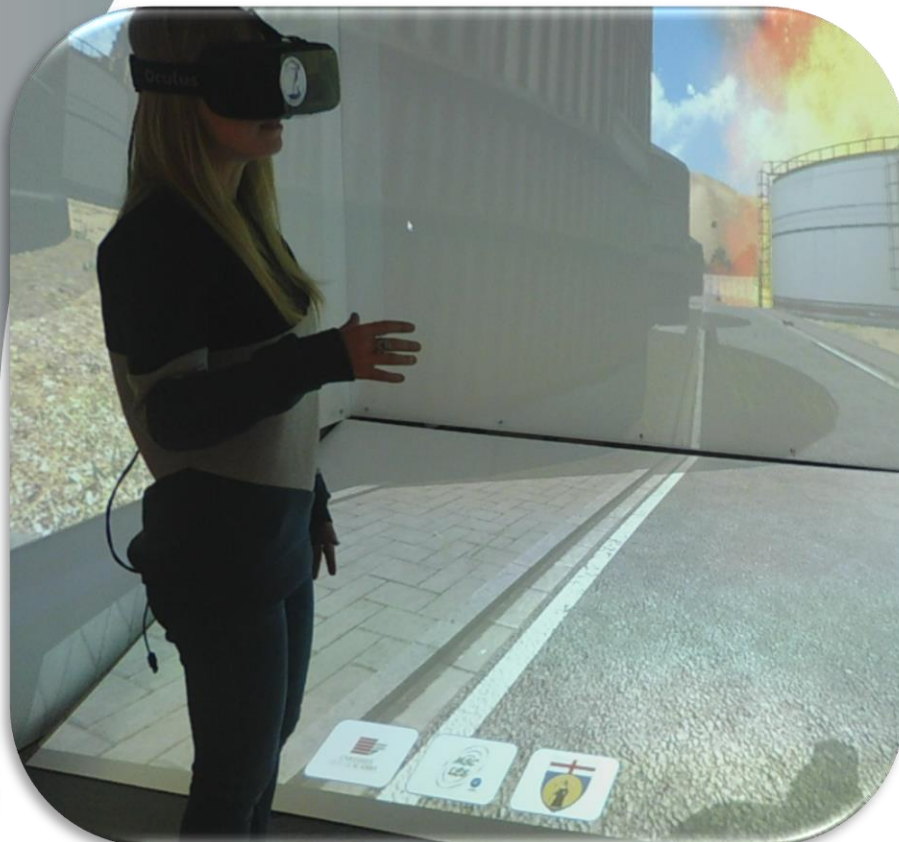
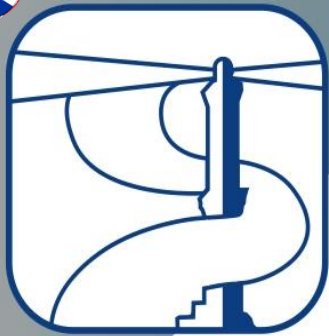# Investigation & Solutions by AI & Autonomous Systems

New generation of AI & Autonomous Systems are expected to bring strong benefits from their operational interoperability with other systems including legacy assets.   The interoperability and standardization procedures need to be defined through experimentation in virtual environment. M&S addresses specific issues related to training in future scenarios, as well as on capability assessments.
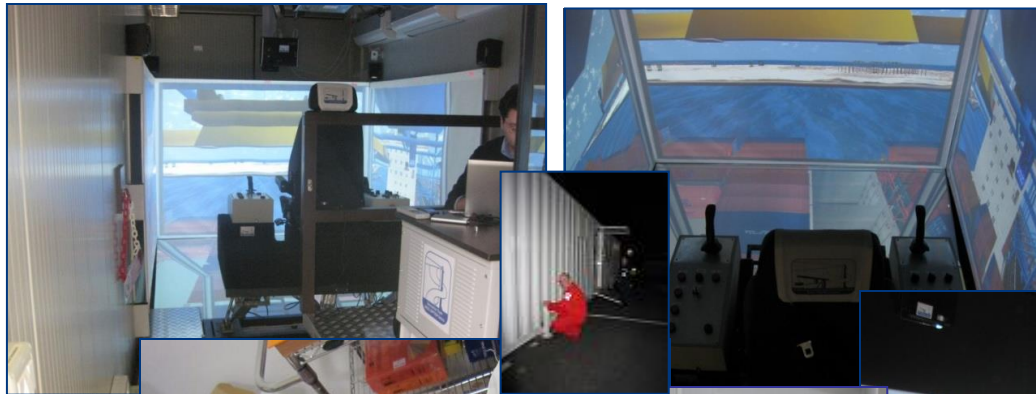
Simulation Team

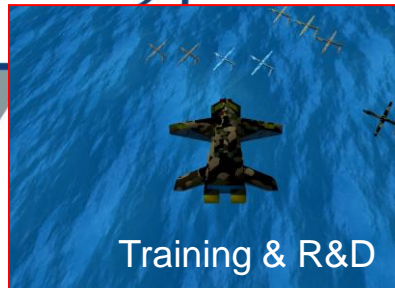# SPIDER: Experiencing the Simulation within an Immersive Collaborative Environment

Simulation Team

Modularity & Flexibility

Università di Genova

Interreg MARITTIMO IT FR MARITIME
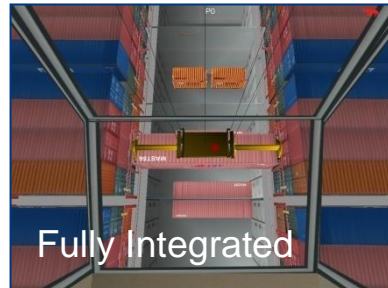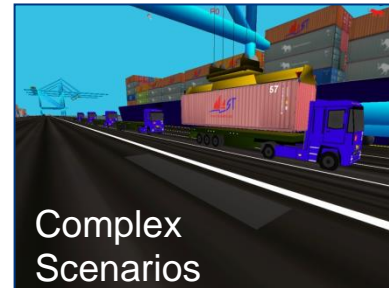
ALACRES2

CCI VAR

ARPAL

quinn

Example of Virtual Marine Sim

Training & R&D

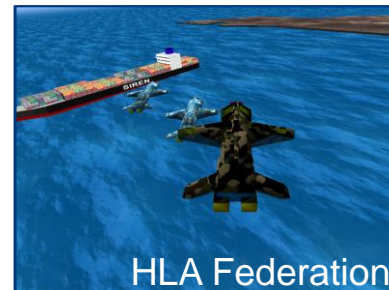Fully Integrated

Complex Scenarios

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

On-Line Action Review

Cave H270° V130°

HLA Federation
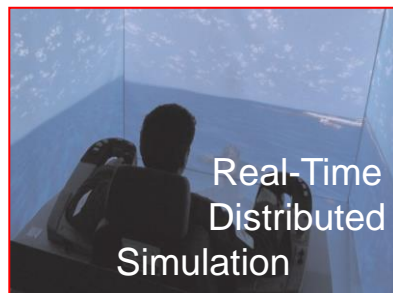
Real-Time Distributed Simulation

Bio-measures Integrated in Simulation

Full Motion, Sound & Vibrations

Extract from Bruzzone A.G., Gough E. (2012) "M&S in Maritime Environment: Challenges and Opportunities", Invited Speech at I3M2012, Wien, September

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Atout of Virtual Simulation

Training & R&D

Cave H270° V130°

Containerized

Fully Integrated

Interactive Aula

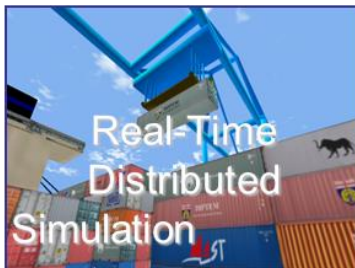On-Line Action Review

HLA Federation

Full Motion, Sound & Vibrations

Real-Time Distributed Simulation

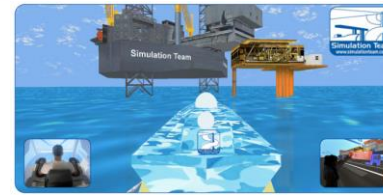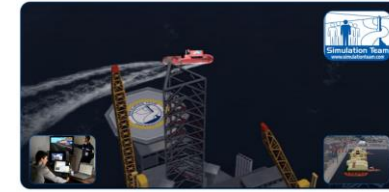Bio-measures Integrated in Simulation
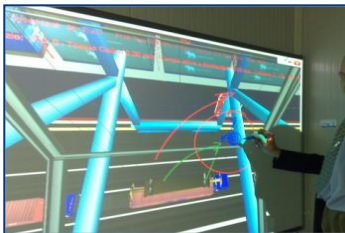
Strong VV&A

Scalable Solutions

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, Safety and Security, Procedure Definition, Equipment Design and Virtual Prototyping

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, etc.

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).

Summarizing

- **The Ports and EMF are major Strategic Resources that require to develop solutions to reduce Vulnerabilities and improve Safety**
- **Direct Connection between Operators, Users, Players Scientists, Subject Matter Experts is a key enabler**
- **Marine Domain is fast evolving introducing new issues and new threats affecting more and more subjects that need Models to support decisions**
- **Simulation, AI and Cognitive Technologies are key issues for investigating Marine Domain respect new threats and supporting development of New Solutions**
- **It is fundamental to develop Trans-disciplinary Teams with strong common background on Marine Framework and to develop Networking with Excellence Centers**
- **The Comprehensive approach related to Marine it is a challenge that need deep scientific know-how in the different areas as well as interoperability capabilities and simulation experience**

Proposed Solution

We propose the integration of new and legacy simulation as solutions for maritime security based on the innovative concept of MS2G (Modeling, interoperable simulation and Serious Games) and SaaS (Simulation as a Service). The examples carried out on Extended Maritime Framework confirmed the benefits of this approach. Currently several services and products have been completed and new ones are on going. Future developments involve the engagement of SME (Subject Matter Experts) in using our models for analyzing maritime security and port safety scenarios and identifying specific solutionthat should be adopted.
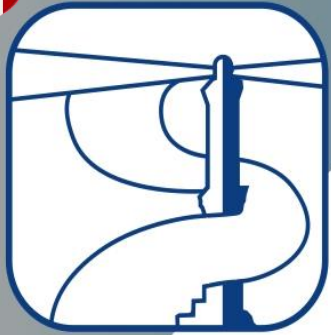
Conclusions

The objective of the presented project is to create a permanent laboratory capable to identify, test and validate procedures for emergency management in the event of crises or significant accidents with particular attention to procedures of loading and unloading of goods and hazardous material in port areas.

The project is at early stage and the alternative models to be used, paradigm to be adopted and general architecture are currently identified, while the survey on accidents and critical issues is finalizing scenario definition.

*Fires
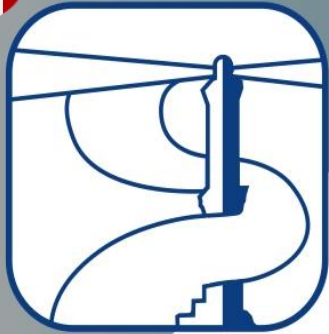in New York South Street Seaport*

*Explosion
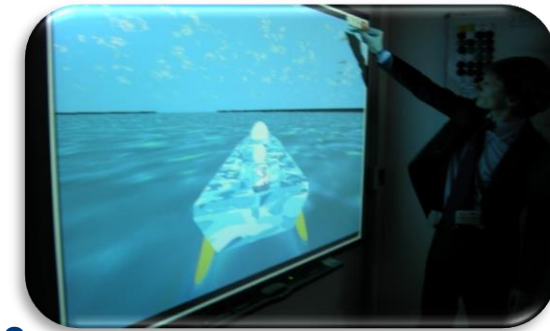In Tianjin*

*Fire and Chemicals Leaks
in Laem Chabang*

Thank You…

…and Time for Questions

Simulation Team

Conclusioni

- Questa rapida panoramica rende evidente il potenziale dell' approccio MS2G per supportare la sicurezza all'interno dell' Extended Maritime Framework e per creare il Laboratorio Virtuale di ALACRES2

- Questi modelli riproducono in modo efficace sistemi complessi e sono prototipi virtuali in grado di interagire con gli utenti e con sistemi di controllo reali per valutare soluzioni alternative per supportare logistica, sicurezza, operations

- Il paradigma MS2G proposto conferma la capacità di sviluppare una soluzione di simulazione intuitiva e interoperabile in tempi rapidi per affrontare le principali sfide e supportare vari aspetti dalla valutazione delle capacità al training

- I modelli e i simulatori proposti possono essere facilmente adattati per adattarsi a diversi scenari e per essere utilizzati per diversi utenti con problemi specifici da risolvere nella protezione di Porti o nella formazione di manager e operatori

- Attualmente il Simulation Team è attivo nello sviluppo di nuove soluzioni personalizzate in base alle esigenze dell'utente finale e nel supporto allo sviluppo di soluzioni di formazione e formazione nonché di progetti di ricerca e sviluppo

Simulation Team

Conclusions
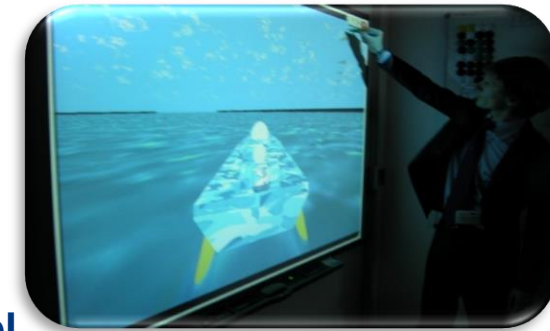
- **Cette présentation rapide met en évidence le potentiel de l'approche MS2G pour renforcer la sécurité et la sûreté dans le cadre maritime étendu et créer le laboratoire virtuel d'ALACRES2.**

- **Ces modèles reproduisent efficacement des systèmes complexes et sont des capables d'interagir avec les utilisateurs et avec de véritables systèmes de contrôle afin d'évaluer solutions alternatives pour logistique, sécurité et opérations.**

- **Le paradigme MS2G proposé confirme la capacité de développer rapidement une solution de simulation intuitive et interopérable afin de relever les principaux défis et de prendre en charge divers aspects comme la formation.**

- **Les modèles et simulateurs proposés peuvent être facilement modifié pour s'adapter à différents scénarios et pour être utilisés par différents utilisateurs ayant des problèmes spécifiques à résoudre dans la protection des ports ou dans la formation des gestionnaires et des opérateurs.**

- **Simulation Team est active dans le développement de nouvelles solutions personnalisées basées sur les besoins de l'utilisateur final et soutient le développement de simulateurs de formation, ainsi que de projets de recherche et développement.**
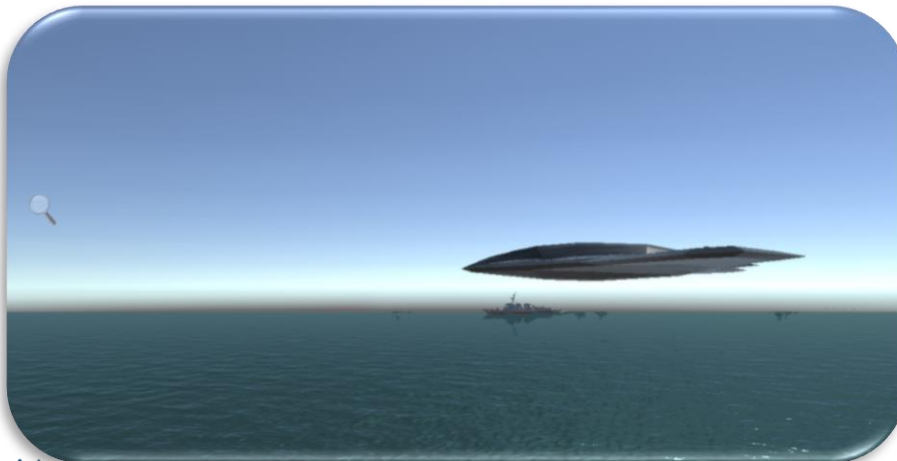
Simulation Team

References

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