Training in Port Environment and Simulation

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Objectives

• Simulation is needed in a complex system as Port Training
• Potential of simulation in a port training
• Comparison among different training solutions
Port Challenges in Training

- 24 Hours / 365 days year
- All Weather Conditions
- Multi-Players
- Different Equipments
- High Productivity
- Safety Issues
Benefits of Modeling & Simulation for Training

• Avoid use of Real Equipment
  – High Productivity
  – High Safety
  – Less Operative Costs
  – Less Maintenance Costs due to Improper Operations, Errors and Collisions

• Operating in a Virtual Framework
  – Possibility to Operate Critical Scenarios
  – Different Weather Conditions and Limit Conditions
  – Psychomotor Skills

• Operating in an Interoperable Federation
  – Cognitive Training
  – Co-Operative Training
  – Learning Procedures and Operations
Negative Training & Simulation?

• Attention to Negative Training Issues…

• Therefore Training on Real Crane is sometime less Realistic than on Simulator, i.e. during early phases Trainee operates on
  – Empty Containers
  – On the Yard
  – Not Accessing Ship Bays
Terminal Operators Experiences

Terminals Operators Experiences:

- Genova, VTE, Almost all the Terminal Operators in Genoa
- Trieste, TCT
- Venezia, Vecon
- Taranto, TCT
- Civitavecchia, Operations
- Novara, Intermodal Terminal CIM, Eurogateway
- Marseille, MPA & Fos Container
- Many Terminal Operator in Italy taking Courses in Genoa
Courses and Training Sessions

Courses :
• Basic Training
• Safety, Safety & Security, Firefighting Courses
• Maintenance Operator Courses
• Courses for Lashers
• Polyfunctional Truck Driver Courses Driv.Lic.C - Truck Simulator
• Courses for Checker
• ReachStacker, Forklift, FrontLoader Operator - ReachStacker Simulator
• Transtainer Operator (WT, RT) - Transtainer Simulator
• Portainer Operator - Gantry Crane Simulator

Other Courses :
• Logistics Courses, IFTS
• Supervisors Courses - CUMANA Web Simulator
• Vehicle Service & Maintenance Course - CBT (Computer Based Training)
• PLC & Automation Courses - PLC Simulator
• Infrastructure Networks Courses (Power, Electrical, Hydraulic, Gas)
• Wireless & IT Networks Courses
• Acceptance & Temporary Keeping Courses
• IT Courses (Ship, Dock, Yard Planning System) - Yard Planner Simulator
• Warehouse Forklift for General Goods Courses - Forklift Simulator
• Ship Box Constructor
Training Projects

Several Projects within Training Purpose:

• Simon Boccanegra, Master Shipping Agents
• IEPAL, Post Graduate Transatlantic Courses - Logistics Node Simulator
• Sitranet - Construction Cranes & Terminal ReachStacker Simulators
• Innovare - ReachStacker e Transtainer Simulators
• Cybersar - Gantry Cranes Simulators
• Ras - Internal Trucks and Carrier Simulators
Effective Design of mobile training requires attention on:

- **Device**: is important to assess usability, mobility and reusability
- **Trainee**: trainee’s abilities, knowledge, motivations are critical
- **Social aspect**: social interaction and cooperation have to be considered in reference to exchanges, learning process and knowledge management
Mobile Training

Simulation have great potential in many applicative areas therefore currently there is a growing need for developing Mobile Training Simulation Solutions

“there are three ways that learning can be considered mobile: in term of space, in different areas of life and with respect of time”

Vavoula and Sharples
Potential of Simulation for Mobile Training

Simulation represent a very powerful Technology Enabler for Mobile Training considering:

• Simulation create Virtual Worlds where it is possible to interact
• Simulation can be distributed and/or moved
• Model can be reused and adapted to different scenarios
• Simulation is maintainable along time
Quick Re Deployable Simulator

In order to be effective mobile training requires to be quickly re deployable. It is fundamental to approach the following issues:

• Easy Packaging
• Modular Configuration
• Compact Solutions
• Maintainable Components
• Support for WorldWide Operations
Some Example of Mobile Training Opportunities

Distributed Virtual Environment

- HLA
- Distributed, Cooperative Planning and Management
- Distributed Operation Control
- Procedure Design, Risk Analysis, Re-Engineering, and Distributed Training

This is a Platform Independent Distributed Environment for Maritime Applications
Virtual Simulation

In Simulation it is critical the Development of Virtual Simulation, here special attention is dedicated to Driving Vehicles and Equipment within Logistics Environment. These Virtual Simulation have been extensively used in Training Session for Professional Operators (trucks, inter-modal cranes, port cranes, etc.) The new solutions are real-time distributed simulation based on High Level Architecture allowing compositibility, modular approach and cooperative/competitive exercising.
Port Crane Simulation

The innovation in Port Crane Simulator (i.e. ST_VP by Simulation Team) is related to the capability to develop New Solutions supporting both Operator Training, Procedure Definition, Equipment Design & Virtual Prototyping

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

ST-PT Simulator allows to operate Port Cranes in a Virtual World by an immersive Cave (270° Horizontal and 130° Vertical), reproducing Sounds, Vibrations and Motion.

ST-PT includes a Full-Scope Simulation for Training Crane Operations & Procedures, an Integrated Class Room, the Instructor Debriefing Room, and secondary Interoperable Simulators of Trucks and Other Cranes, Biomedical Module for Ergonomic and Posture Enhancement.

ST-PT World is tailorable for each Port, Crane & Procedure and Equipment.
Truck Simulation

The ST_RS is an Innovative Interoperable Truck Simulator fully integrated with ST_PT and Virtual Port; it provides opportunities for Training, Operative Planning and Terminal Procedure Redesign and Re-Engineering.

ST_RS is fully containerized real-time distributed HLA Truck Simulator with Port & Inland Terminal and External Scenarios. ST-RT is integrated in a 40’ High Cube Container ready to be used on site immediately after arrival.

ST_RS Simulator allows to operate Trucks in Terminal and over External Roads within a Virtual World by an immersive Cave (270 ° Horizontal and 130° Vertical), reproducing Sounds, Vibrations and Motion.

ST_RS includes a Full-Scope Simulation for Training Truck Driving, Logistics Procedures, an Integrated Class Room, the Instructor Debriefing Room, and secondary Interoperable Simulators of Different Cranes Cranes, Biomedical Module for Ergonomic and Stress Level Enhancement.

ST_RS World is tailorable for each Terminal Scenario, Truck, Procedure and Equipment.
ST-VP Objects & Federation
This new generation of simulator is mobile, real-time, scalable and interoperable and compliant with state of art technology and standards.
Atout in Virtual Port Simulation
Training on Virtual Simulation

The Simulators developed by Simulation Team are an important support in Training both Operative Resources and Decision Makers.

The Interoperability of our simulators 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.
Modularity & Flexibility
Performance of a Flexible Mobile Training Systems

The definition of a Performance Metrics it is fundamental to quantify the benefits obtainable by the innovative simulation approach:

\[
T_{\text{tot}} = \begin{cases} 
\alpha < 1 & n_s \left[ T_{tr} + n_p \left( T_{ri} + T_{tm} \right) \right] + T_{st} + T_{sa} + T_{sh} \\
\alpha = 1 & n_s \left[ T_{tr} + n_p T_{tm} \right] 
\end{cases}
\]

\[
N_{\text{ports}} = \frac{uc \cdot P}{T_{\text{tot}}}
\]

\[
E_{\text{x}} = T_{p} \cdot \left( \frac{\alpha \cdot rcr + (1-\alpha) \cdot vcr \cdot pu}{n_p} \right)
\]

\[
C_{\text{tot}} = \begin{cases} 
\alpha < 1 & T_{\text{tot}} \left( Is + (\alpha \cdot Arcr + lc) + (1-\alpha) \cdot Aver \right) + C_{st} + C_{sa} + C_{sh} \\
\alpha = 1 & T_{\text{tot}} \left( Is + Arcr + lc \right) 
\end{cases}
\]

Aver: Time Cost for using virtual crane
C_{st}: setup cost for the mobile solution
C_{sa}: cost for tailoring scenario for the mobile solution
C_{sh}: cost of shipping for the mobile solution

\( T_{\text{tot}} \): Total Training Time for a Site
\( n_s \): Number of sessions on a Site
\( \alpha \): Percentage of time on real crane respect Simulation
\( T_{p} \): training time
\( uc \): use of the time frame for training (i.e. 8 hours per days, 5 days/week)
\( n_{pu} \): number of users concurrently training on the simulator
\( lc \): production losses due to unavailability of the real crane
\( rcr \): number of real cranes
\( vcr \): number of virtual simulators
\( T_{ri} \): student transition time on simulator
\( T_{sa} \): student transition time on real crane
\( T_{s} \): setup time for the mobile solution
\( T_{sh} \): time for tailoring scenario for the mobile solution
\( T_{sh} \): time of shipping for the mobile solution
\( P \): Period available for training
\( N_{\text{ports}} \): Number of serviced Ports over P timeframe
\( E_{\text{x}} \): Trainee time operating directly
\( n_{p} \): number of people in a training session
\( Aver \): Total Costs on a Site including all sessions
\( Is \): Instructor Cost
\( Arcr \): Time Cost for using real crane
An Example Comparing Alternative Solution

As example is proposed a comparison among different solutions for Port Training:

- Mobile Training based on Interoperable Simulation
- Traditional Mobile Pack with Crane Simulator
- Traditional Containerized Crane Simulator
- Fixed Solution for Crane Simulator
- Traditional Training on the Job: Real Crane
Some Example on Costs/Benefits

Comparison on Scenario with Tailoring

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<th>Direct Training Experience [hours]</th>
<th>Costs [Euro/Site]</th>
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</thead>
<tbody>
<tr>
<td>Mobile Training</td>
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<tr>
<td></td>
<td>Containerized Simulator</td>
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<tr>
<td></td>
<td>Pack Simulator</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Fixed Simulation</td>
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<td></td>
<td>Real Crane</td>
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<tr>
<td>Total</td>
<td>Total Direct Training Time</td>
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</tr>
<tr>
<td>Site</td>
<td>Total Costs [€/Site]</td>
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Including Tailoring

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<th>Containerized Simulator</th>
<th>Pack Simulator</th>
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<th>Total Costs [€/Site]</th>
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<td>25.8</td>
<td>69.8</td>
<td>67.6</td>
<td>67.6</td>
<td>120.4</td>
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<td>120.4</td>
<td>20.6</td>
<td>350,000</td>
</tr>
</tbody>
</table>

Notes:
- Number of selected ports and P-timeframe
- Number of selected ports and P-timeframe
- Trainee time operating directly
- Trainee time operating directly
- Trainee time on site including all expenses
- Trainee time on site including all expenses
Conclusions

The final goal is to develop applications that can easily be managed and diffused. Simulation based on modern technologies and up-to-date methodologies is able to support effectively several applications such as: Training, Design of New Solutions, Analysis and Decision Support.
References

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