Submarine Simulation leading to a ‘Total Boat Training’ environment
Contents

Submarine Control Simulation (SCS)

Submarine Command Team Trainer (SCTT)

Italian Navy 212A SCS & SCTT Modernisation and Obsolescence Programs

Total Boat Training – an introduction
Submarine Control Simulation - Explanation

Provides a complete ‘high fidelity’ crew team training for:

– Steering stand / autopilot, diving / surfacing, manoeuvring and engineering tasks of a submarine,

by substituting the actual submarine with mathematical, physical, hydrodynamic and engineering systems simulation modelling,

to simulate, emulate or stimulate Original Equipment Manufacturers’ (OEM) actual systems.

To provide:

– complete systems training without needing the actual submarines saving costs
– Training of emergency and other situations not possible in reality
– can be used for technical, procedure and tactical tests

212A Class Submarine Simulation modelling and Environment modelling

SCS with original Avio Steering Stand and Siemens EMCS
Simulator Technology - Definitions

**Stimulation**
- Scenario Simulation → System HW-Stimulator
- Original System

*High level of proficiency can be achieved, but normally the most expensive solution*

**Emulation**
- Scenario Simulation → System Simulator
- Re-hosted System SW → Original HMI (Rehosted)

*Re-hosting possible in collaboration / interfacing with system supplier*

**Simulation**
- Scenario Simulation → System Simulator
- Simulated HMI

*Training level depends upon the actual knowledge of the entire system and equipment*
Submarine Control Simulation - SCS
Submarine Control Simulation
Training Objectives / Subsystems

- Steering Station
- Diesel Engine
- Air Independent Propulsion
- Engineering Monitoring and Control System (EMCS)
- Air- and Water-management
- Snorkel
- Propulsion Control
- Diesel Control
Submarine Control Simulation
Training Objectives / Overview

- Training of crew of technical control centre
- Familiarisation with equipment
- Familiarisation with submarine’s dynamics
- Familiarisation with operating modes
- Training of emergency situations
- Procedure training
- Sub-team and part-task training
Submarine Control Simulation

System Configurations

- **Full Scale SCS**
- **PC based classroom trainer**
- Original Equipment / Complex Functional Mock-Up
- Functional Mock-Up
- Graphical

- Customised with subsystems
- Customised
- Standard (600t, 1200t, 2000t)

- 2 Degrees of Freedom
- 1 Degree of Freedom
- Without Motion System

Trainee Stations

- Complex Functional mock-up

3D Virtual environment

- Mathematical Model

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Submarine Control Simulation
PC based classroom training / Architecture
Submarine Control Simulation
PC based classroom training / Overview

Part task training and instructorless training

Applications:
- On-board orientation
- Part task training
- Instructorless training
- Sub-team training
- Team training

Configuration:
- PCs connected by TCP/IP network
- PCs can be dynamically assigned by instructor to specific application

Two trainees and one instructor
(sub-team training)

Several trainees and one instructor
(team training)
Submarine Control Simulation
Full Scale SCS / Infrastructure Overview

Debriefing Room
External Instructor Station (in Supervision Room)
In-cabin Instructor Station
Cabin (CAB)
Trainee Stations
Motion System (MOT)
## Submarine Control Simulation

### References (1)

<table>
<thead>
<tr>
<th>Customer</th>
<th>Year</th>
<th>Submarine Class</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey</td>
<td>1990</td>
<td>209 Class / 1200 209 Class / 1400</td>
<td>Two different types of Submarine by exchange of software. 3 - men steering consoles. Hydraulic motion system.</td>
</tr>
<tr>
<td>Italy</td>
<td>1992</td>
<td>NAZARIO SAURO CLASS – SUBMARINE</td>
<td>Simulator representing a full operational replica of Italian N. SAURO Class Submarine. SEPA - Steering Control Console, Air-/Waterman - Station, Snorkel Equipment. Hydraulic motion system.</td>
</tr>
<tr>
<td>Korea</td>
<td>1994</td>
<td>209 Class / 1300</td>
<td>Simulator covering the Submarine Control Section of the 209 / 1300 Submarine. Salzgitter Steering Control Console, Waterman - Station. Hydraulic motion system.</td>
</tr>
<tr>
<td>Germany</td>
<td>1997</td>
<td>212A Class</td>
<td>Covering the Submarine Control Section of the 212A submarine of the German Navy. One man Steering Control Console, two Emergency Control Stands (fore plane, X-rudder).</td>
</tr>
<tr>
<td>Italy</td>
<td>1998</td>
<td>212A Class</td>
<td>Covering the Submarine Control Section of the 212A Submarine of the Italian Navy. One man Steering Control Console, two Emergency Control Stands (fore plane, X-rudder).</td>
</tr>
</tbody>
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# Submarine Control Simulation

## References (2)

<table>
<thead>
<tr>
<th>Customer</th>
<th>Year</th>
<th>Submarine Class</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Africa</td>
<td>2000</td>
<td>209 Class / 1400</td>
<td>Simulator covering the steering station, air- and water-management and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>submarine subsystems of the 209 class submarines of the South African</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Navy.</td>
</tr>
<tr>
<td>Germany</td>
<td>2001</td>
<td>206A Class</td>
<td>Modernisation of existing Submarine Control Simulator delivered in 1983.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Replacement of computers, interface electronics and motion control unit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Integration of state-of-the-art instructor station.</td>
</tr>
<tr>
<td>Germany</td>
<td>2002</td>
<td>212A Class</td>
<td>PC based Submarine Control Simulator for Steering Stand training in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>classroom environment.</td>
</tr>
<tr>
<td>Singapore</td>
<td>2003</td>
<td>Challenger Class A12</td>
<td>Submarine Control Simulator with 2 degrees of freedom motion system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>covering the steering station, main functions of air- and water-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>management. Two instructor stations and debriefing station.</td>
</tr>
<tr>
<td>Singapore</td>
<td>2007</td>
<td>Vastergotland A17</td>
<td>Submarine Control Simulator with 2 degrees of freedom motion system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>covering the steering station, functions of air- and water-management.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Two instructor stations and debriefing station.</td>
</tr>
<tr>
<td>Italy</td>
<td>2009</td>
<td>212A Class</td>
<td>Siemens Engineering Monitoring Control System (EMCS) classroom trainer</td>
</tr>
<tr>
<td>Spain</td>
<td>2009</td>
<td>S-80 Class</td>
<td>Motion System and Cabin</td>
</tr>
<tr>
<td>Italy</td>
<td>2010</td>
<td>212A Class</td>
<td>Integration of Siemens EMCS simulation into existing SCS for 212A</td>
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## Submarine Control Simulation References (3)

<table>
<thead>
<tr>
<th>Customer</th>
<th>Year</th>
<th>Submarine Class</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey</td>
<td>2012</td>
<td>209 Preveze &amp; Gür Class</td>
<td>In cooperation with Havelsan, Turkey to supply the hydrodynamic and support system, Instructor operating System (IOS), Instructor mimic adaption package, data Recording and Debriefing System (DRDS) and Motion System (MOT) with supporting infrastructure technical specification.</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2013</td>
<td>209 Class</td>
<td>Phase 1 of SCS Project 2013</td>
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Marina Militare 212A Class Submarine Control Simulator (SCS) with integrated Siemens Engineering Monitoring and Control System Simulation and integrated DIS interface
Taranto, Italy – 15 January 2013
Italian Navy Program Overview

Steering Stand Simulator and Autopilot (SSS) 212A with ‘Phased’ Program integration of Siemens Engineering Monitoring Control System (EMCS) to realise a Submarine Control Simulator (SCS) Batch 1 212A Class.
Submarine Command Team Trainer

Applications

- Training of CIC teams by simulation of combat and environmental scenario

Configuration

- Simulation and replica of weapon control system, incl. weapon and periscope simulation
- Simulation of sonar multi-sensor system and weapon control procedures by stimulation of real systems, radar, electronic warfare, communication
- Periscope simulation including coast lines and target ships
- Torpedo operating simulation and guidance methods
- Many targets (ships, boats, helicopters, torpedoes, buoys)
- Auditorium including slave displays of the CIC. Briefing and debriefing and instructor’s console
Submarine Command Team Trainer (SCTT): Overview
SCTT: Use as Land Based Test Station

**Land Based Test System**
for engineering, integration and test during the life cycle of the submarine

**Reference System**
for the submarine during the life cycle of the submarine

**Team Training**
for the submarine during the life cycle of the submarine

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**U212 Project Milestones**

- **Development 1**
  - Integration/Test of the Boat

- **Development 2**
  - Used as Reference System
  - Used for Training
  - Integration TAS Winch
  - Extended TMA
  - DM2A4 Family Concept
Marina Militaria SCTT 212A
Modernisation and Obsolescence Management Program

The Phased concept
Our Companies Changed – Our support remains

1997 - 2003
Shareholders
Rheinmetall
BAE Systems

2003 - 2006 BAE Systems
2006 - ThyssenKrupp & EADS
Naval Business

Electronic Solutions
• Simulation and Training
• Defence Electronics

2003 – Rheinmetall Defence

SCTT 212A
- Delivery in 2004
- Support Contracts since 2006
Modernisation & Obsolescence Program SCTT 212A – Overview of the Phases

Phase 1
- DISI X - Visual System Upgrade, In-Service Support & Obsolescence Management

Phase 2 & 2A
- Distributed Interactive Simulation (DIS) Interface & SCTT/SCS Coupling

Phase 3
- Implementation of Advanced Naval Synthetic Environment (ANSE) Simulation Control

Phase 4
- Batch 2 Training Concept tasked by Italian Navy

Phase 5
- NSP Torpedo integration
- Operational Improvements and Hardware Modernisation

Batch 1 & Batch 2
Total Boat Training – an introduction
The aim: Achieving an integrated skilled submarine crew

- (task group tactical training)
- watch / crew training
- (sub) team training
- Individual training
Achieving an integrated skilled submarine crew through the training pyramid

- Networked Training
- Team Training
- Part Task Training
- Familiarisation & Fundamentals
Train as you operate – with a focus on the crew

The total boat training

- Navigation and tactical manoeuvres
- Operation and combat management
- Engineering and control
- Battle damage control
Train as you operate – some benefits of submarine simulator linking

**Submarine Command Team Trainer**
- Diving / emergency procedures ...
- Tactical mission preparation under realistic tactical conditions ...
- Engagement of sensors / weapons ...
- Prioritise tactical manoeuvres ...

**Submarine Control Simulator**
- ... consideration of mutual procedural dependencies
- ... with mission preparation in engineering
- ... under chief engineer’s constraints
- ... while struggling with failures
Networked Training through networked Systems

It’s mainly about communication and data exchange
Thank you for your attention!

Any Questions?