



CONGRESO INTERNACIONAL DE  
**IV DISEÑO E**  
INGENIERÍA  
**NAVAL**

11 - 13 DE MARZO DE 2015



**THALES**

**Successful missions  
guaranteed with  
Thales on board.**

# Combat Management System & Combat System Integration

# Introduction

## ■ Kees Kuenen

- Former operations officer Royal Netherlands Navy
- Area Manager Sales SE- Asia (above water systems)
- M&S director Malaysia/Brunei (Naval division)
- BL- Small Systems Director (Naval Division)
- Director Marketing & Business Development (Naval systems)

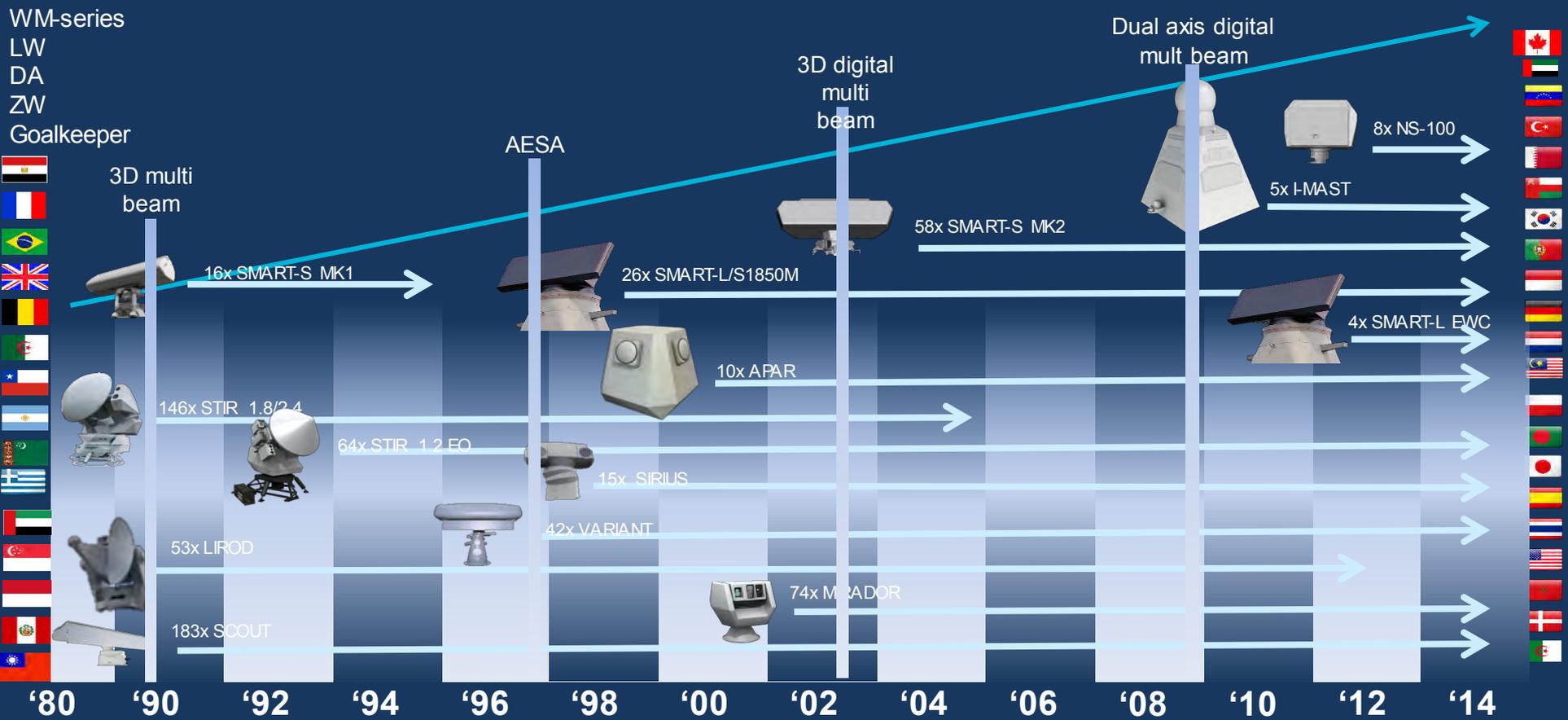
## ■ Thales Naval Systems – The Netherlands

- Since 1922 (mechanical Fire control)
- Centre of Excellence for Thales
  - Above Water Systems
  - Naval sensors , surveillance and Fire Control
  - Combat System Integration



## Track record

# Worlds widest naval sensor portfolio



# Worlds widest naval sensor portfolio

- **> 200 FC radars**
  - 212 STIR
  - 53 LIROD
- **> 300 2D & 3D surveillance radars**
  - 74 SMART-S
  - 20 SMART-L / S-1850
  - 8 NS-100
  - 39 MW-08
  - 30 MRR
  - 42 VARIANT
  - 183 SCOUT
- **> 100 EO surveillance & track**
  - 74 MIRADOR
  - 5 GATEKEEPER
  - 15 SIRIUS
- **43 Multi function systems**
  - 10 APAR
  - 18 HERAKLES
  - 5 IMAST
- **Still supporting**
  - > 100 WM
  - > 50 LW & DA
  - > 50 GOALKEEPER

# World's favourite CMS

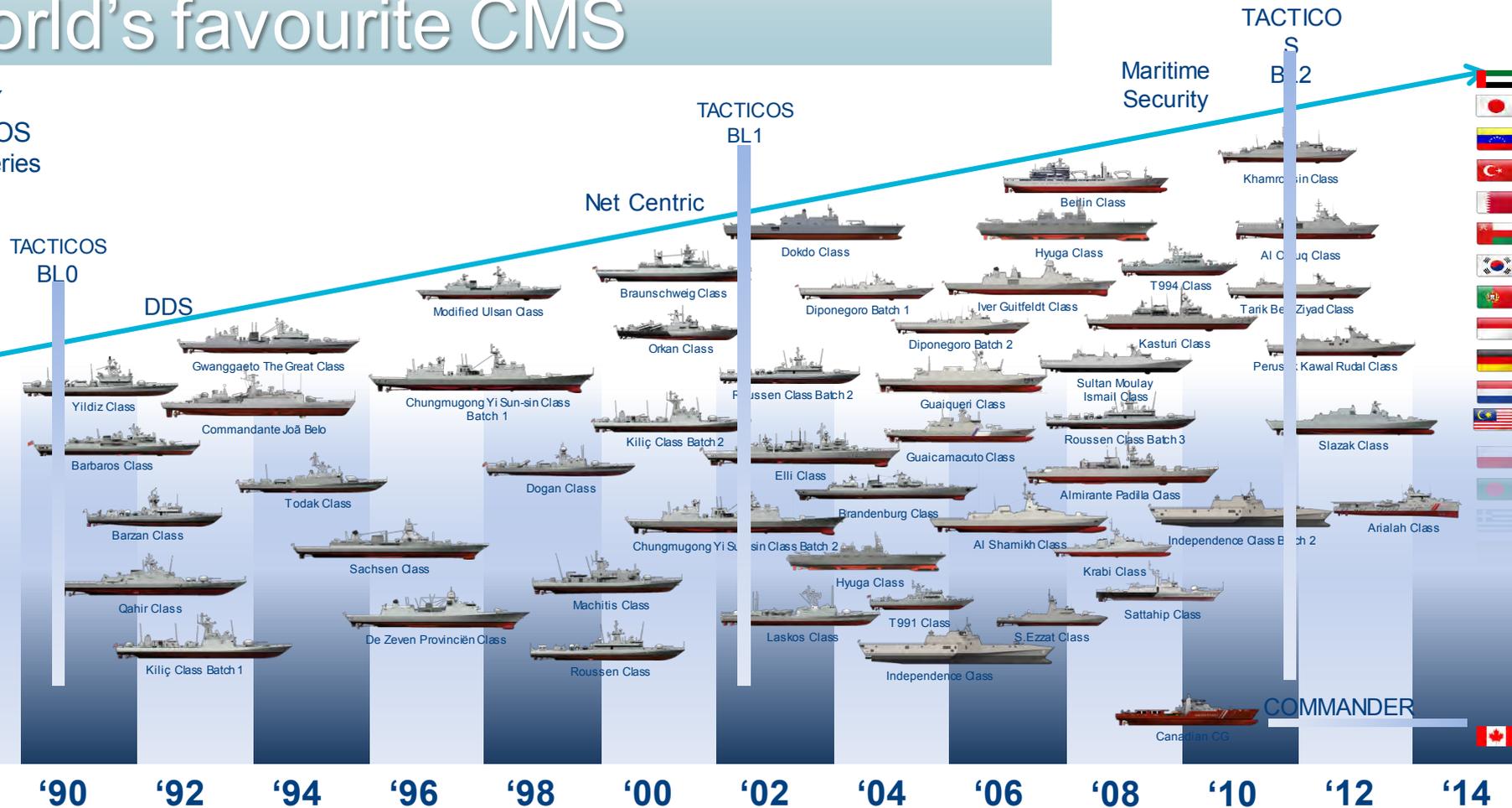
- 582 CMS systems in the last 40 years
  - 171 TACTICOS Open Architecture systems
  - 80 Commander systems
  - 25 IMARCS systems
- 40 Ship classes
- 22 Different Navies & Coast Guards
- 8 NATO countries,
  - incl USN LCS (TACTICOS CDS license build by Northrop Grumman)
- 11 Upgrade programs
- 44 Currently under contract



Track record

# World's favourite CMS

DAISY  
STACOS  
WM-series



# Transfer Of Knowledge And Technology

## Local industrial partnering



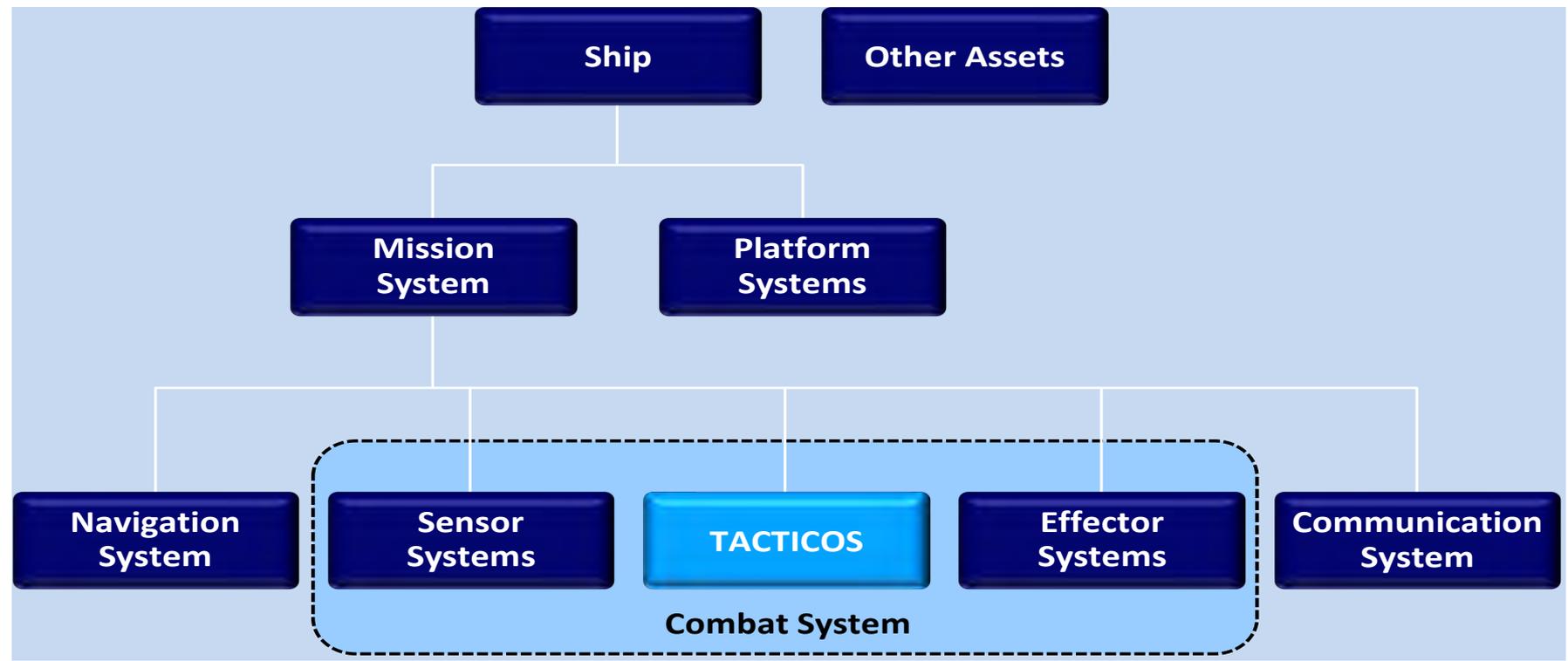


**Tacticos**

CDS product overview

# Introduction

## What is TACTICOS?



- One CMS for Combat Operations and Maritime Security Operations (MSO)
- Unrivalled integration track record
  - All own and 3<sup>rd</sup> party sensors
  - All weapons - 1<sup>st</sup> and sole integrator of VL-MICA (MBDA)
  - All shipyards
- Trendsetting MSO packages
- Periodic new releases
  - MSO Upgrade available for any vessel



#### Facts

- 3<sup>rd</sup> generation
- 478 operational
- 21 Navies / CGs

# TACTICOS for Combat & MSO

## Combat



- Tacticos World's Best Selling CDS
- Superior Combat functionality
- Trend setting MSO functionality
- Tacticos Combat and MSO = 1 system

## MSO



Something to improve .....



# Trendsetting MSO capabilities

- Optimal Situation Awareness
  - Any sensor (radar, AIS, ADSB, UAV, ESM, internet, databases, ...)
  - Various layers (seachart, landmap, meteo, satellite, ....)
- Unique Situation Understanding & Prediction
  - User friendly visualization
  - Professional analysis tools(trends, anomalies, relations, time sliding...)
- Legal Evidence recording & creation
  - 90 days recording all data
  - Geo & time stamped

**“Turning incident driven, into pro-active ops”**

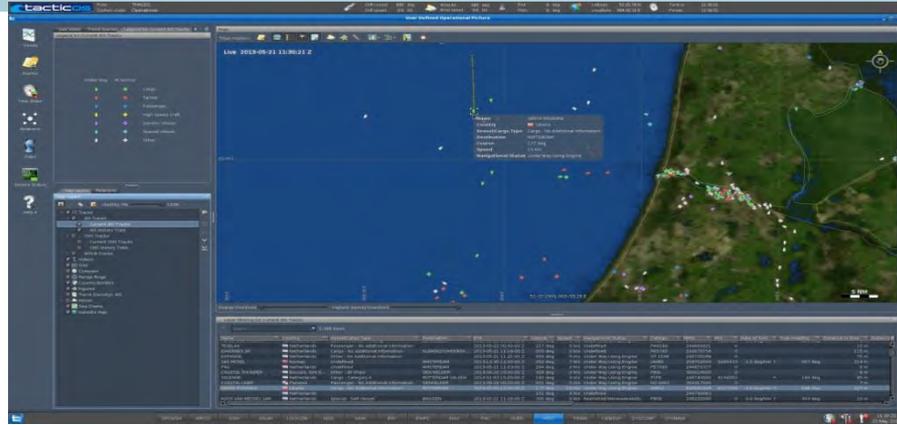
Capt Ed Veen, Director NL CG

## Facts

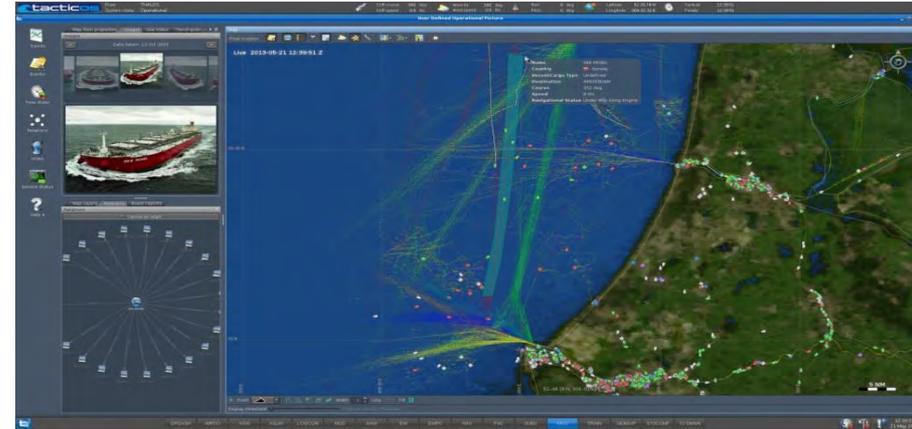
- Co-developed with RNLN
- Now on board OPV Zeeland

Thales CDS

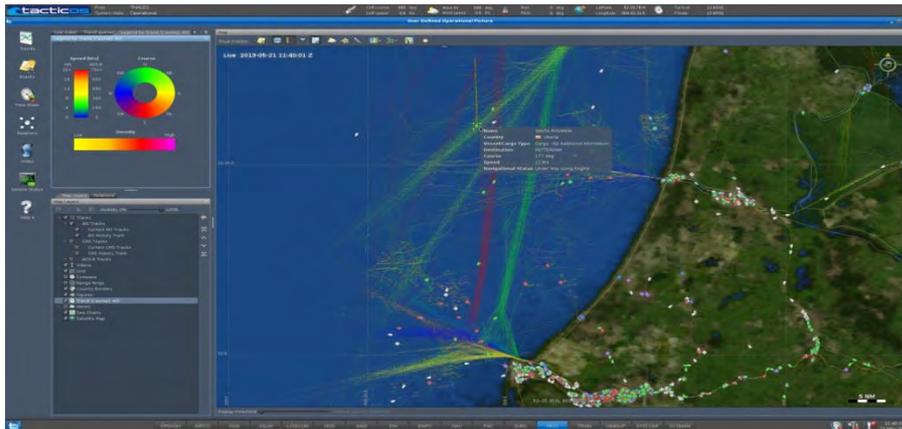
# Trend setting MSO functionality



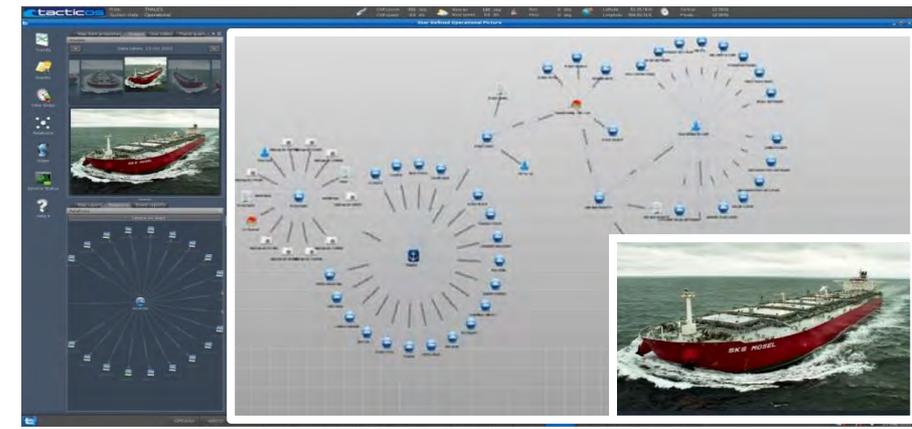
AIS, ADS-B, radar, ...



Anomaly detection



Trends



Relation mapping, legal evidence

TACTICOS MSO in action

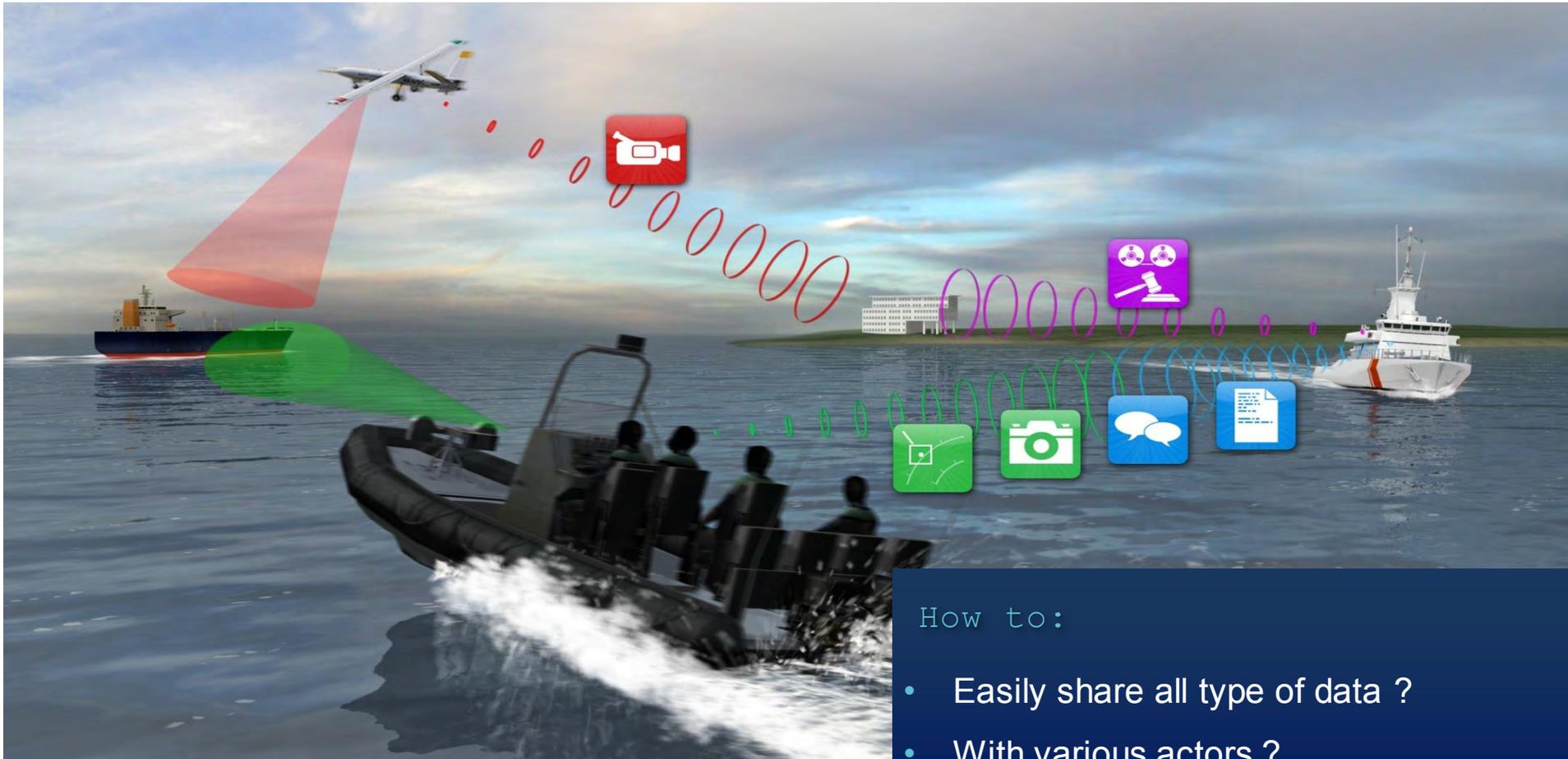
## NL OPV experiences in Carib CD operations

- Event rules & anomaly detection tool > permanent triggering at ships with specific CD profiles
- Relation mapping tool > for triggering at black-list ships
- Trend tool > at open sea
- Replay function > analyzing for possible overload



## Challenge

# Information sharing



How to:

- Easily share all type of data ?
- With various actors ?

# Tactical data exchange

## Create Common Operational Picture

- Sharing: tracks, tactical orders, text messages
- Data forwarding, relaying, dual link use, .....
- Naval, Airborne and Land based versions

## NATO and non-NATO

- TDL 11, 16 and 22
- Link-Y Mk 2

## Fully integrated in TACTICOS

- Easy integration in any CMS, or stand-alone



## Facts

- 2<sup>nd</sup> Generation
- 84 Ship borne
- 44 Airborne
- 3 Land based
- 11 Navies

# IP based information sharing

## TACTICOS with COMMANDER & IMARCS

- Sharing of formatted, free and (streaming) imagery data
  - Tracks, pictures, docs, (UAV) video, BFT, ...
- Connects sea, air, shore and mobile assets
- Interfaces with V/U/HF, Satcom, Wifi, ...
- Apps for swift and easy info sharing
  - Chat, data & radio mgt, tailored tasking, ....
  - Info quality / urgency, ...



Facts CAN + AUS CG

- 78 CG vessels
- 14 Navy vessels
- 28 RHIBs
- 8 Ops centers

# TACTICOS World Class Combat system



## Critical Awareness

- Sensor Control
- Tactical Picture Compilation
- Tactical Information Exchange
- Asset Control
- Recognition & Identification

## Assessment & Decision

- Anti Air Warfare
- Anti Surface Warfare
- Anti Submarine Warfare
- Electronic Warfare
- Land Attack Warfare

## Execution

- Resource Allocation
- Effector Control
- Fire Control

Thales answer #5

# TACTICOS World Class Combat system



# Combat Operations

## Example: Swarm Defence

Asymmetric Warfare - Harbour Protection Mode

Preparation | **Operation** | Advanced

Tracks in range:

Range	Track #	Image
600-1000 yrd	S #1331	
600-1000 yrd	S #4461	
600-1000 yrd	S #1572	
300-600 yrd	S #6615	
300-600 yrd	S #6621	
150-300 yrd	S #3112	
150-300 yrd	4 #5611	
0-150 yrd	3 #3123	

Rules of Engagement:

Weapon	Weapon	Weapon	Weapon	Weapon
VHF radio	VHF radio	VHF radio	LRAD	LRAD
Horn	Spot Light	Spot Light	LRAD	LRAD
Water cannon	Water cannon	12.5 mm	12.5 mm	
12.5 mm	12.5 mm	30 mm	30 mm	

Identity | Warn | Deter | Engage

Gatekeeper

-30s | now | IR | TV | Head 1 | Head 2 | **Head 3** | Head 4

THALES TACTICOS

Preferences: WCO (Active), Active

Services: WORKSET 2, Bind service

Available | Tracking

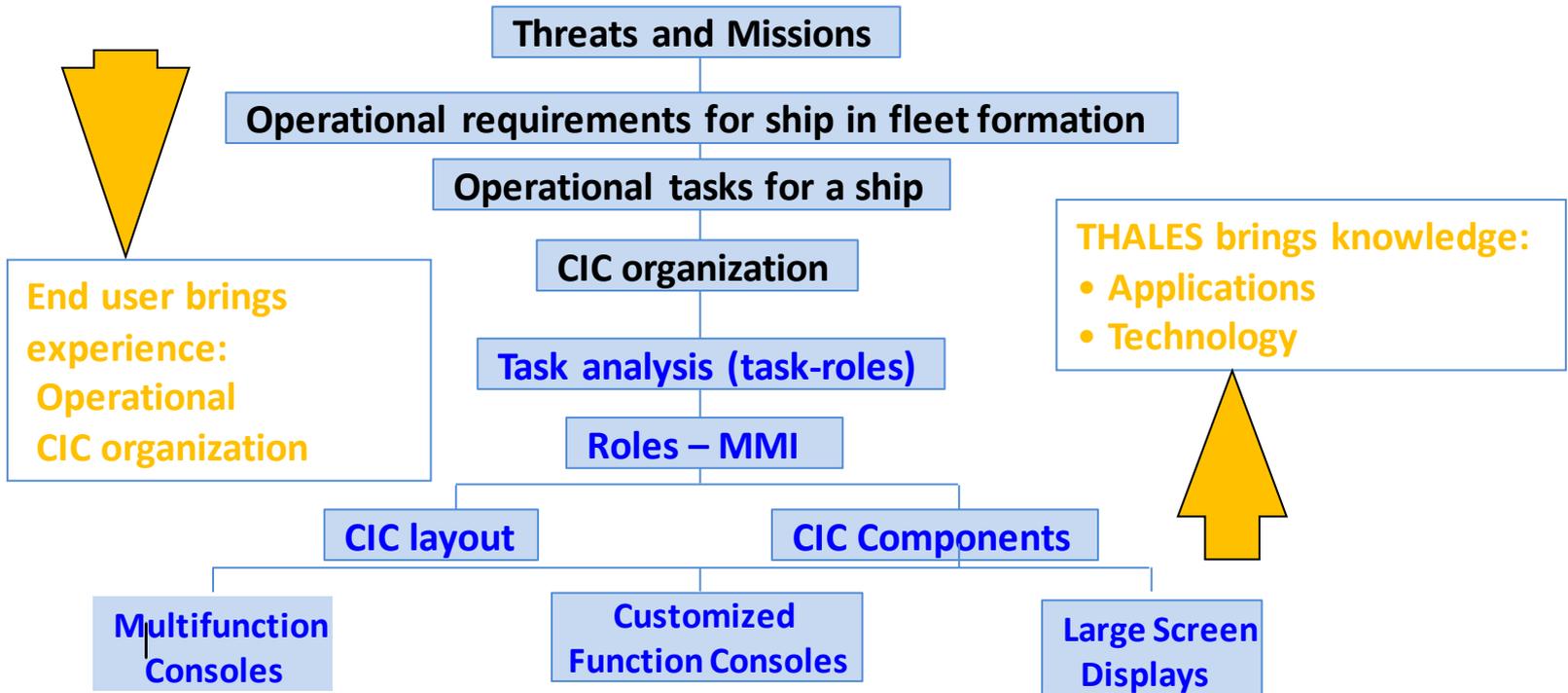
# Combat Operations

## Example: Training



# Naval Mission Solutions

## CIC / Ops room design





# CIC / Ops room design

OPS room design process (end-user & Thales)

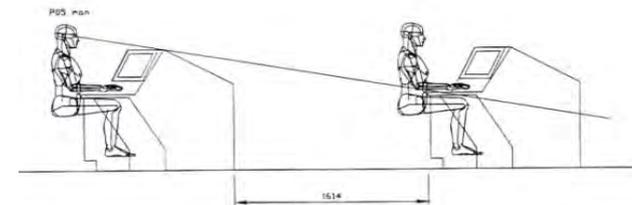
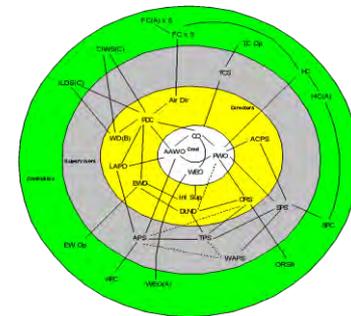
- Missions > CIC organisation > task analysis > HMI > lay-out
- Brainstorm > 3D > virtual reality > mock-up

Human factors in OPS room design (with TNO)

- Operator focus (1-3 screen, ...)
- Ergonomics
- Light (shadow / reflection , ...),  
noise, vibration, temp, ...

OPS room components

Thales EXPERIENCE





# New MOC Mk4



Single high resolution screen

Very user friendly, while all relevant data in one view

Unobstructed view to rest of CIC, improving team performance

Modern USB mouse control + QEK

Further improving user friendliness

Compact footprint

Saving space in new CIC's

Fits well in existing CIC's

## MOC Mk 4 + ICU



## Conference table



## Command chair



# Welcome to the THALES Experience



# PURPOSE

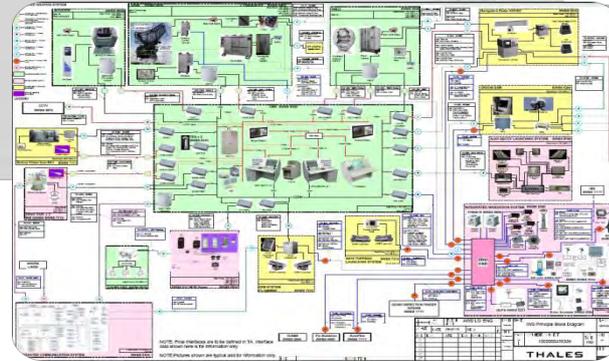
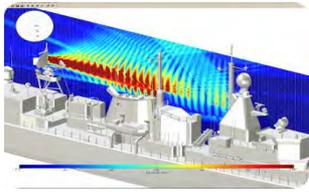
- Customer Demonstrations
  - ✓ TACTICOS Capabilities
  - ✓ Integration
  - ✓ Mission Solutions
- Concept Development
  - ✓ Roadmap
  - ✓ Functionality
- Training



**TRY before you BUY!**



- Shared Awareness
- Mission Status
- Video (organic and non organic)
- Debriefing and training
- CIC, Bridge, ...



# Combat System Integration

# Integrated Risk Management solution

Mission System



Responsibility level for

- System Performance
- Cost
- Time

Required  
Management and  
Engineering

the ultimate  
goal



**covering the overall  
Mission System performance responsibility**

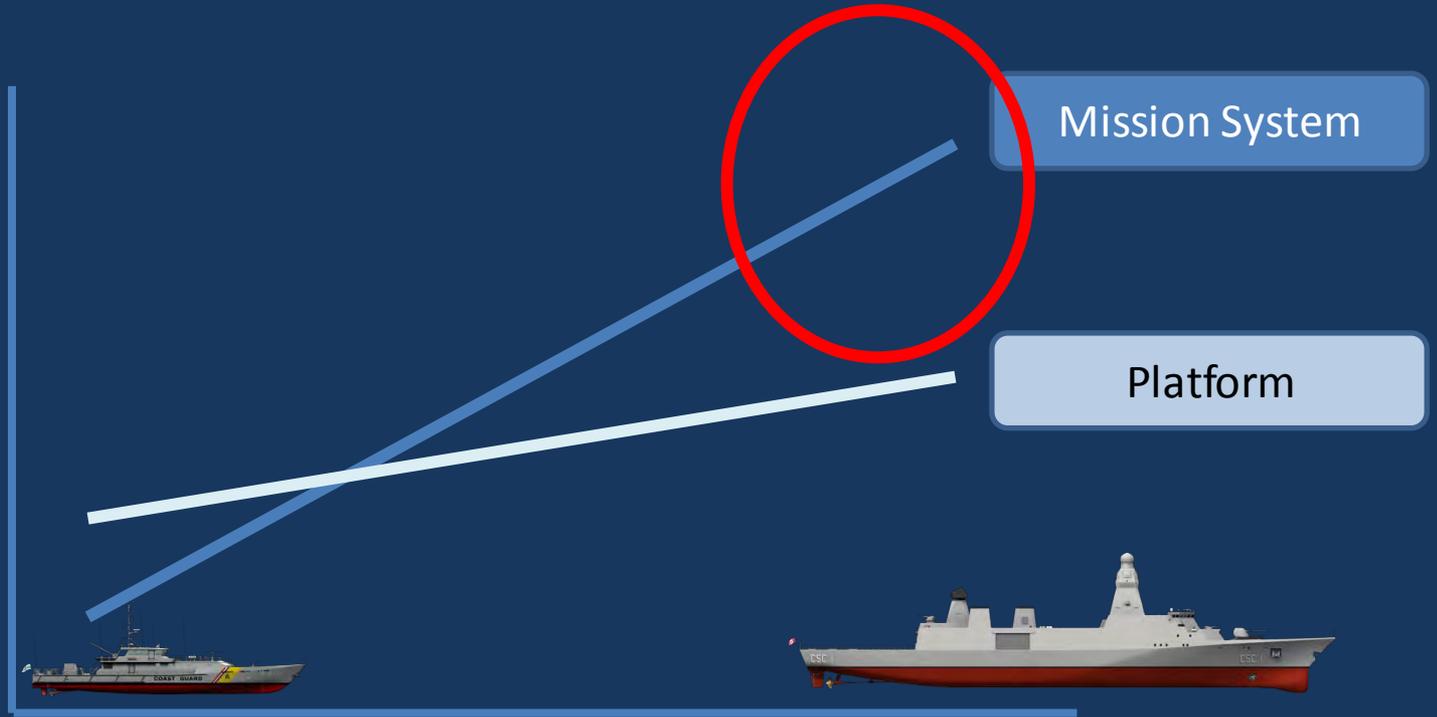
# Unique Integration Record



SURVEILLANCE	COMMS / IIR	TRACKERS	MISSILES / TORPEDOES	LAUNCHERS	SENS	EW
<p>APAR, SMART-L, SMART-S (Mk1 + Mk2) MW08, DA08, LW08, JUPITER, VARIANT, MRR, SCOUT, SURFACE SCOUT WM-SERIES (a.k.a. Mk92) C2P IRSCAN, SIRIUS GATEKEEPER (study)</p> <p><u>NAVIGATION RADARS</u> KH 1007/ 2007 SPS 64 RACAL MARINE BRIDGEMASTER E FURUNO SCANTER 2001 Vision Master SPS 95K, Sharp Eye</p> <p>AIS / ADS-B</p> <p><u>Other Radars</u> AWS 4, AWS 5 AWS 6, AWS 9 SPS 49 Sea Giraffe AMB TRS 3D</p> <p>IFF MK X/XII (various)</p> <p><u>SONARS</u> SPHERION, KINGKLIP, CAPTAS series (study) SQS505, SQS-56, DSQS21B DSQS-24C, ASO-90 UMS 4110-CS, TASS</p>	<p><u>DATA LINKS:</u> LINK 11 LINK 16 LINK 22 (demo) LINK Y Mk2 C2P DLPS DLIP (study)</p> <p><u>INTERNAL COMMS</u> NGIN FOCON SOTAS PA System (SOLAS) Sound Power Tel.</p> <p><u>EXTERNAL COMMS</u> All Transceivers: VHF / UHF / HF / MF / LF SATCOM (various) Crypto's &amp; Modems</p> <p>GMDSS</p> <p>MMHS</p> <p><u>NAVIGATION</u> Speed Log GPS / SatNav Echo Sounder Inertial Nav. System Wind Speed &amp; Dir.</p>	<p>APAR STIR 1.8 STIR 1.8 / 2.4 HP STING-EO STIR 1.2 EO Mk1&amp;2 LIROD Mk2 LIOD MIRADOR WM-SERIES CASTOR</p> <p>TMX VIGY</p> <p><u>EO</u> MSP500 LSE OS Mk2</p>	<p><u>SSM</u> HARPOON EXOCET MM38 EXOCET MM40 ITL 30 + 70 Bl. 1,2,3 OTOMAT Mk2 PENGUIN GABRIEL RBS15 Mk2/3 NSM (study) C-STAR MANSUP</p> <p><u>SAM</u> SM1 &amp; SM2 &amp; SM3 NSSM 7H / 7M / 7P ESSM ASTER 15 &amp; 30 (study) ASPIDE RAM, RAM HAS CROTALE BARAK 1 UMKHONTO SEAWULF (VL) MISTRAL / SADRAL TETRAL VT1 / SIMBAD FM90 VL MICA</p> <p><u>TORPEDOES</u> Mk 32, Mk46 MU 90 AS 244 SUTT</p>	<p><u>SAM</u> GMLS Mk13 GMLS Mk29 VLS Mk48 VLS Mk41 VLS Mk56 ALBATROS BARAK SEAWULF CROTALE NG SADRAL TETRAL RAM Mk31</p> <p><u>TORPEDO</u> B515 FAUN</p>	<p><u>GUNS</u> 152mm (6") 127mm (5") 115mm (4.5") 100mm 76mm CG &amp; SR 57mm Mk2, Mk3 40mm 35mm 30mm 27mm 25mm PHALANX GOALKEEPER</p> <p>AK630M AK176M</p> <p>DART (study) VULCANO (study) AK306 (study) AK230 (study) AK725 (study)</p> <p>Various Suppliers: OTO Melara Bofors OTO Breda FMC MSI Rheinmetal Emerlec Crusot Loire</p>	<p><u>ESM</u> SUSIE DR3000 SKW, SLC VIGILE series APX (study) ALTESSE</p> <p>ARES-SN CUTLASS APECS II MAIGRET FL1800 / UL5000K WBR 2000 BREN-R EDO CS 3701 DEFENSOR, SONATA RIGEL, EDS</p> <p><u>ECM</u> SALAMANDRE SCORPION Mk 1 &amp; 2 FL1800 SII NIXIE SONATA, RIGEL NETTUNO 4100</p> <p><u>DECOY</u> DAGAIE, SAGAIE SRBOC/ALEX MASS SKWS SUPERBARRICADE CS-3701</p> <p><u>Laser Warning Systems</u> NLWS-310</p>

# Complex assets > main risk reduction areas

Cost ratio

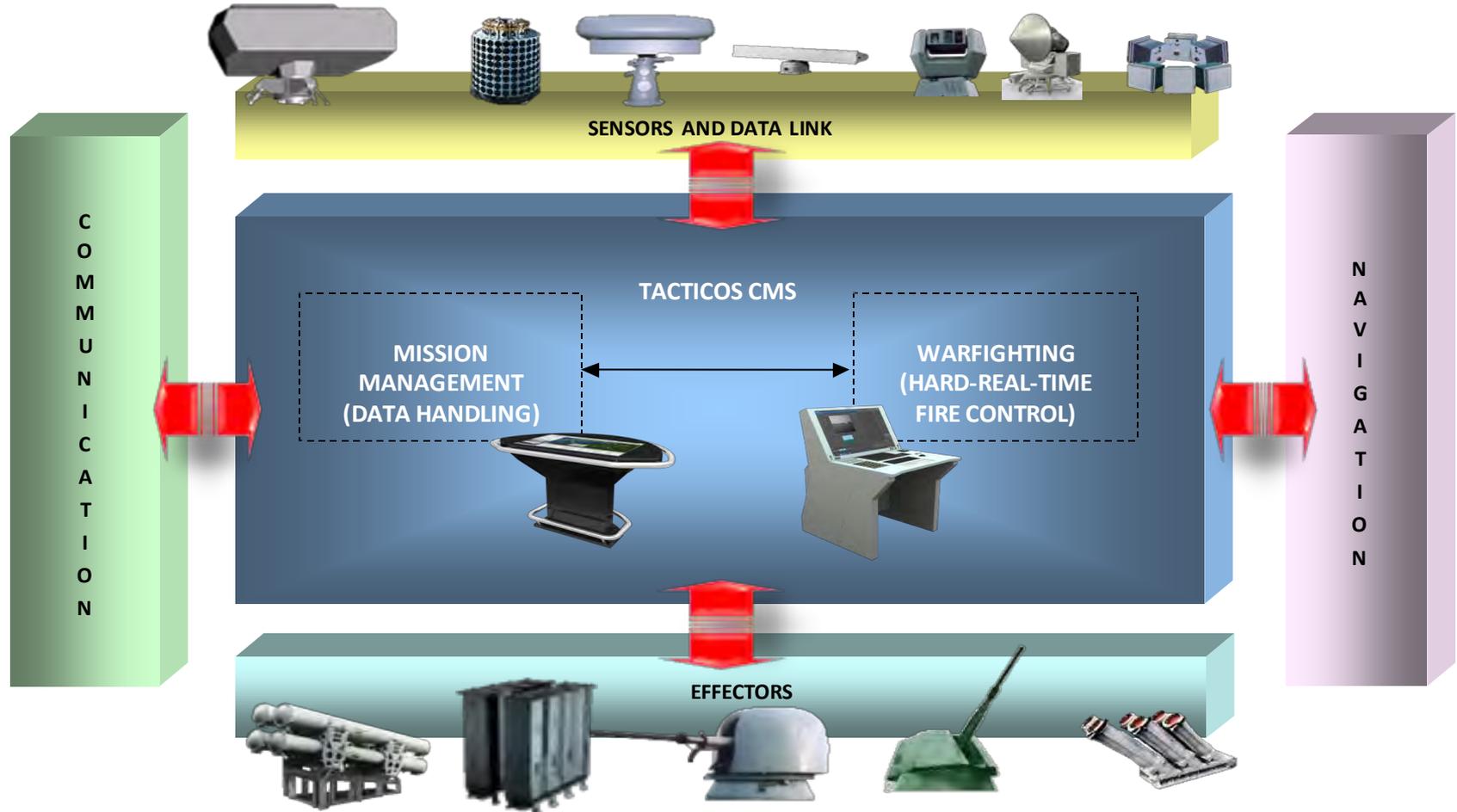


Mission System

Platform

Complexity

# CSI capabilities based on a proven CMS

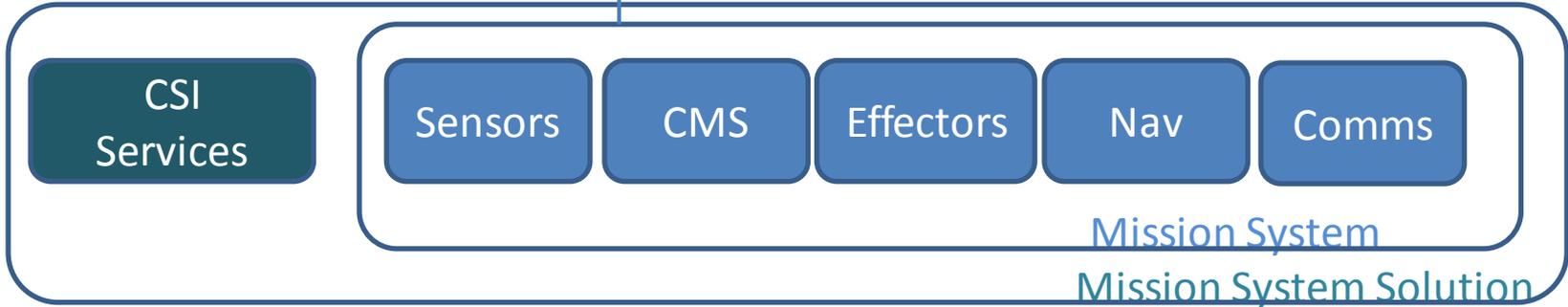


# Combat System Integration services



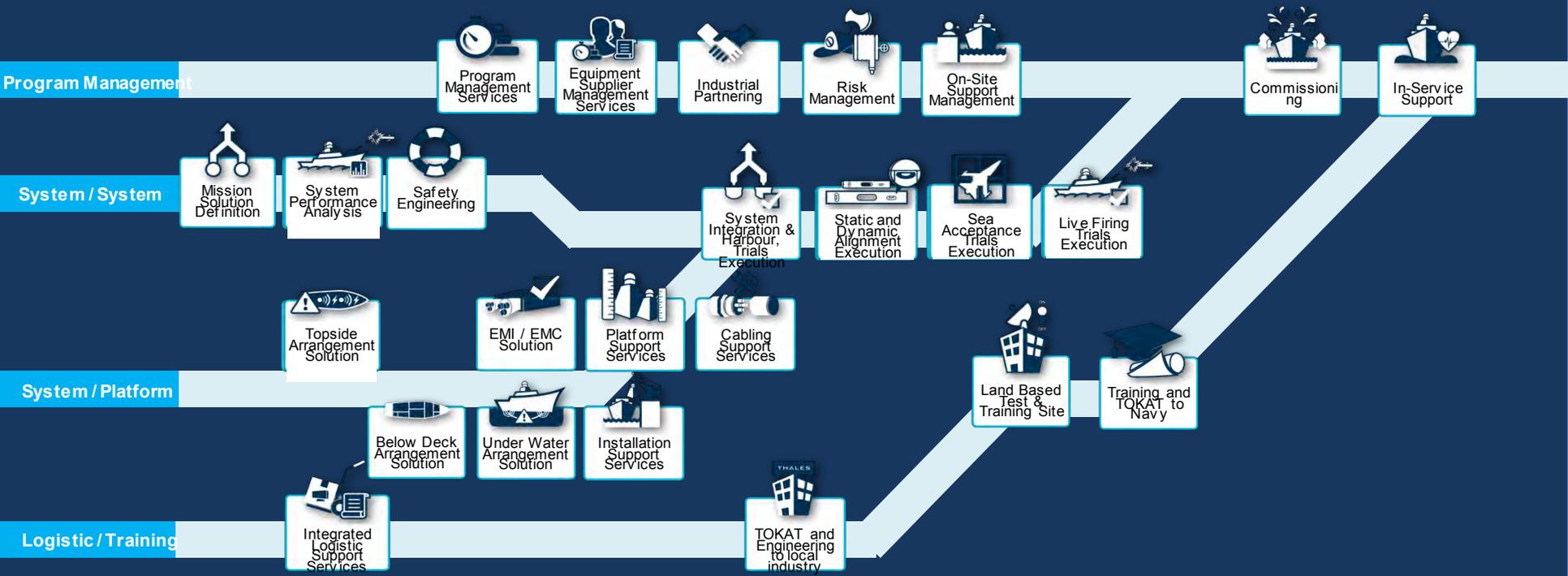
Mission System

Platform

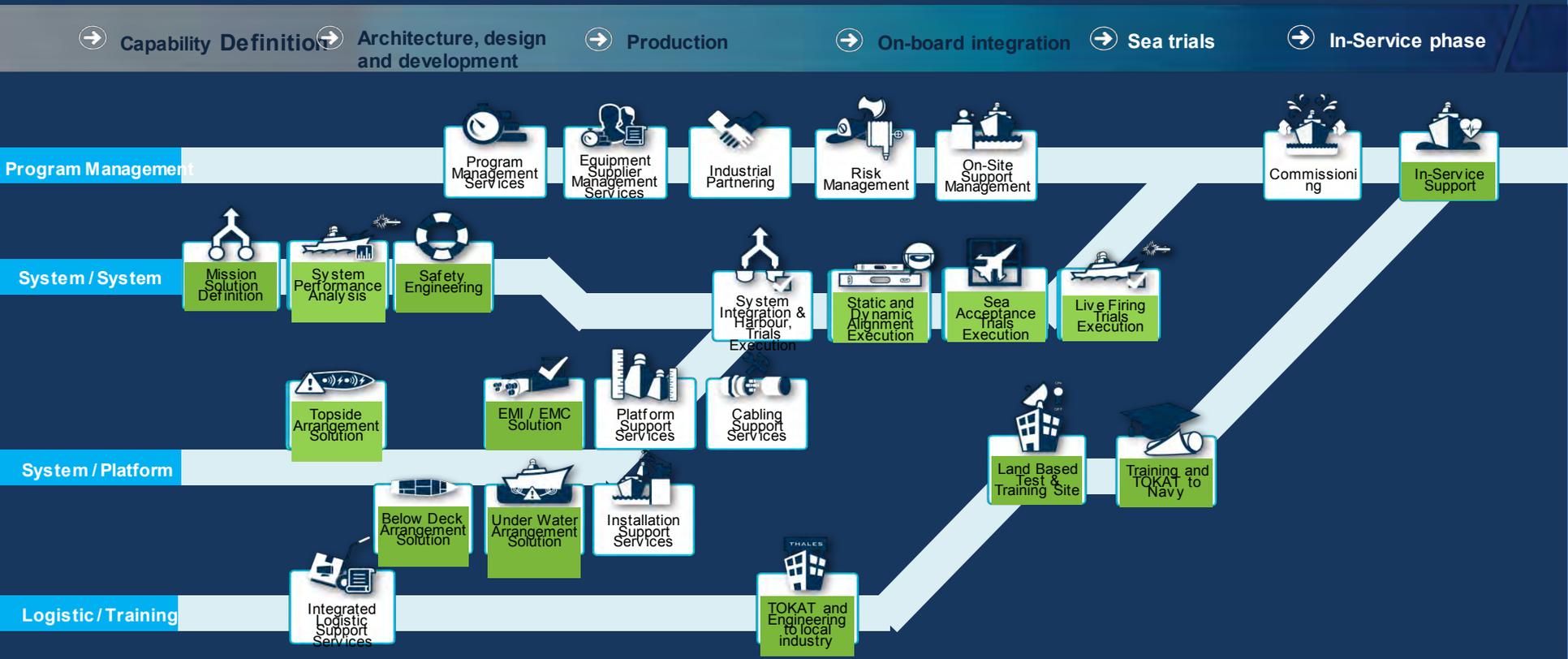


# Combat System Integration services

→ Capability Definition → Architecture, design and development → Production → On-board integration → Sea trials → In-Service phase



# Combat System Integration services



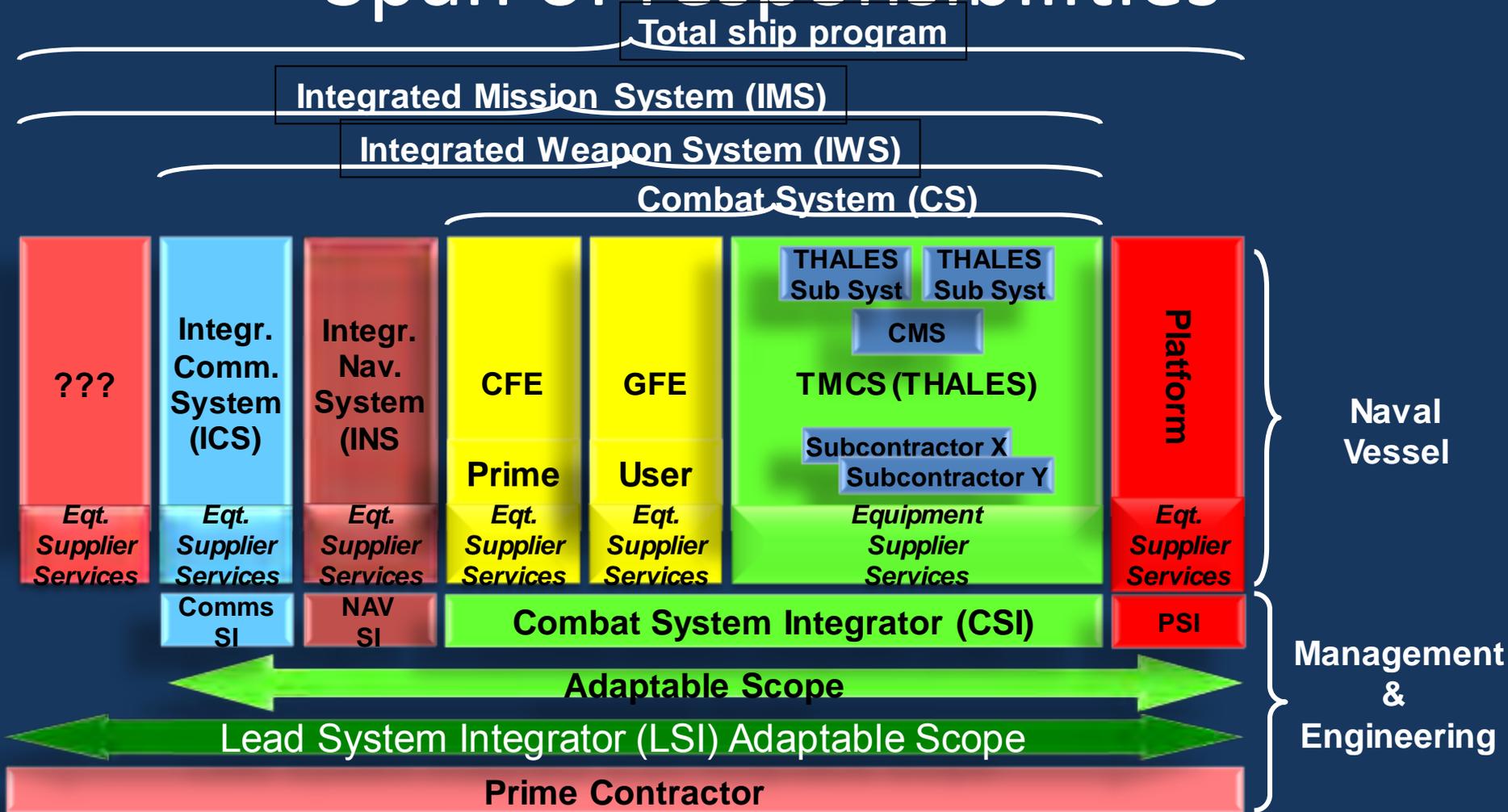
# Thales CSI services – per ship type

Typical Mission System Solution Provider services - per segment	Safety	Security Littoral	Security Ocean Patrol	Point Defence Guns	Point Defence Guns & Missiles	Wide Area Defence	Service Life Extension / Overhaul
Mission System Solution Definition				Included			
System Performance Analysis		Recommended	Recommended	Included			
Safety Engineering	Included	Included	Included				
Topside Arrangement Solution		Optional	Optional	Recommended	Included		
Below Deck Arrangement Solution				Optional	Recommended	Recommended	Included
Under Water Arrangement Solution				Optional	Recommended	Recommended	Recommended
Integrated Logistic Support Services		Optional	Optional	Optional	Recommended	Included	Recommended
Project Management Services				Recommended	Recommended	Recommended	Included
Equipment Supplier Management Services		Optional	Optional	Recommended	Recommended	Included	
On-Site Support Services				Recommended	Recommended	Included	
Risk Management				Recommended	Recommended	Included	Recommended
EMI / EMC Solution	Optional	Optional	Optional	Recommended	Included		
Platform Support Services				Optional	Recommended	Recommended	Included
Cabling Support Services				Optional	Optional	Optional	Recommended
Installation Support Services				Optional	Optional	Optional	Recommended
System Integration & Harbour Trials Execution	Recommended	Included	Included	Included			
Static and Dynamic Alignment Execution		Recommended	Recommended	Included			
Sea Acceptance Trials Execution	Recommended	Recommended	Recommended	Included			
Live Firing Trials Execution		Recommended	Recommended	Recommended	Included		Recommended
Landbased Test & Training Site				Optional	Optional	Included	Optional
Training and TOKAT to Navy		Optional	Optional	Included	Included	Included	Included
TOKAT and engineering to local industry		Optional	Optional	Optional	Optional	Optional	Optional
In-Service support	Optional	Optional	Optional	Recommended	Recommended	Recommended	Recommended

**Legend:**

- Included
- Recommended
- Optional
- If required

# Span of responsibilities



# How to perform LSI

The LSI manages the program risk by:

- ◆ Covering the overall Integrated Mission System (IMS) performance responsibility (warfare flows)
- ◆ One unique management & engineering control body
- ◆ Producing the IMS level specifications and test procedures
- ◆ Acting as the EMI / EMC definition & control authority
- ◆ Definition and co-ordination of all engineering, integration and test activities
  - System to System and System to Ship
- ◆ Execution of risk mitigating activities:
  - Sensors fully functional and transmitting
  - Limited flight trials
  - All system components (HW + SW) brought together for Software Computer Integration Testing (SCIT)
  - Non-Thales subsystems simulated
  - Approx. 90% pre-integration



# Ability to cover various LSI roles

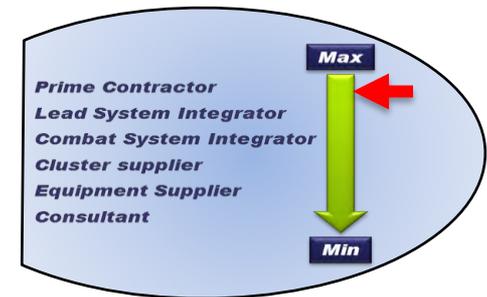
- ◆ THALES is a System House (products and services)
- ◆ THALES produces most critical IMS elements, except weapons, in-house:

- CMS + Fire Control
- Surveillance & Tracking Sensors (AAW, ASuW, ASW, EW)
- Communications



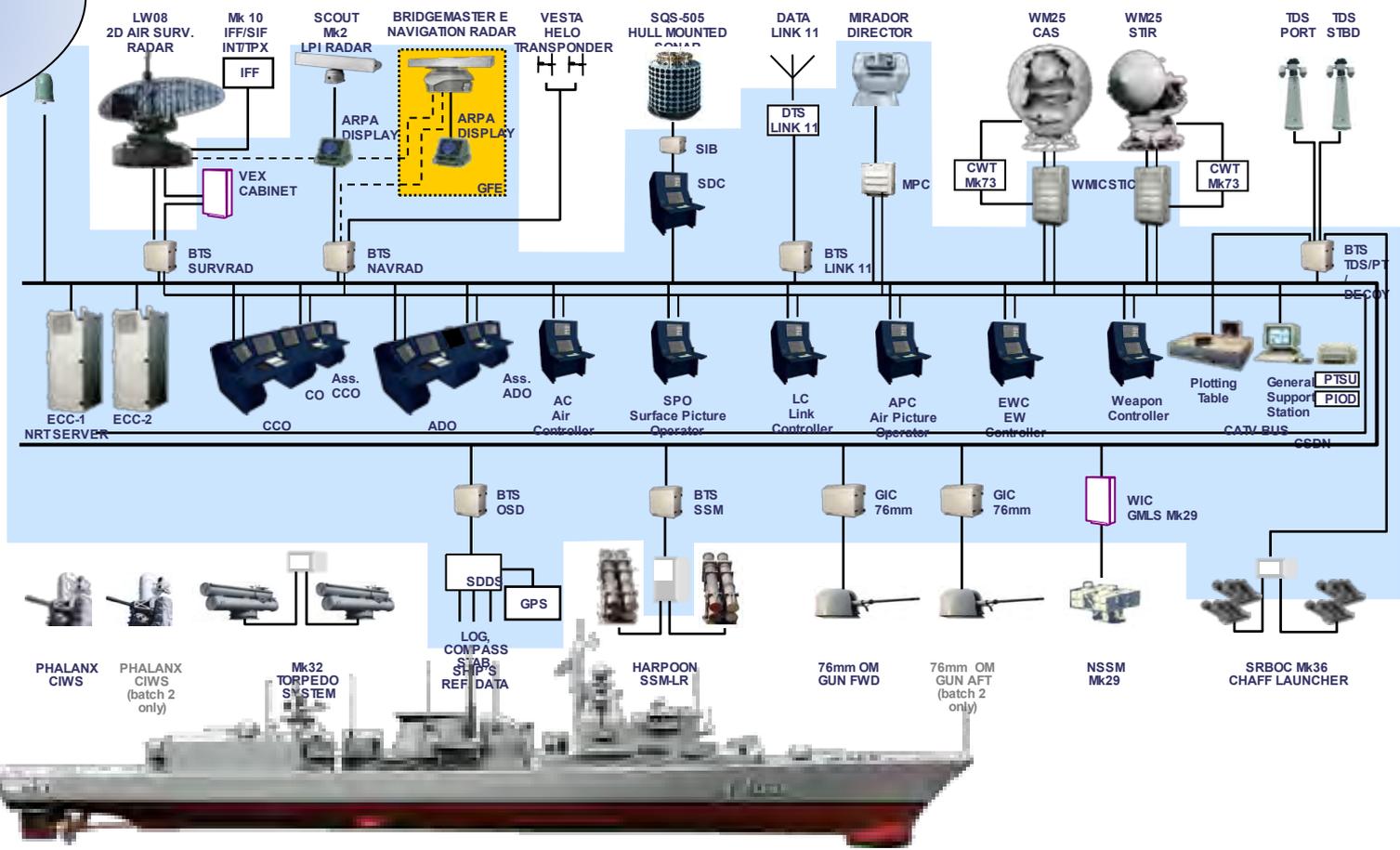
- ◆ THALES has an extensive and proven interface track record
- ◆ Authorized integrator of US and FR missiles
- ◆ THALES has in depth knowledge of naval subsystem suppliers
- ◆ THALES has executed all responsibility roles:

- Prime Contractor
- Lead System Integrator
- Combat System Integrator
- Cluster supplier
- Equipment Supplier
- Consultant



# Greek S-Frigates modernization – Thales = LSI

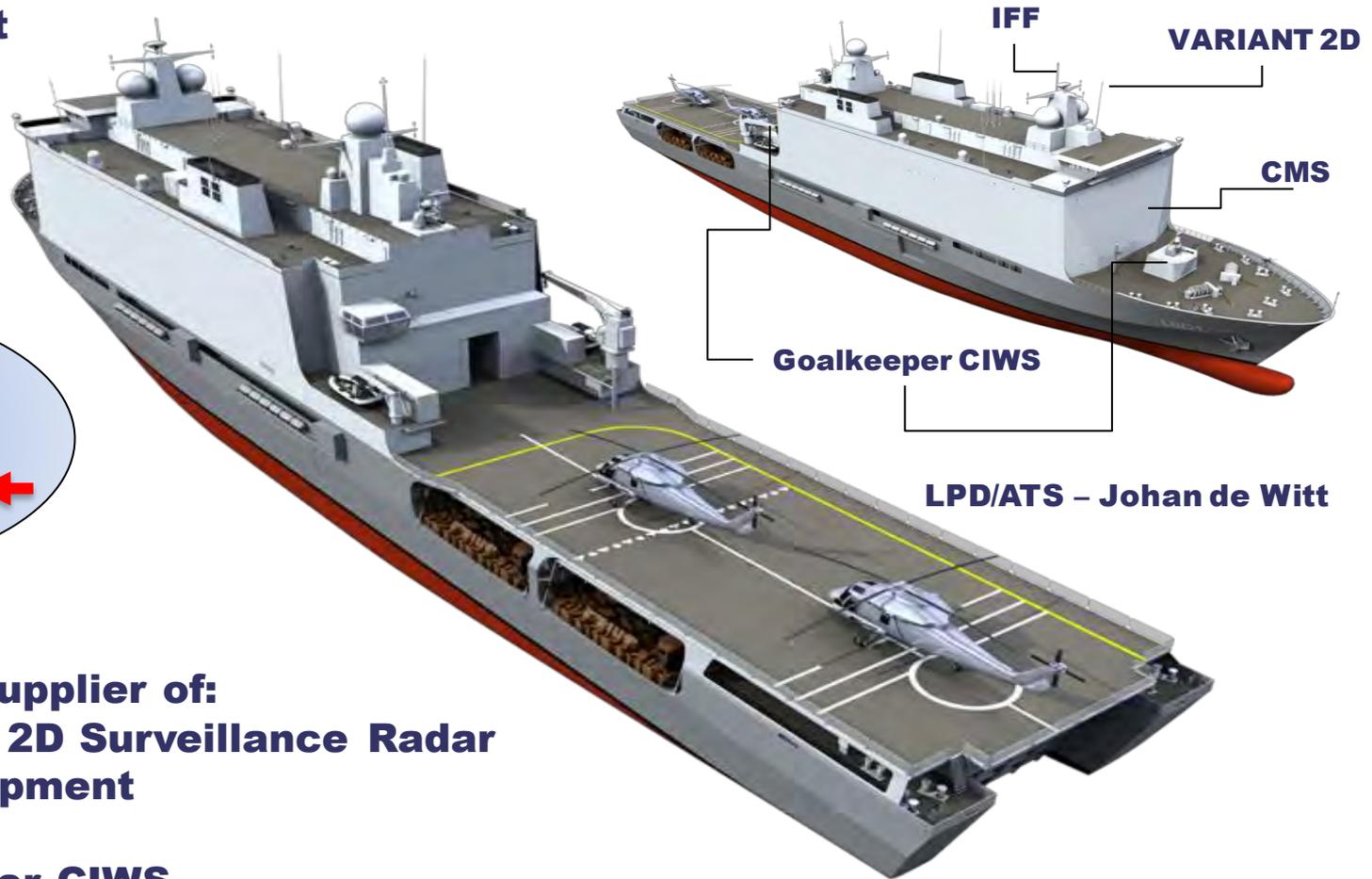
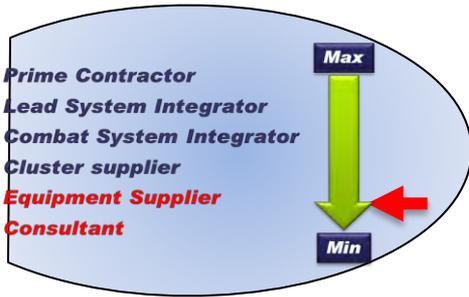
- Prime Contractor**
- Lead System Integrator**
- Combat System Integrator**
- Cluster supplier**
- Equipment Supplier**
- Consultant**





# Example: RNLN LPD – Equipment Supplier & CSI consultant

## CSI Consultant



## Equipment supplier of:

- **VARIANT 2D Surveillance Radar**
- **CMS Equipment**
- **IFF**
- **Goalkeeper CIWS**

# Use of Synthetic Environments

Modelling and Simulation for Capability Planning

# Key Messages

## PROVEN THALES SYNTHETIC ENVIRONMENT

from acquisition, development, integration, V&V and in-service support

## GUARANTEED PERFORMANCE and CAPABILITY

at contract award, validated by live firing trials

## M&S SUPPORTS DESIGN TRADE-OFFS

increased capability, decreasing cost, time and risk

# Synthetic Environment Expertise

Thales is a major leader in the area of Synthetic Environment Based Acquisition (SEBA) and Simulation Based Acquisition (SBA)

In a representative synthetic environment we are able to take the design of platforms and or systems and engage them in realistic scenarios This enables a comprehensive appraisal of operational capability and various interfaces, including the human machine interface connection

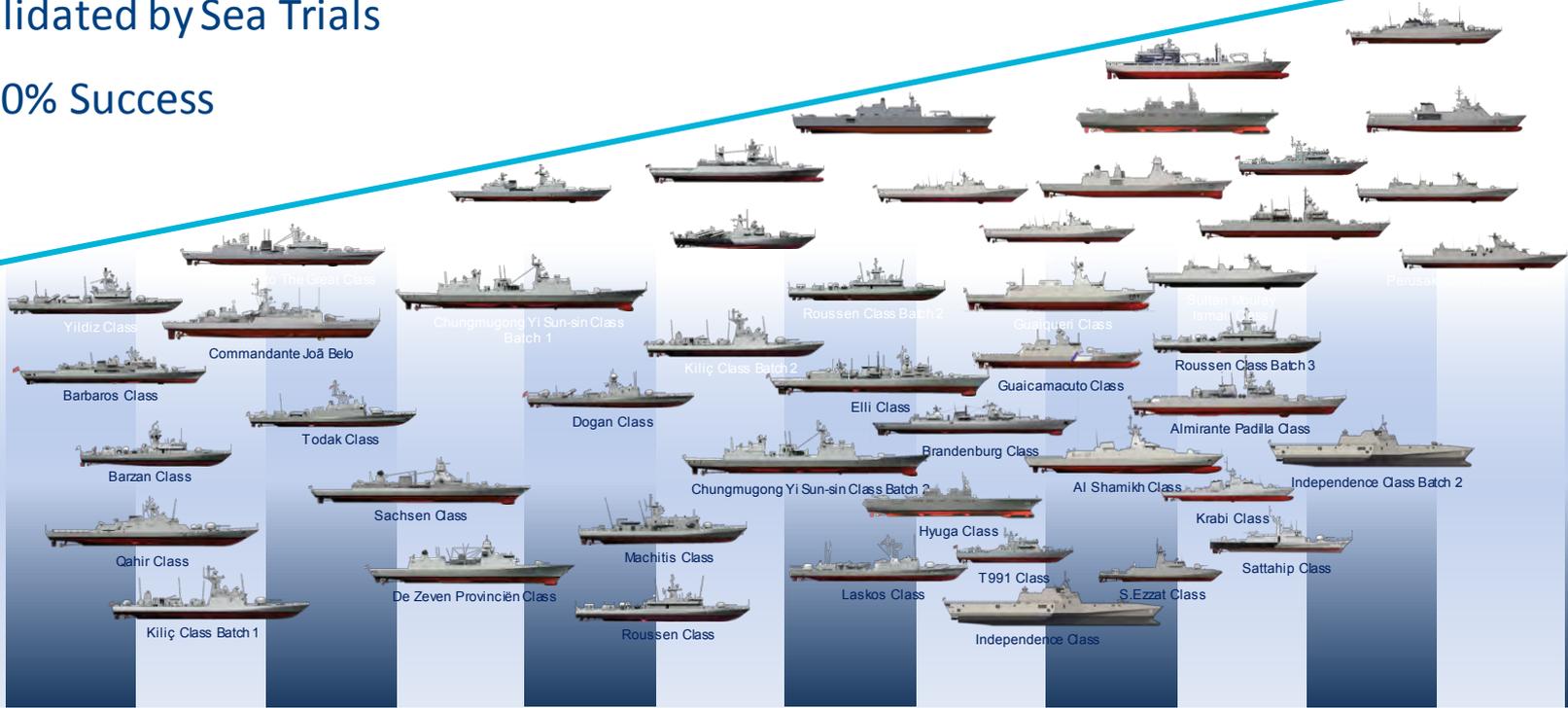


# Thales Naval Synthetic Environments

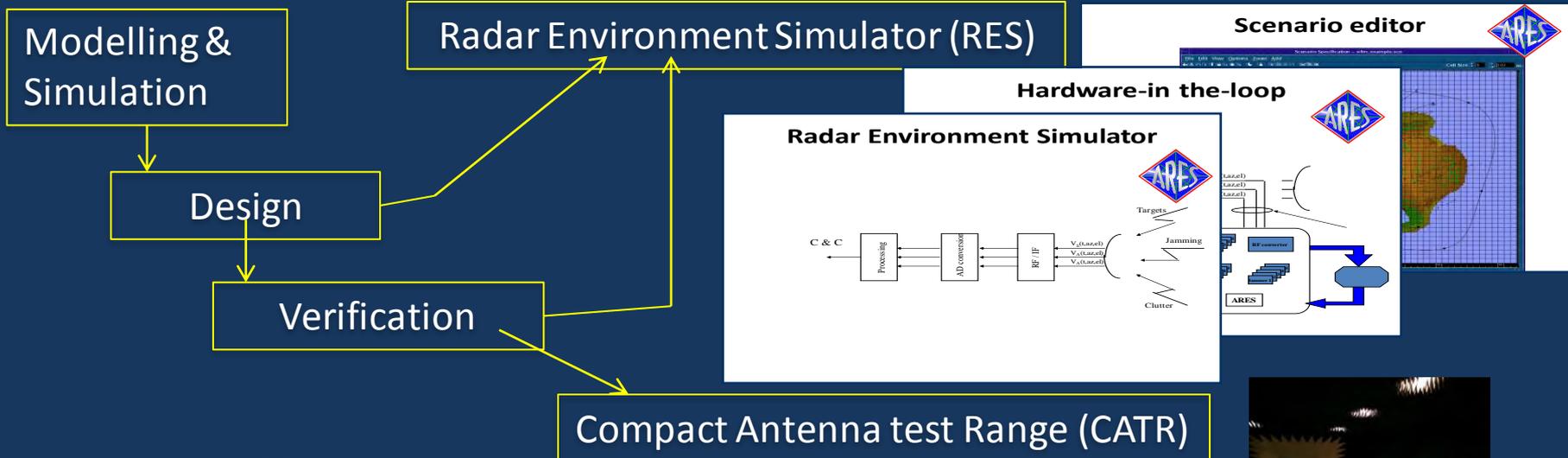
- **Guaranteed Contractual performance based on performance models**
- **Adaptive Radar Environment Simulation**
- **Synthetic Environments at Mission System level**
- **Synthetic Environments Architecture**
- **Interactive Ship Optimization**
- **CIC/Ops room design**
- **Synthetic Environments and Training**
- **Synthetic Environments projects experience**
- **Synthetic Environments benefits for Canada and the Industry**
- **Validate CSC's CS Performance**

# Synthetic Environments evolution

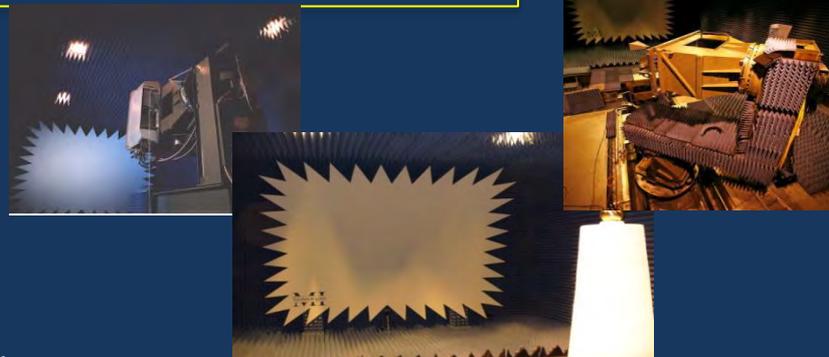
- From early 90's: **Guaranteed** Contractual Performance based on performance models →
- Validated by Sea Trials
- 100% Success



# Synthetic Environments for Radar Sensors (system level)

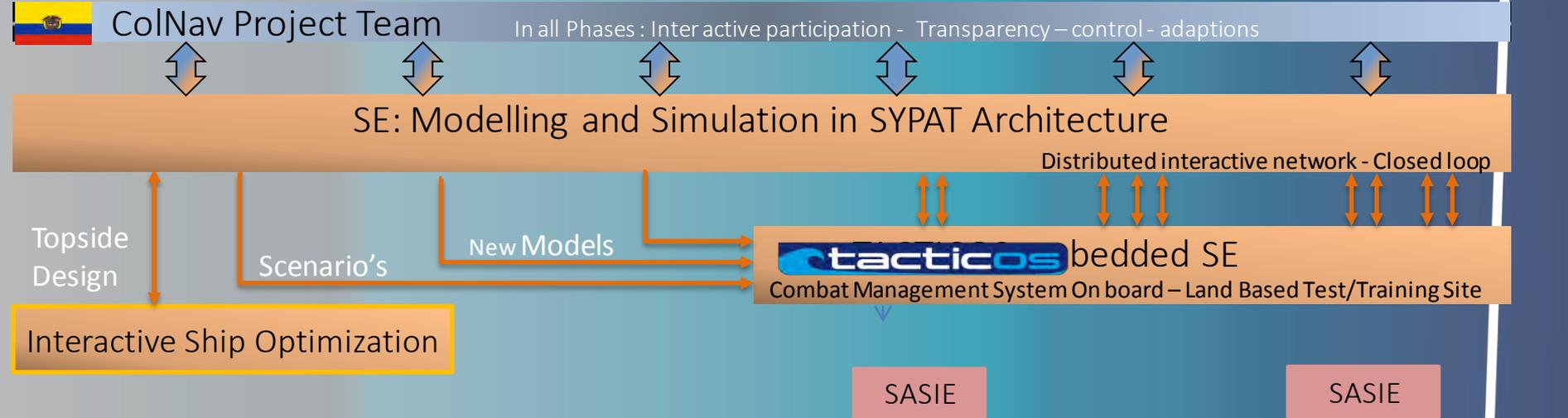


- Antenna Measurements:
  - Active antennas in full power Transmit
  - Antennas with digital beam forming
- Radar Cross section measurements:
  - Small objects 0.01 m<sup>2</sup>
  - Large antenna structures

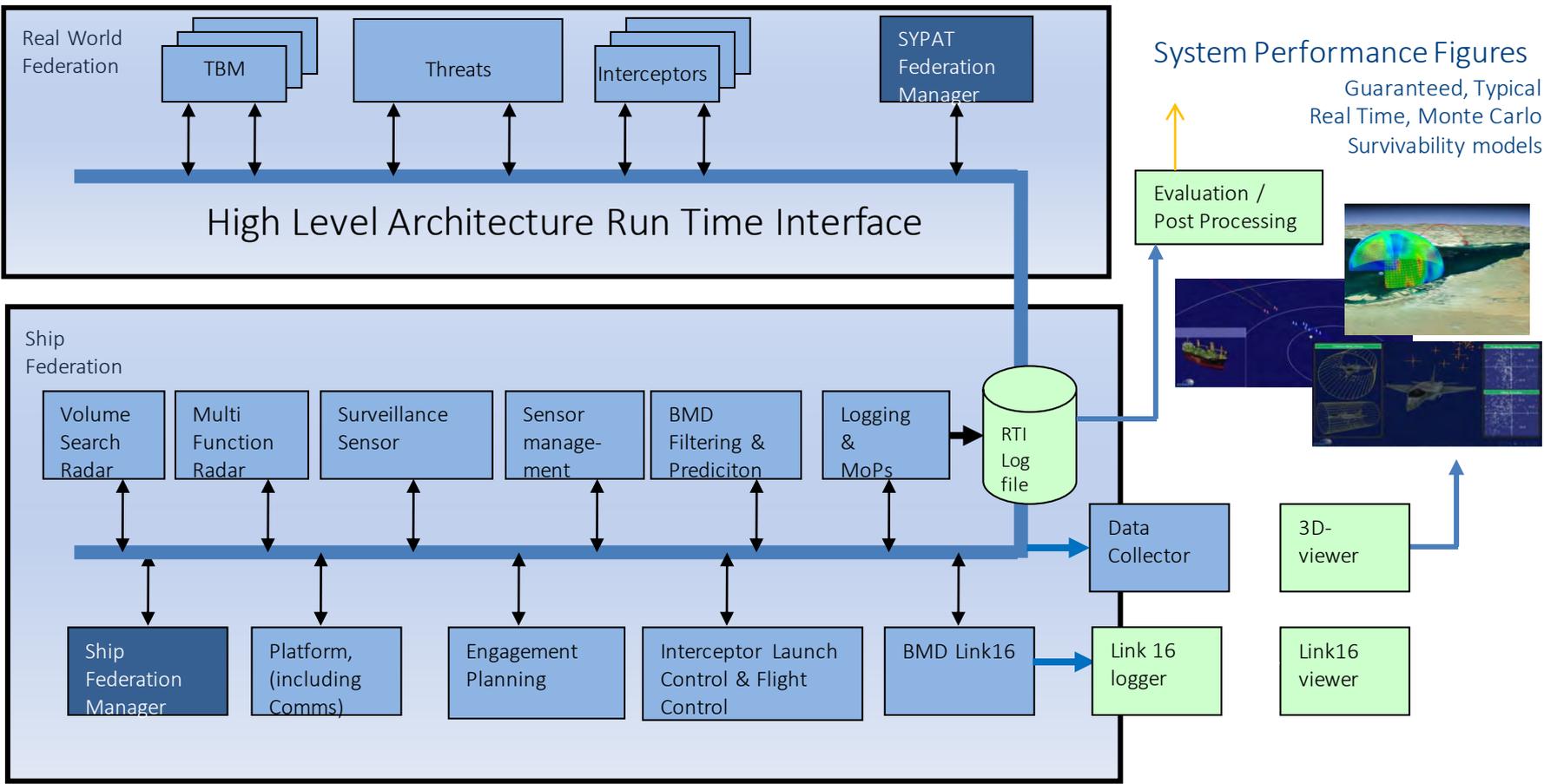


# Synthetic Environments at Mission System level

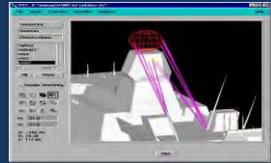
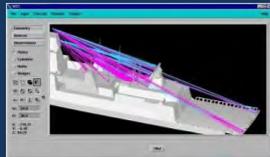
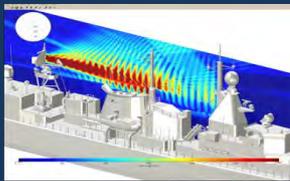
➔ Capability Definition	➔ Architecture, design and development	➔ Production	➔ On-board integration	➔ Sea trials	➔ In-Service phase
<i>Requirements capture</i>	<i>Analysis</i>	<i>Auto Testing</i>	<i>Analysis</i>	<i>Acceptance execution:</i>	<i>Scalable Training</i>
<i>Optimal Topside design</i>	<i>Typical performance</i>	<i>Regression</i>	<i>Dynamic</i>	<i>Live Firings</i>	<i>Mission Preparation &amp; Execution</i>
<i>Concept development and experimentation</i>	<i>Acceptance criteria</i>	<i>Agile working</i>	<i>Alignment</i>	<i>Logging</i>	<i>Real time monitoring</i>
<i>Guaranteed performance</i>			<i>Logging</i>	<i>Replay</i>	<i>Logging, Replay</i>
<i>Solution, Trade off</i>			<i>Replay</i>		<i>Analysis, Debriefing</i>
					<i>Upkeep</i>



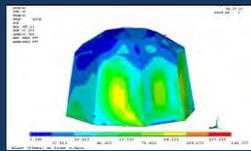
# Synthetic Environments SYPAT Architecture



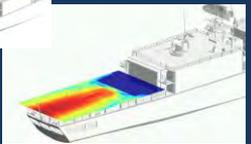
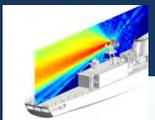
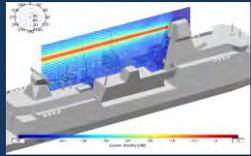
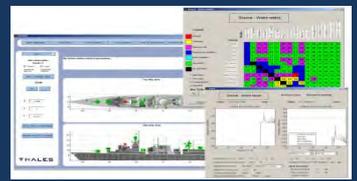
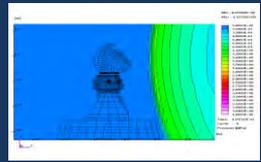
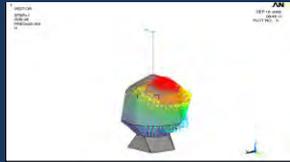
# Interactive Ship Optimization ITD Model



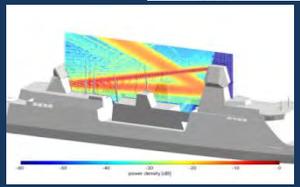
Ray Tracing and Casting



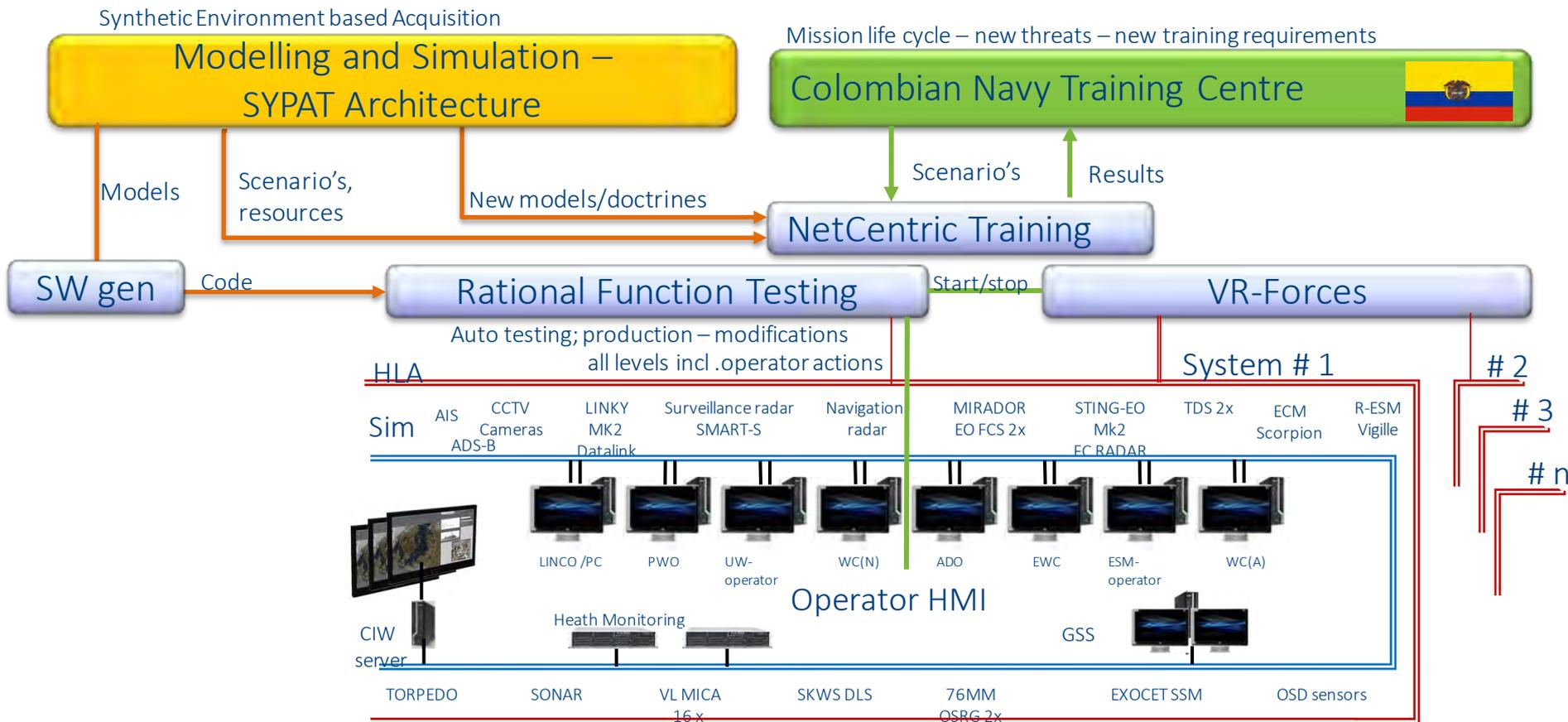
Structural analysis



Radar hazard



# Test Automation and Training Framework



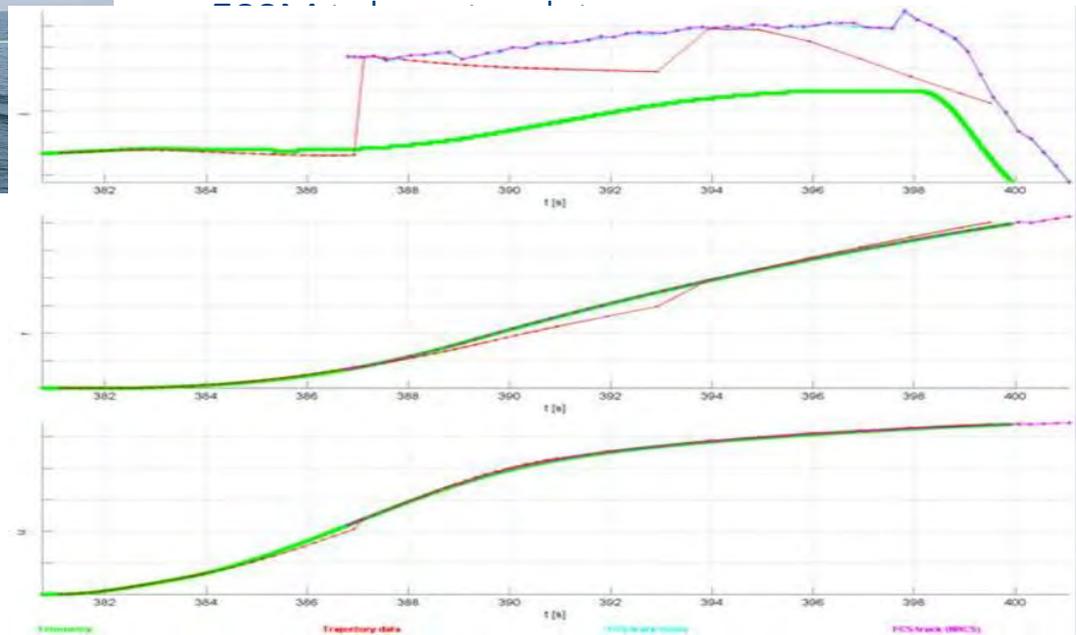
# LCF/F124 CS SM2 Integration



*F124 Frigate SACHSEN fires a SM 2*



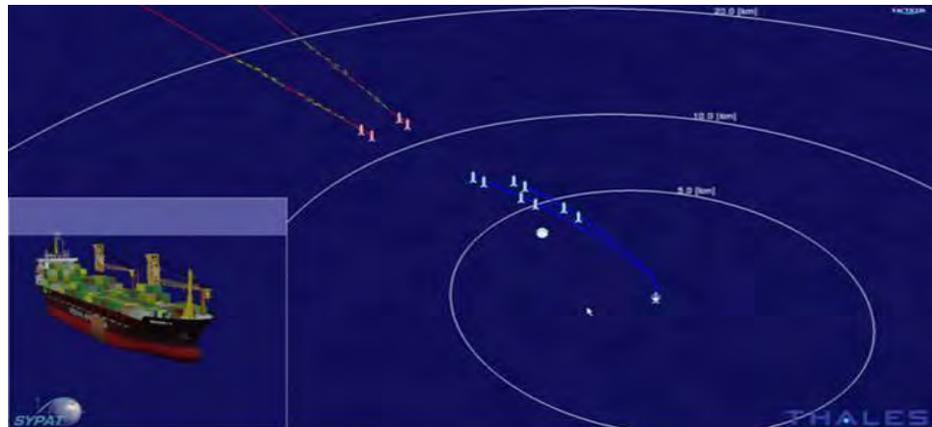
Missile pre-launch Integration  
Missile post-launch Integration  
Validation using ESSM Model  
Phased Array Track data



# Naval Mission Solutions

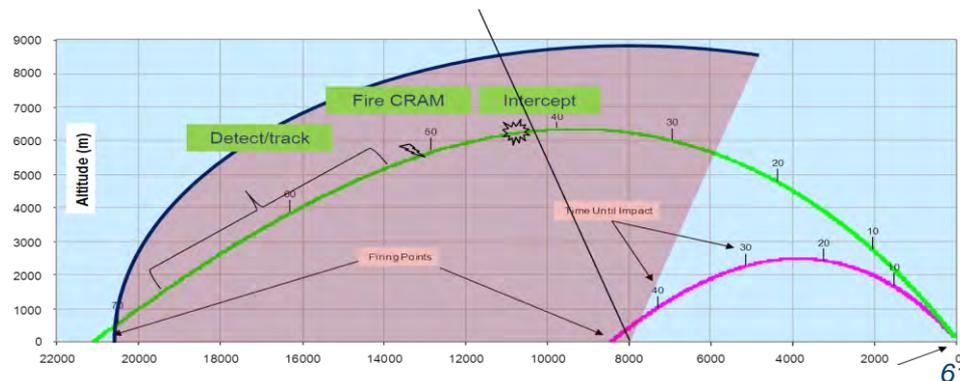
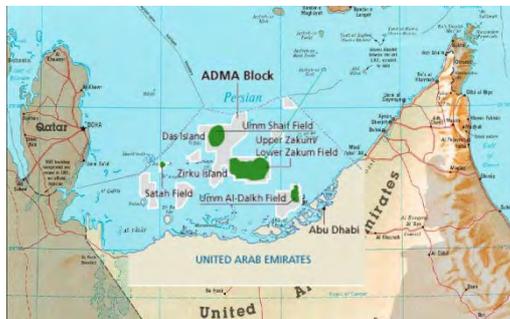
## Real Scenarios

### Scenarios for High Value Asset Defence



### Scenarios for Oil Field protection

#### C RAM Missile Detection and Tracking requirements



See you in Amsterdam June 2015 ?



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