Successful missions guaranteed with Thales on board.

Combat Management System
&
Combat System Integration
About Thales

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
World's widest naval sensor portfolio

WM-series
LW
DA
ZW
Goalkeeper

3D multi beam

AESA

Dual axis digital multi beam

58x SMART-S MK2

5x I-MAST

8x NS-100

4x SMART-L EWC

3D multi beam

58x SMART-S MK1

26x SMART-L/S1850M

10x APAR

5x LIROD

15x SIRIUS

42x VARIANT

74x MIRADOR

183x SCOUT

16x SMART-S MK1

64x STIR 1.2 EO

146x STIR 1.8/2.4

64x STIR 1.2 EO

146x STIR 1.8/2.4

Track record

2080 '80 '90 '92 '94 '96 '98 '00 '02 '04 '06 '08 '10 '12 '14
Track record

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
Introduction

What is TACTICOS?

Navigation System

Communication System

Other Assets

Combustion System

Mission System

Platform Systems

Sensor Systems

Effector Systems

Ship

TACTICOS

Platform Systems

Mission System

Ship

Other Assets

Definition
TACTICOS – Latest generation CMS

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

Facts
- 3rd generation
- 478 operational
- 21 Navies / CGs
• Tacticos World’s Best Selling CDS
• Superior Combat functionality
• Trend setting MSO functionality
• Tacticos Combat and MSO = 1 system
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
Trend setting MSO functionality

Thales CDS

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?
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
- 2nd Generation
- 84 Ship borne
- 44 Airborne
- 3 Land based
- 11 Navies
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
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
Combat Operations
Example: Training
Naval Mission Solutions
CIC / Ops room design

Threats and Missions

Operational requirements for ship in fleet formation

Operational tasks for a ship

CIC organization

Task analysis (task-roles)

Roles – MMI

CIC layout

CIC Components

Multifunction Consoles

Customized Function Consoles

Large Screen Displays

End user brings experience:
Operational CIC organization

THALES brings knowledge:
• Applications
• Technology
Naval Mission Solutions

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
• 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

### TRAJECTORY
- APAR
- SMART-L
- SMART-S (MKT-1, MK2)
- MWR-100A, DARS, LUEBE, JUPITER,  VARIANT, MRK, SCOUT
- SURFACE-SCOUT
- WM-SERIES (e.g., MK02)
- TPSR, SPAR S
- CATTIREFIX (study)

### NAVIGATION RADARS
- KIF 1057/2007
- SP5 103
- RACAL MARINE BRIDGEMASTER
- ORION
- SCAN HX 2003
- Vision Master
- SPS-89, Sharp Eye
- AJS, ADS-B

### OTHER RADARS
- AWS-4, AWS-5
- AWS-6, AWS-9
- SPS-40
- Sea Giraffe AMB
- TRS 3D
- 111 Mk X/XII (various)

### SONARS
- SCHOLLER, KINGFISHER
- CATHARUS series (study)
- SQS555, SQS 56, 113Q5218
- DRS, 194, ASO 90
- OMS 4110, CTI, IASS

### ANTENNAS
- VITA 11
- VITA 16
- VITA 22 (Fema)
- VITA 42

### DATA LINKS
- LINK 11
- LINK 16
- LINK 22 (Fema)
- LINK 152
- E7P
- DUPS
- DUPS (study)

### INTELLIGENCE COMM
- NGIN
- FOXON
- GOSAT
- PA System (SOLAS)
- Standard Power Tel

### EXTERNAL COMM
- AIS Transceivers, VHF / UHF / HF / MF / HF
- SATCOM (various)
- Cryptos & Modems
- GMDSS
- MMSIS
- NAVIGATION
- Speeding
- GPS / SatNav
- Inertial Nav. System
- Wind Speed & Dir.

### SURVEILLANCE
- APAR
- SMART-L
- SMART-S (MKT-1, MK2)
- MWR-100A, DARS, LUEBE, JUPITER, VARIANT, MRK, SCOUT
- SURFACE-SCOUT
- WM-SERIES (e.g., MK02)
- TPSR, SPAR S
- CATTIREFIX (study)

### TRUSTED SERVICES
- VERA
- HARMONY
- LOOM 11 MM18
- EXEDRA MM48
- HLR 1 / HLR 2
- HLR 32
- PENGUIN
- GARRA
- RGR 27 MK2/3
- NSM (study)
- L. STARR
- MANQP

### STEMS
- VAM
- SM21 & SM22 & SM3
- NSM 40 / 40 / 40
- FSCM
- ASTER 15 & 40 (study)
- ASDFR
- RAM, RAM HAS
- COTALE
- DARAK I
- UMMHUNTO
- SEAFISH (VI)
- MISFALL / SATRAL
- TETRAL
- VI / SIMBAD
- TMIU
- VI MRA

### VOGUE
- GMLS Mk.13
- GMLS Mk.29
- VCS Mk.40
- VCS Mk.11
- VCS Mk.3
- ABA 11005
- BARAK
- DIWALL
- SPIRIT LEEching
- SAFAR
- FLAR
- RAM MK31

### FIREPROOF
- DS15
- RAIN

### GUNS
- 12.7mm (6"
- 12mm (5"
- 11mm (4.5"
- 30mm
- 16mm G & MK
- 57mm MK5, MK9
- 40mm
- 20mm
- 25mm
- 16mm
- 12.7mm

### GOALKEEPER
- AKB410
- AKB10

### DART
- VULCANO (study)
- AK30 (study)
- AK77 (study)

### VARIOUS SUPPLIERS
- OTO Melara
- Inforos
- OLU Breda
- FMC
- MSA
- Rheinmetall
- Euronor
- OGSF

### LORAN
- NIMES

### LEAD WARNING SYSTEMS
- NISW-110
Complex assets > main risk reduction areas

Cost ratio

Mission System

Platform

Complexity
Thales CSI

CSI capabilities based on a proven CMS

MISSION MANAGEMENT (DATA HANDLING)

SENSORS AND DATA LINK

TACTICOS CMS

WARFIGHTING (HARD-REAL-TIME FIRE CONTROL)

COMMUNICATION

EFFECTORS

NAVIGATION
Naval Mission Solutions

Combat System Integration services

Mission System

Platform

CSI Services

Sensors
CMS
Effectors
Nav
Comms

Mission System
Mission System Solution

Commercial in Confidence
Naval Mission Solutions

Combat System Integration services

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

Program Management
- Program Management Services
- Equipment Supplier Management Services
- Industrial Partnering
- Risk Management
- On-Site Support Management

System / System
- Mission Solution Definition
- System Performance Analysis
- Safety Engineering
- System Integration & Trial Flow, Execution
- Static and Dynamic Performance Execution
- Sea Acceptance Trials Execution
- Live Firing Trials Execution
- Topside Arrangement Solution
- EMI / EMC Solution
- Platform Support Services
- Cabling Support Services
- Training and TOKAT to Navy

System / Platform
- Below Deck Arrangement Solution
- Under Water Arrangement Solution
- Installation Support Services
- Integrated Logistic Support Services
- Land Based Test & Training Site

Logistic / Training
- TOKAT and Engineering to local industry
- Commercial in Confidence
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission System Solution Definition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Performance Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Topside Arrangement Solution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below Deck Arrangement Solution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under Water Arrangement Solution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integrated Logistic Support Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Management Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Supplier Management Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-Site Support Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMI / EMCSolution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platform Support Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabling Support Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation Support Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Integration &amp; Harbour Trials Execution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static and Dynamic Alignment Execution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea Acceptance Trials Execution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live Firing Trials Execution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landbased Test &amp; Training Site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training and T0KAT to Navy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T0KAT and engineering to local industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-Service support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Included
- Recommended
- Optional
- If required
Span of responsibilities

Integrated Mission System (IMS)

Integrated Weapon System (IWS)

Combat System (CS)

Prime Contractor

Integrated Weapon System (IWS)

Integrated Mission System (IMS)

Total ship program

Adaptable Scope

Lead System Integrator (LSI) Adaptable Scope

Prime Contractor

Management & Engineering

Naval Vessel
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
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
Example: Morocco – Thales as CSI towards DSNS

100% Thales equipment

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

THALES NEDERLAND B.V.
November '11
Example: RNLN LPD – Equipment Supplier & CSI consultant

Equipment supplier of:
- VARIANT 2D Surveillance Radar
- CMS Equipment
- IFF
- Goalkeeper CIWS

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

Min
Max

LPD/ATS – Johan de Witt
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
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.
• 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
Naval Mission Solutions

Synthetic Environments for Radar Sensors (system level)

- **Modelling & Simulation**
- **Design**
- **Verification**

**Radar Environment Simulator (RES)**

**Compact Antenna test Range (CATR)**

- **Antenna Measurements:**
  - Active antennas in full power Transmit
  - Antennas with digital beam forming

- **Radar Cross section measurements:**
  - Small objects 0.01 m²
  - Large antenna structures

**Hardware-in-the-loop**
Naval Mission Solutions
Synthetic Environments at Mission System level

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

Requirements capture
Optimal Topside design
Concept development and experimentation
Guaranteed performance
Solution, Trade off

Analysis
Typical performance
Acceptance criteria

Auto Testing
Regression
Agile working

Analysis
Dynamic
Alignment
Logging
Replay

Acceptance execution:
Live Firings
Logging
Replay

Scalable Training
Mission Preparation & Execution
Real time monitoring
Logging, Replay
Analysis, Debriefing
Upkeep

ColNav Project Team
In all Phases: Interactive participation - Transparency - control - adaptions

SE: Modelling and Simulation in SYPAT Architecture
Distributed interactive network - Closed loop

Topside Design
New Models
Scenario’s

Interactive Ship Optimization

56
Naval Mission Solutions
Test Automation and Training Framework

Modelling and Simulation – SYPAT Architecture

Colombian Navy Training Centre

Rational Function Testing

VR-Forces

NetCentric Training

Scenario’s
Results
Start/stop

System # 1

HLA

Sim

AIS
CCTV Cameras
LINKY MK2 Datalink
Surveillance radar SMART-S
Navigation radar
MIRADOR EO FCS 2x
STING-EO Mk2 FC RADAR
TDS 2x
ECM Scorpion
R-ESM Vigille

SW gen

Models
Scenario’s, resources
New models/doctrines

Code

Auto testing; production – modifications all levels incl. operator actions

Operator HMI

TORPEDO
SONAR
VL MICA 16 x
SKWS DLS
76MM OSRG 2x
EXOCET SSM
OSD sensors

CIW server
Heath Monitoring
GSS

Commercial in Confidence

# 2
# 3
# n

59
Naval Mission Solutions

LCF/F124 CS SM2 Integration

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

F124 Frigate SACHSEN fires a SM 2
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?
Muchas Gracias