

Rapid Prototyping & Validation of Human Factors in a Model Based Naval Systems Engineering Application

Speaker: Daniele Frisoni



Agenda

- Definitions
- Designing for Usability
- Human Factors in Model Based System Engineering
- HCI Fast Prototyping – ModVIS experience
- Benefits
- Conclusions



➤ **Definitions**

➤ **Designing for Usability**

➤ **Human Factors in Model Based System Engineering**

➤ **HCI Fast Prototyping – ModVIS experience**

➤ **Benefits**

➤ **Conclusions**



Definitions

- **Combat System (C/S)**
 - System that performs combat mission on a naval military unit, employing an integrated suite of sensors, weapons, and C4I capabilities;
- **Human Factors (HF)**
 - Set of disciplines that define human constraints in the design of a system;
- **Integrated System Functional Model (ISFM)**
 - Human factors studies' results become part of the System functional Model;
- **HCI Fast Prototyping**
 - From System Model an automatically generated preliminary version of Human Computer Interface panels
- **MODVis**
 - MODel Visualization and Validation : a tool developed by Selex-SI for graphic and textual representation of System Model

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Human Factors Design in Naval Applications



Human Factors based design has seen increasing interest in Naval Applications due to :

- **Reductions** of embarked **Crew** Members.
- **Increasing** number and complexity of **equipments** and **capabilities** for flexible employment of modern multi-role ships.
- The **acceptance** of the whole integrated system is based on **Usability** assessment by the operational Navies members.

Human Computer Interaction Design



- The idea of Human Computer Interaction design is to reduce the distance between systems and the users by designing them to be **usable**.

- Key Questions:
 - User (cognitive and physical capabilities) -- Who ?
 - Technology -- By ?
 - Usability -- How ?
 - User's Tasks -- What ?
 - Context of Use -- Where ?

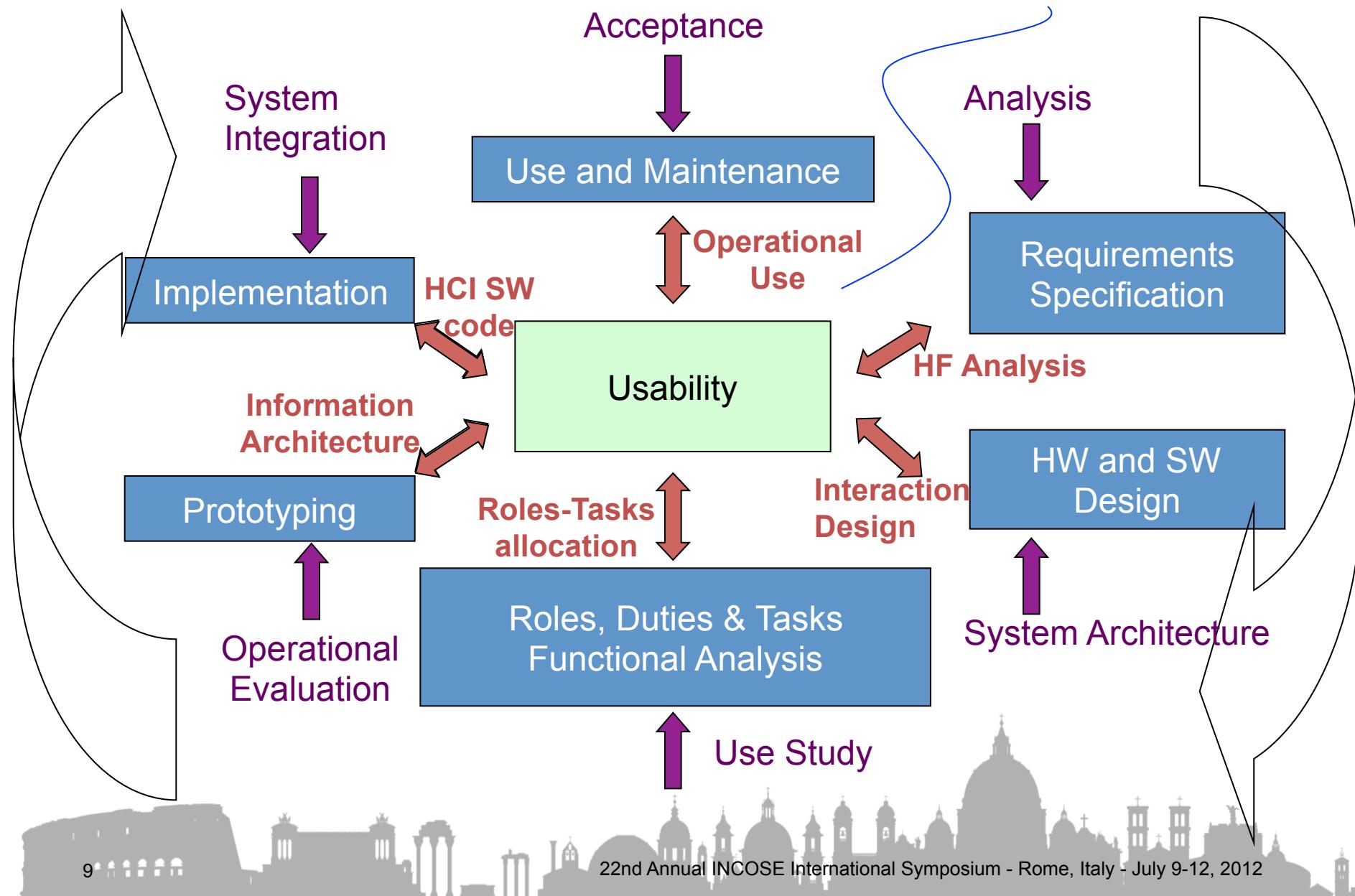
Usability Attributes

Important Usability attributes to be reached in Naval Systems:

- Learnability,
- Efficiency,
- Memorability,
- Robustness,
- Satisfaction.



Usability



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Human Factors in System Engineering Approach

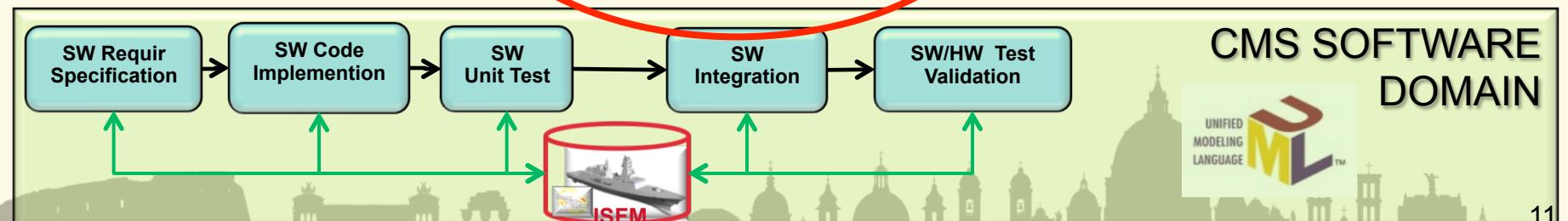
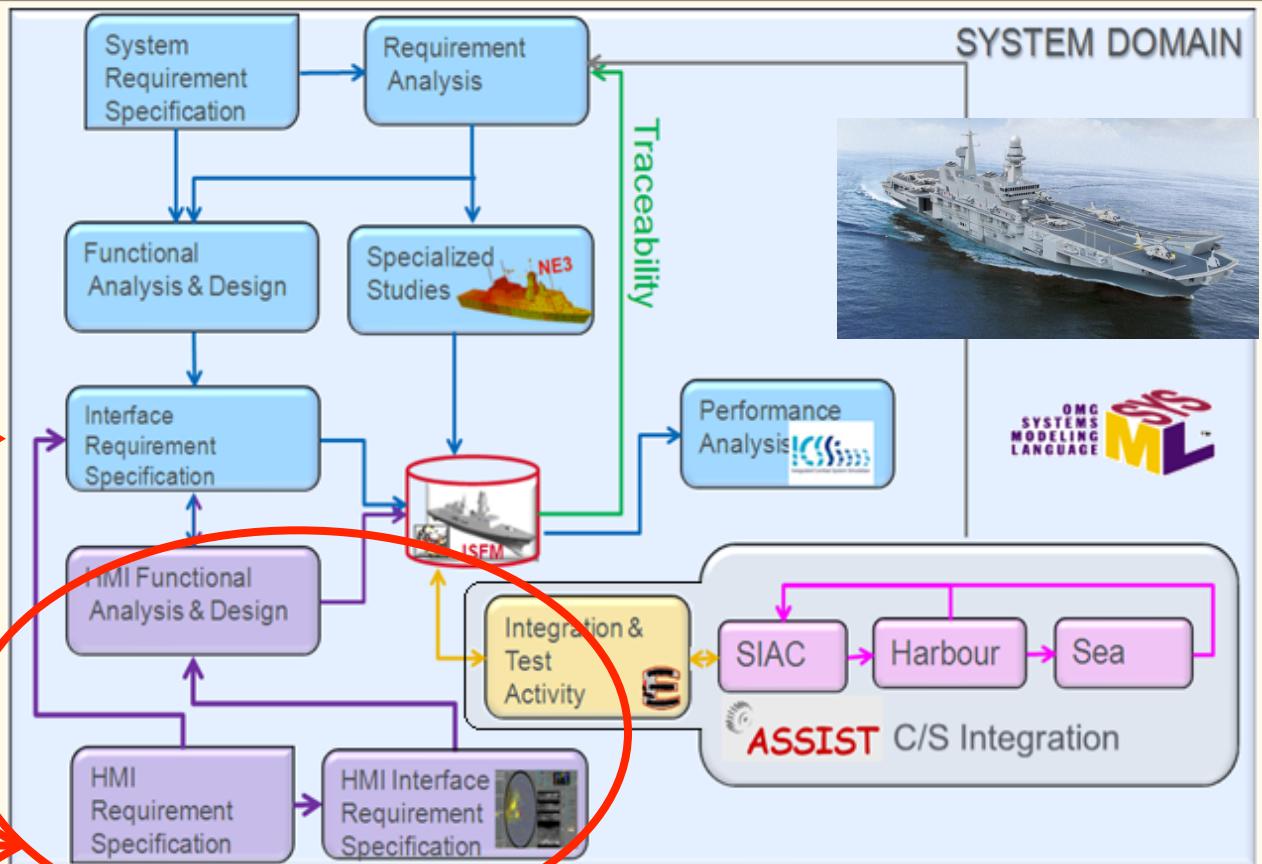
SYSTEM OF SYSTEM DOMAIN



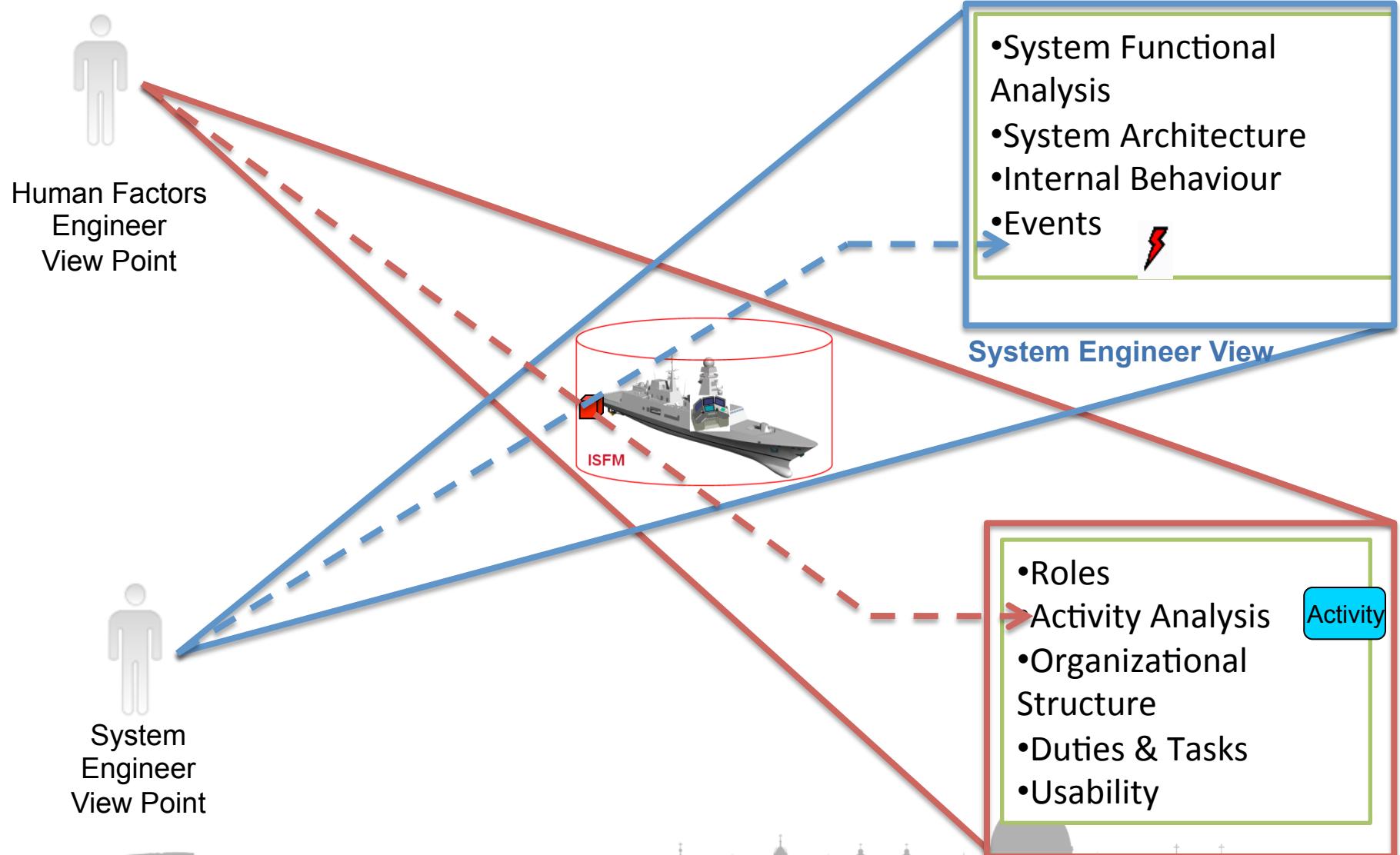
Mission Needs



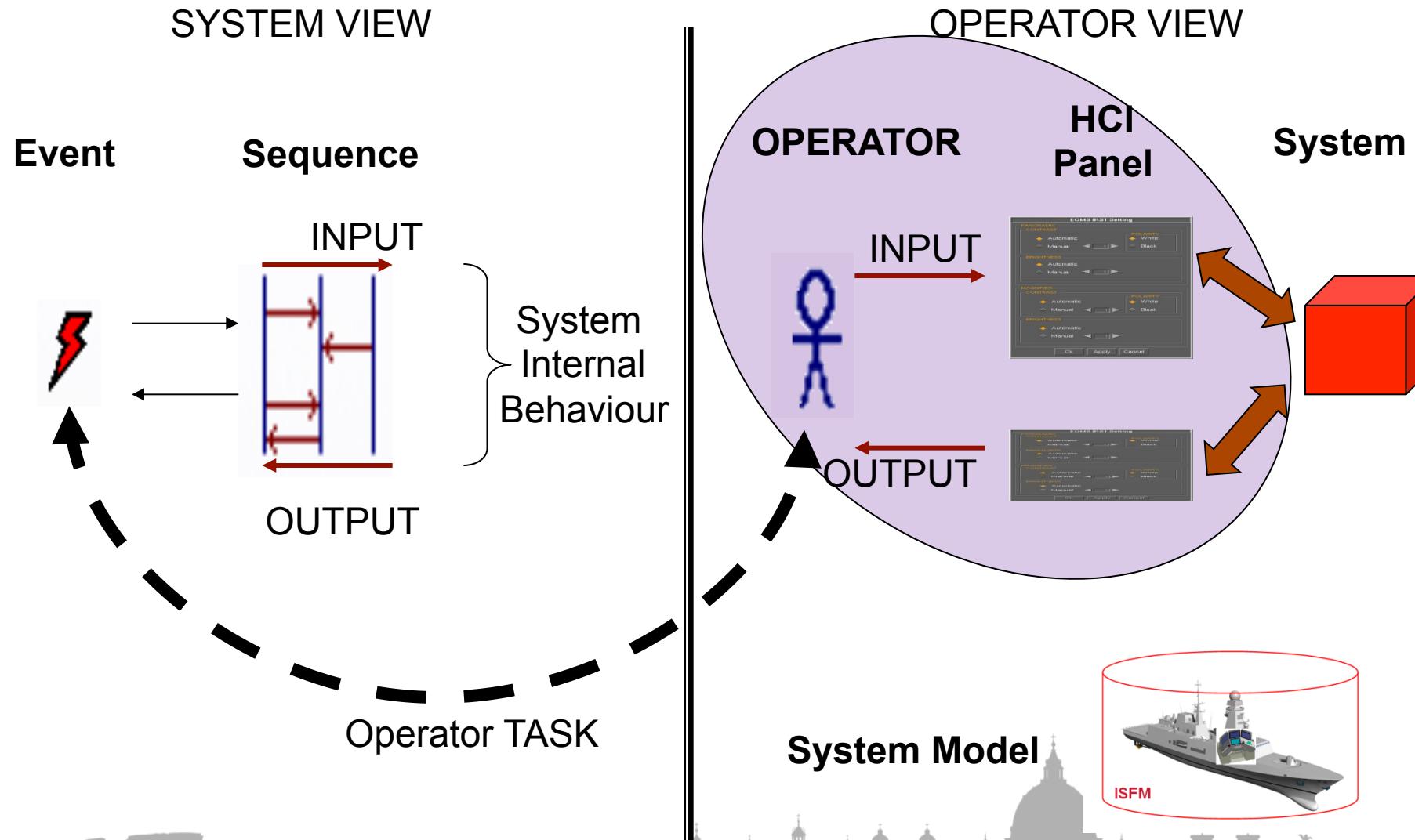
Human Views



Integrated System Functional Model View Point

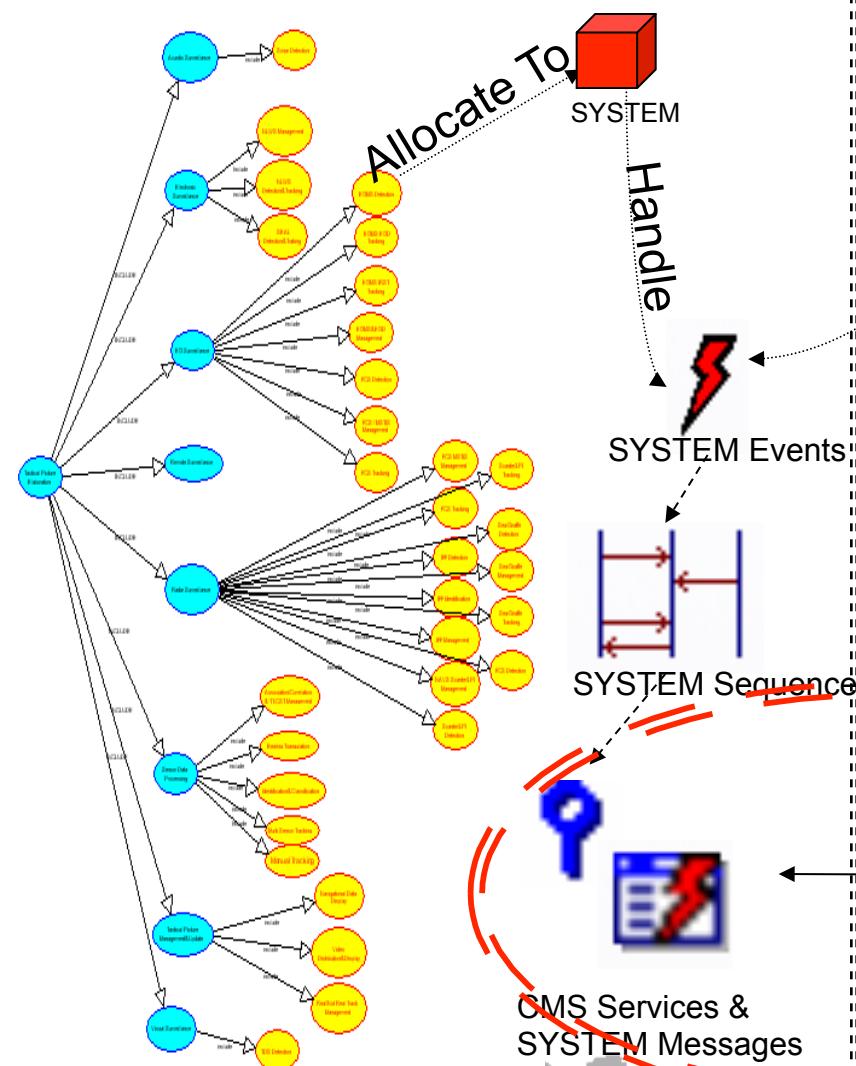


Human Factors and System Views

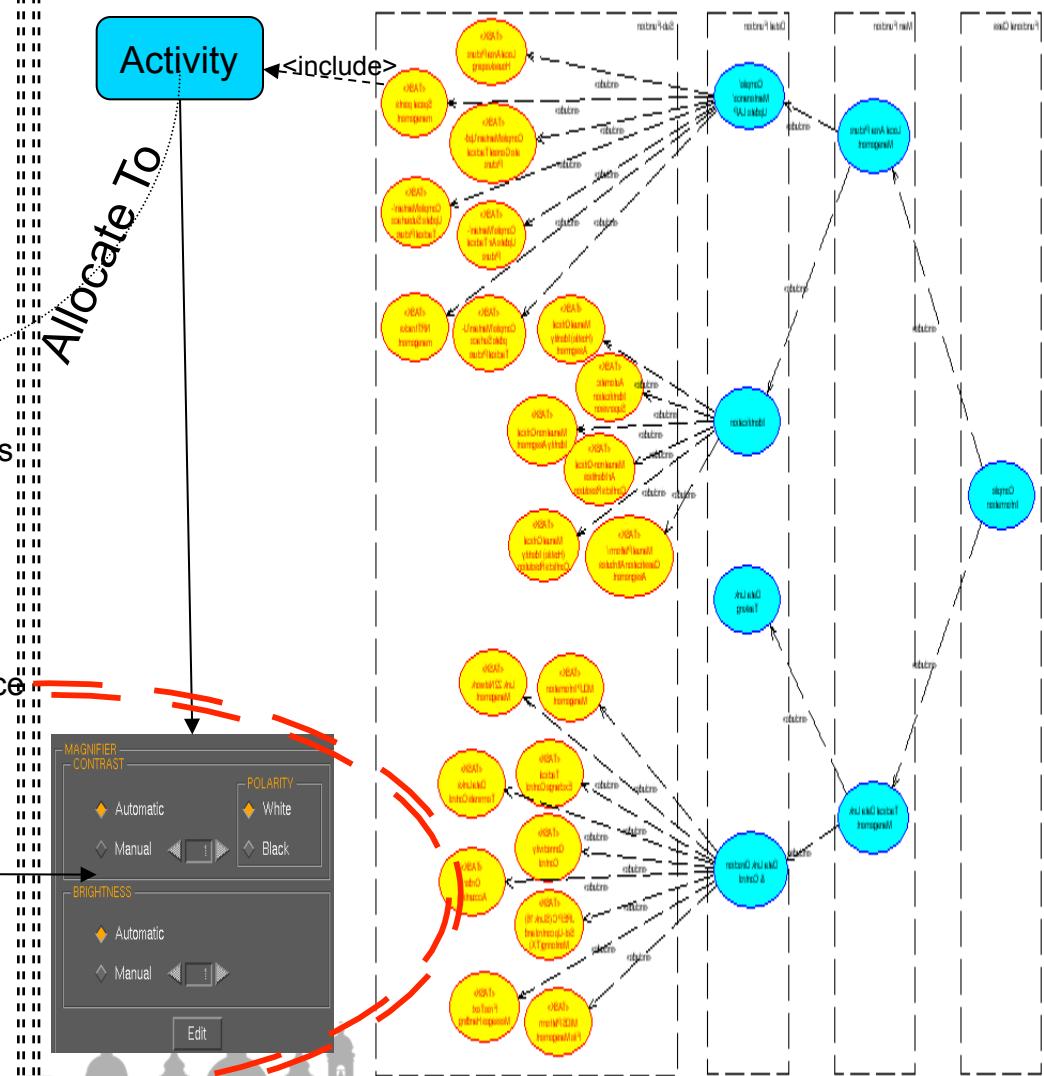


Human Factors Model and System Model

SYSTEM FUNCTION ANALYSIS



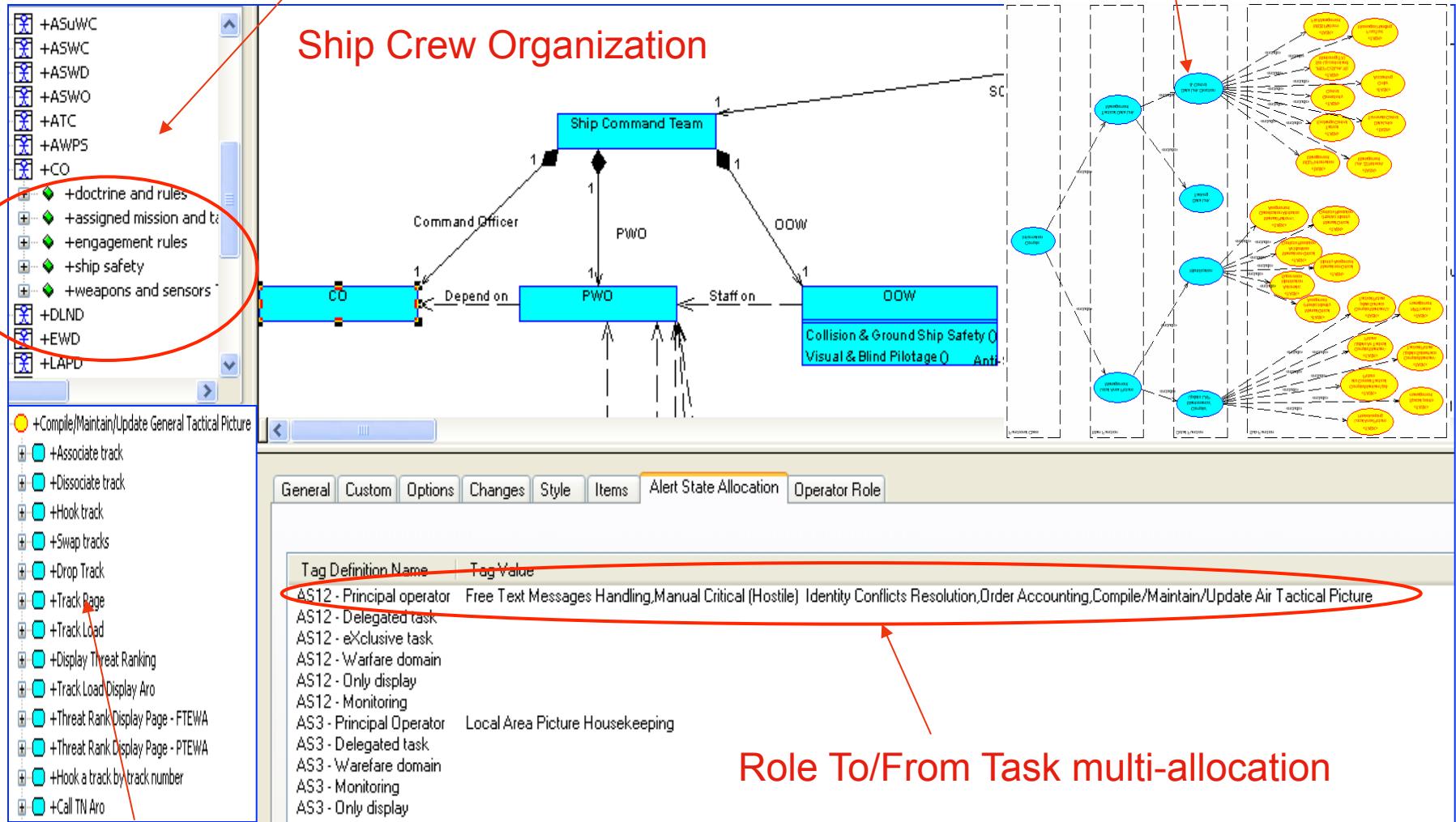
OPERATOR TASK ANALYSIS



Human Factors Modelling Overview

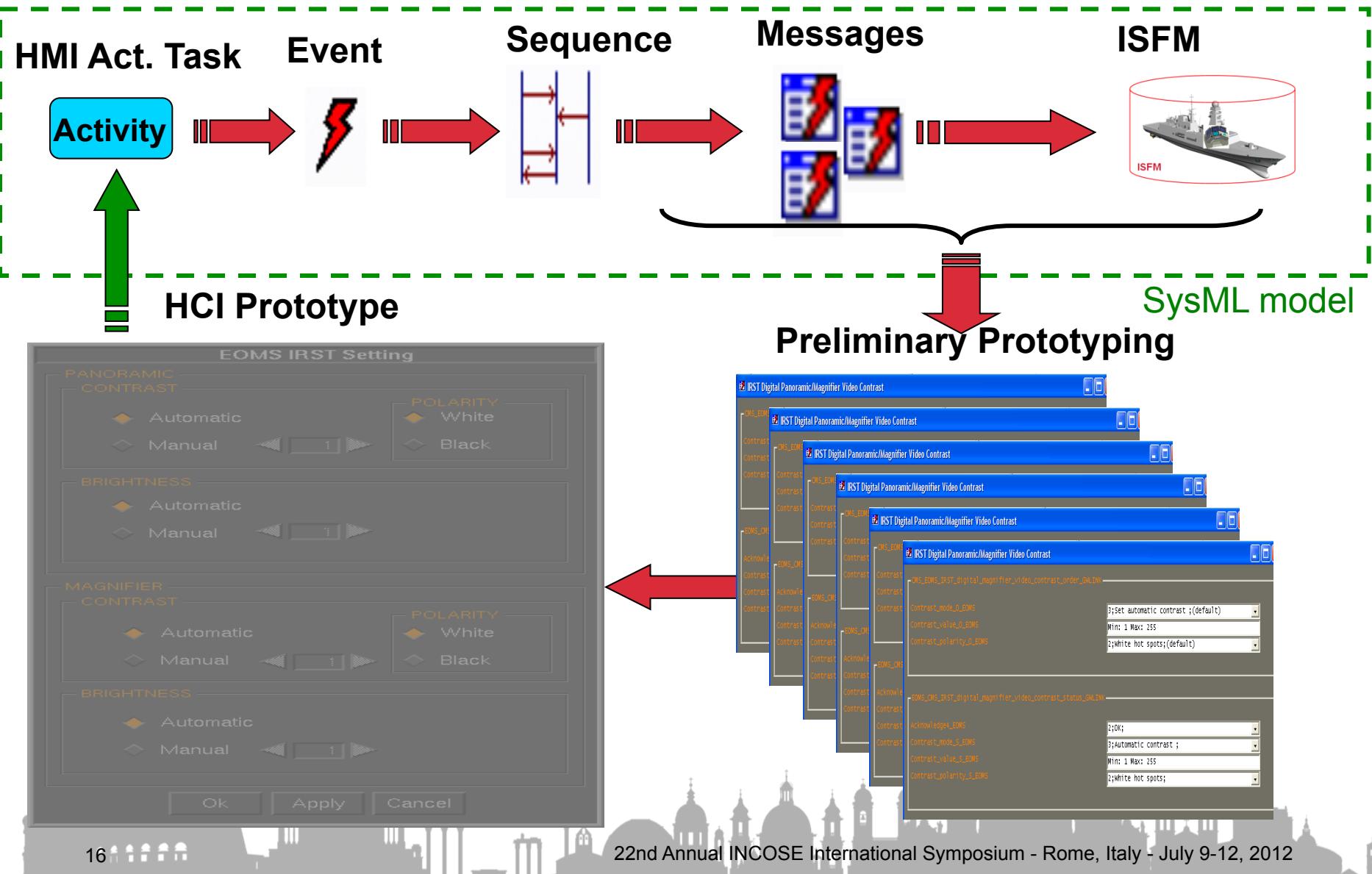
Role Definition and duty

Ship Crew Organization



Task Function Analysis

From SysML Model to HCI Prototype



System Requirement Development Views

System
Development

Human Factor
Development



+CMS-MTP-OPR-3950
NRT Manual initialisation

○ +Real/Not Real Track Management

◆ +Non real time track management

◆ +Facade for Operator Action Management

◆ +CreatePointNRT_ARP

✉ +HCI TPM_CreatePointNRT_ARP_MSG

- header : Message_Header_Type
- oaSubHeader : HCI_Header_Type
- positionXY : T_2DCartesianCoordinates
- arpSignature : T_UnsignedInteger32
- course : T_Float
- speed : T_Float
- altitude : T_Float
- combatSystemTime : T_CSTime
- environment : T_Environment
- identity : T_Identity
- ftn : T_UnsignedInteger32
- subSurfaceClassConfidence : T_SubsurfaceClassifConfidence

◆ +NRT tracks management

◆ +Create NRT Air Point Track

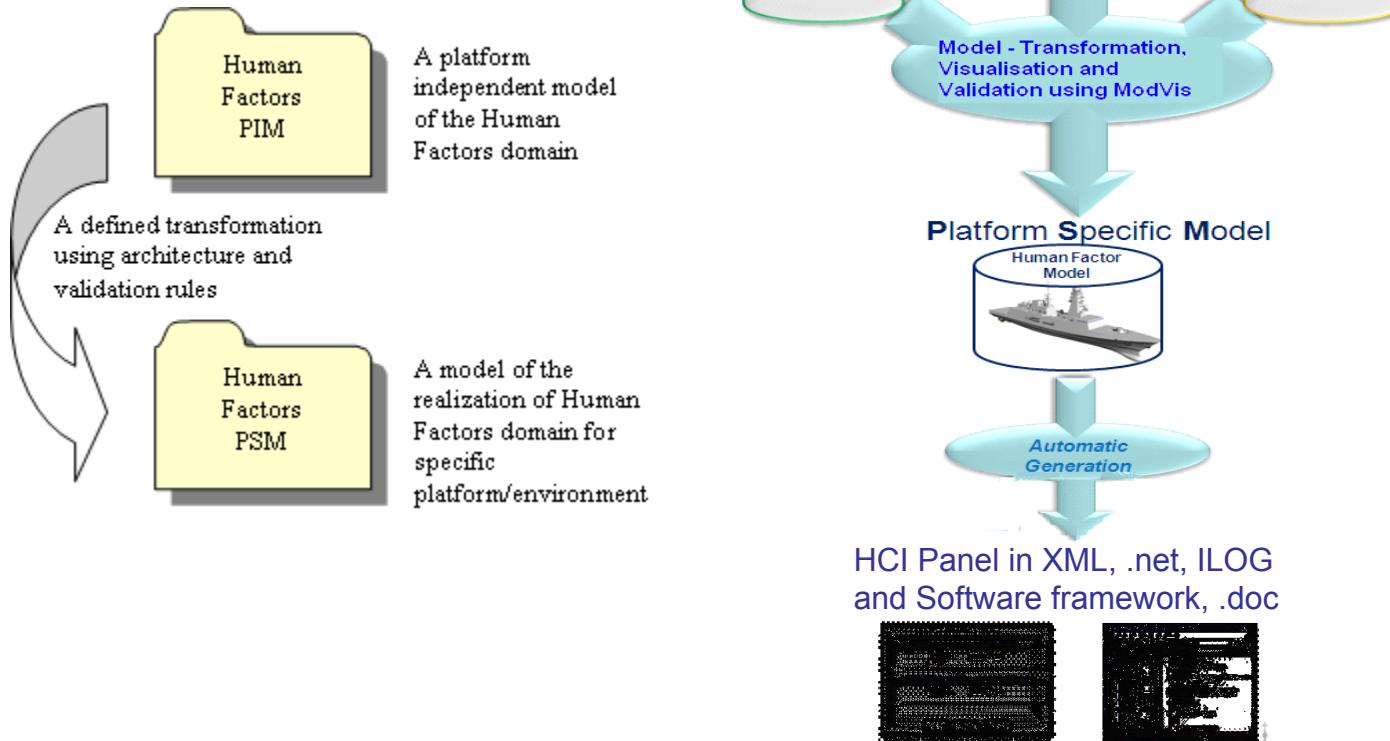
Create NRT Air Point Track

FTN	Course	0.0 deg
Identity	Speed	0.0 kts
Ellipsoid	Altitude	0.0 hft
RU	Time	
◆ OS ◆ Hook	◆ Curr ◆	0 / 0 / 0
◆		0 : 0 : 0 Z
Position		
X/Y	Bearing/Range	Lat/Long
Xpos	0 nm	Memo TB
Ypos	0 nm	
Ok Cancel Apply		

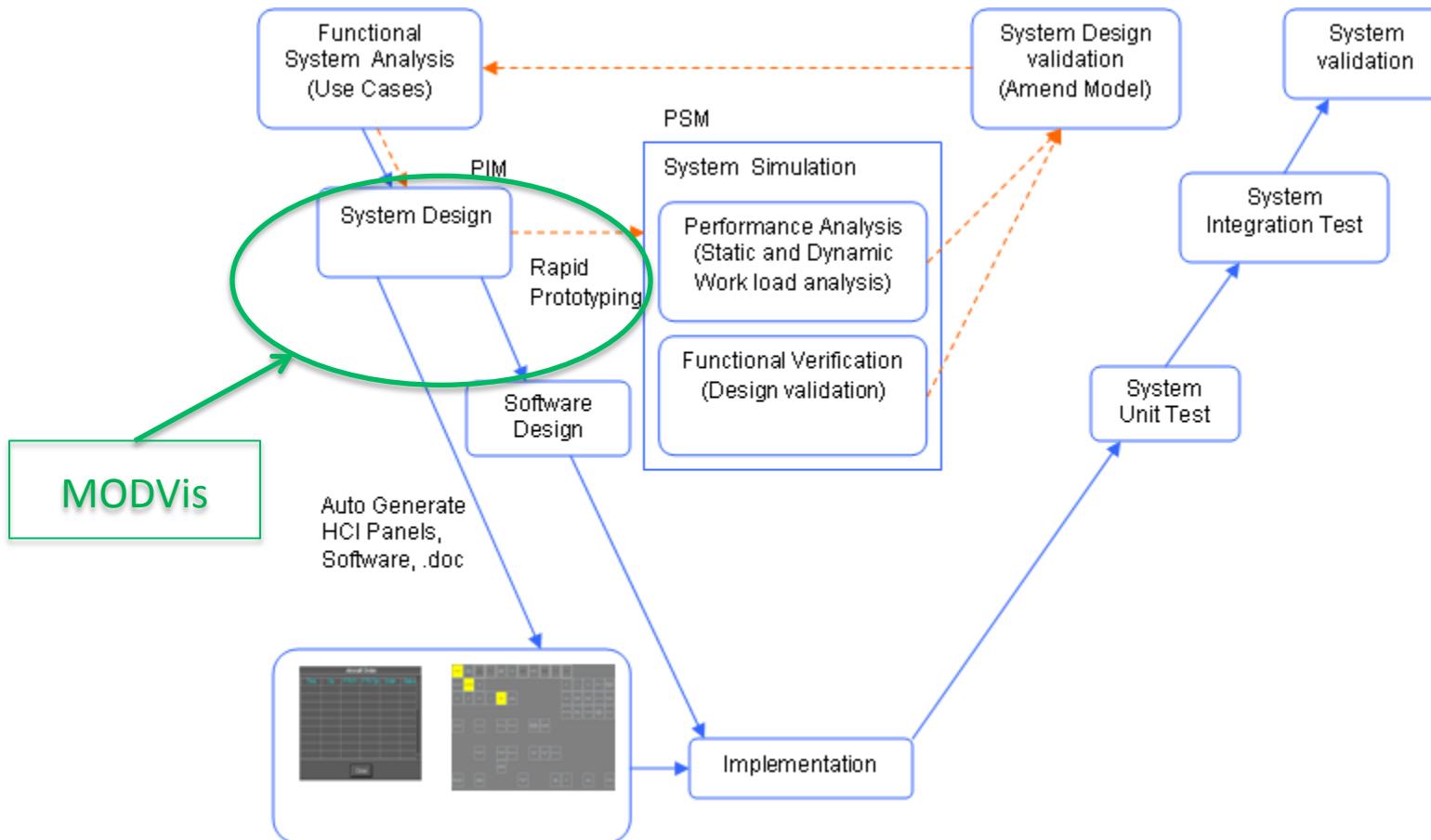
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From PIM to PSM



MODVis in the System Process



MODVis

- ModVis is a .net application which generates software framework and HCI panels.
 - ModVis can generate panels in XML format or in any other graphic format (e.g. IBM-ILOG, QT) providing the relevant libraries.
 - ModVis also provides documents (e.g. .doc files) and the software links to messages.
- ModVis prompts the systems engineer to log in as the desired role or as the operator of interest.
- ModVis queries the model and displays the actors who are part of the use cases. This process is dynamic and hence any addition/ deletion is consequently modified in ModVis.
- Modvis analyses the tasks, activities associated with the chosen operator and adds the appropriate buttons, panels.
- ModVis displays outputs on the associated HCI facility (e.g. Screen, MultiFunctionKeyboards).

MODVis FrameWork



ModVis

Welcome to Operator Role Visualisation and Model Validation (ModVis)

Select the Artisan Project: Human Factor MultiPro

Select the Program: Programme 1

Select the type of view: Console View

LOAD SETTINGS EXIT

TID CONSOLE DISPLAY CONFIGURATION

CONSOLE_WIDTH	15
CONSOLE_HEIGHT	9
CONSOLE_POINT_Y_A	1
CONSOLE_POINT_Y_B	2
CONSOLE_POINT_Y_C	3
FONT TYPE	[Font: Name=Arial, S]
BUTTON DE-ACTIVATE COLOUR	Color [Yellow]
COMMON FEATURES	Common function

SUPPORT SCREEN CONFIGURATION

SCREEN_WIDTH	4
SCREEN_HEIGHT	4
SCREEN PRESENTATION	Image
ILOG FILES LOCATION	\serverartisan\Ta
FONT TYPE	[Font: Name=Aria]
BUTTON DE-ACTIVATE COLOUR	Color [Yellow]
COMMON FEATURES	Common function

GRAPHICS CARD INFO

CONSOLE	\DISPLAY1
SUPPORT SCREEN	\DISPLAY2

CONSOLE SAVE OPTIONS

EXIT CONSOLE	Esc
SAVE AS IMAGE	F1
SAVE AS XML	F2

APPLICATION LOG

ERROR LOG
 EVENT LOG (Admin)

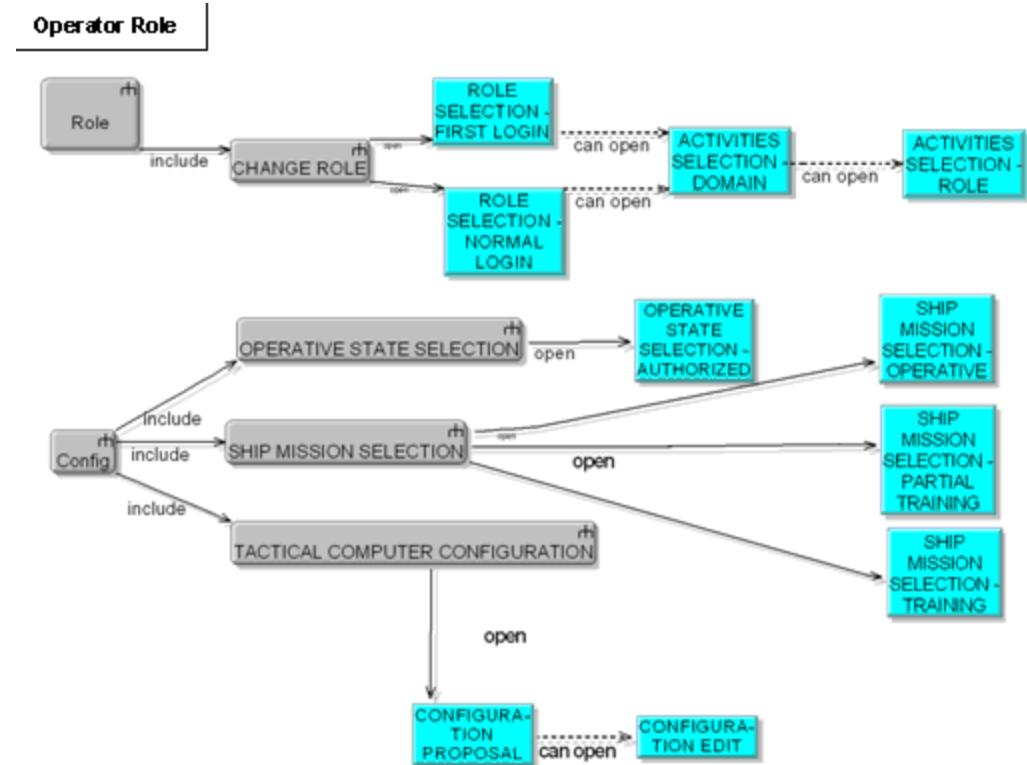
OK CANCEL

MODVis Operator View

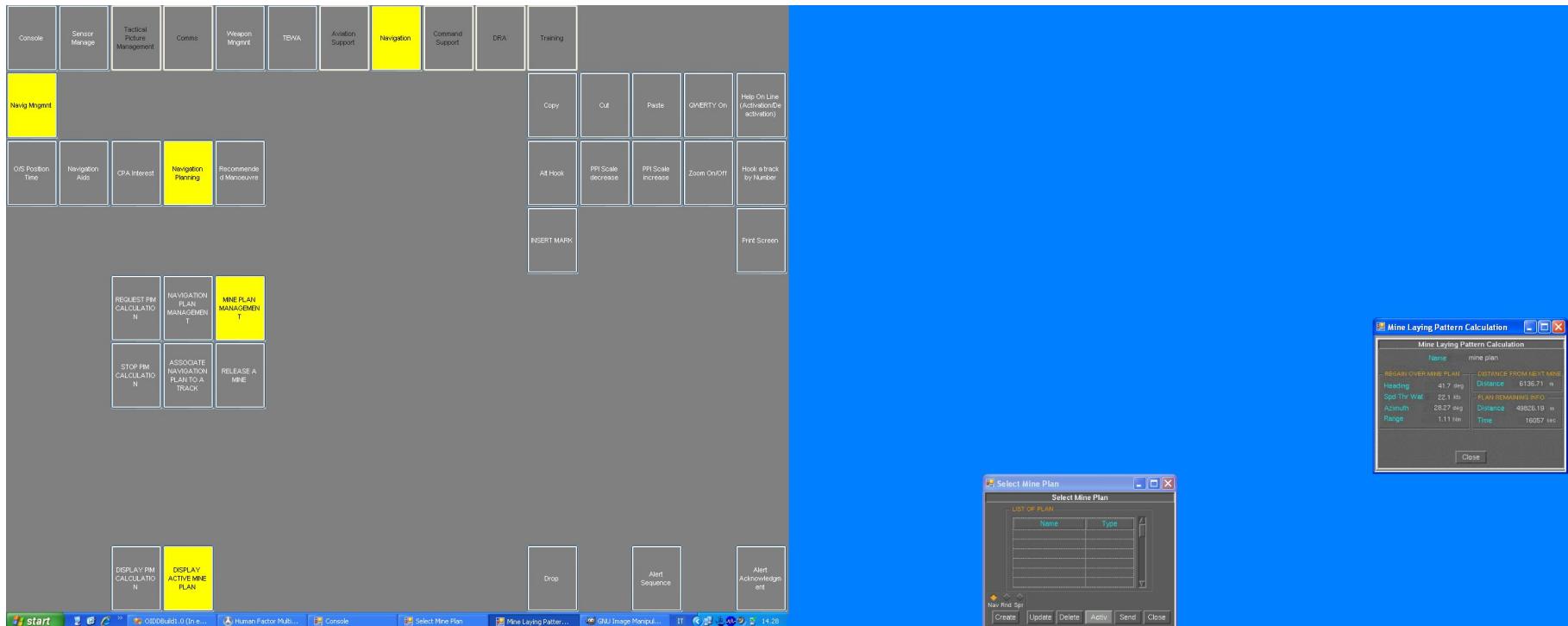
Role Selection

Additional Tactical Picture Supervisor (TPS2) 	Commander Officer 	Electronic Warfare Officer (EWO) 
Exercise Director (ED) 	Fleet Commander (FC) 	Helicopter Controller (HC) 
Interceptor Controller 1/2 (IC1/2) 	Interceptor Controller 2/2 (IC2/2) 	Principal Warfare Officer (PWO) 
Surface to Surface Missile Operator (SSM Op) 	Tactical Picture Supervisor (TPS) 	Warfare Officer 1 (WO1) 
Warfare Officer 2 (WO2) 		

BACK **EXIT**



MODVis Output (Console View)



MODVis Output (Tree View)

Additional Tactical Picture Supervisor (TPS2)

Commander Officer (CO)

Electronic Warfare Officer (EWO)

Exercise Director (ED)

- Console Management
- Training Management
 - TOB

Fleet Commander (FC)

Command Support Management

- Command Support Strategy Management
 - CHANGE SCENARIO DATA
 - CHANGE SHIP DATA (TO CHANGE SENSOR AND WEAPON PARAMETERS)
 - DEFINE KILL BOX
 - DELETE KILL BOX
 - FILTERING
 - INVESTIGATION ON OBJECT
 - INVESTIGATION ON PASSIVE SENSOR
 - KILL BOX 1 AREA DISPLAY
 - KILL BOX 2 AREA DISPLAY
 - KILL BOX AREA DISPLAY/HIDE
 - MISSION PLAN LIST
 - MISSION PREDICTION MANAGEMENT
 - SELECT DISPLAY OF KILL BOX SUB-CELLS
 - SELECT OF MISSION PLAN
 - SELECTION OF THE SCENARIO
 - SENSOR INVESTIGATE DIAGRAM
 - SENSOR INVESTIGATE ORIGIN
 - STATEBOARD MANAGEMENT
- Console Management

Sensor Management

TEWA Management

Helicopter Controller (HC)

Interceptor Controller 1/2 (IC1/2)

Interceptor Controller 2/2 (IC2/2)

Principal Warfare Officer (PWO)

- Surface to Surface Missile Operator (SSM Op)
- Tactical Picture Supervisor (TPS)
- Warfare Officer 1 (WO1)
- Warfare Officer 2 (WO2)

REFRESH LOAD ANALYSIS SAVE BACK EXIT

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Benefits in the Project phases

- **Design Phase:**

- Consistent Check of HCI Data and System Data.
- Balance among information layout display and system information constraints

- **Development Phase:**

- HCI preliminary fast prototyping.
- HCI prototyping with integrated Interface Requirements System.

- **Integration Phase:**

- Follow the Operator actions from the Display Interface to the C/S message exchange and CMS Service calls.

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Conclusions

Human Factors aspects inside the System Model allows to :

- Fast check on system data for consistency.
- Use automatic tools for Fast Prototypes generation (e.g. ModVIS)
 - Support Software Requirements Specifications
 - Receive early feedbacks for usability life-cycle
 - Anticipate HCI SW development
- Automatically generate project documentation
- Verify the functional chains in Integration Phase
- Use of automatic SW test tools
- Exploit a key feature for re-use in similar projects

Questions and Answers



Authors' contacts



Daniele Frisoni
B.U. Sistemi Difesa
Ph. +39.06.4150.4506
Fax +39.06.4150.4259
e-mail: dfrisoni@selex-si.com

Francesco Ciambra
B.U. Sistemi Difesa
Ph. +39.06.4150.3926
Fax +39.06.4150.4259
e-mail: fciambra@selex-si.com

Andrea Tocci
B.U. Sistemi Difesa
Ph. +39.06.4150.5572
Fax +39.06.4150.4259
e-mail: atocci@selex-si.com

Hareesh Gopinathan
SELEX Sistemi Integrati Ltd (UK)
e-mail: hareesh.gopinathan@selex-si-uk.com