29th Annual **INCOSE**
international symposium

Orlando, FL, USA
July 20 - 25, 2019

# Usage of Digital Twin Technologies during System Modeling and Testing in Vessel Traffic Services System Project

# AGENDA

- ➢ **INTRODUCTION HAVELSAN**

- ➢ **VESSEL TRAFFIC SERVICES SYSTEM PROJECT**

  - ➢ **Traffic Management System**

  - ➢ **Sensor System**

  - ➢ **Communication System**

  - ➢ **Security Management System**

- ➢ **MODEL-BASED SYSTEMS ENGINEERING AND DIGITAL TWIN APPROACH**

- ➢ **USAGE OF MBSE AND DIGITAL TWIN IN VTS PROJECT**

  - ➢ **Usage of MBSE in VTS Project**

  - ➢ **Usage of Digital Twin in VTS Project**

# INTRODUCTION HAVELSAN

**HAVELSAN KEY FACTS**

**Command & Control Solutions House of Turkey**

**COMMAND, CONTROL & DEFENSE SYSTEMS**

**A Global Brand in Simulation & Training**
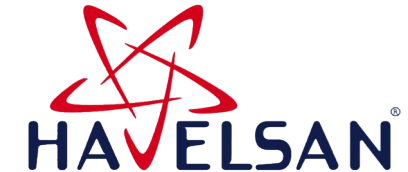
**TRAINING TECHNOLOGIES & SIMULATION SYSTEMS**

**Leading E-Transformation Company of Turkey**
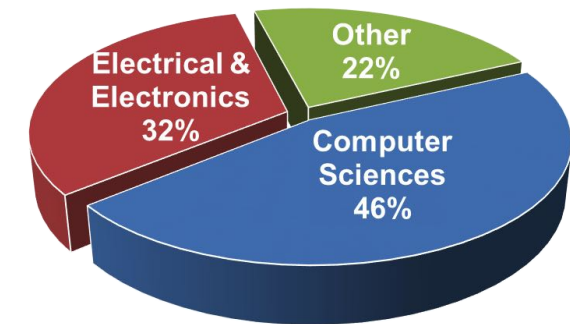
**MANAGEMENT INFORMATION SYSTEMS**

**Center of Excellence in Security Solutions**

**HOMELAND & CYBER SECURITY SOLUTIONS**

**ANKARA**
**İSTANBUL**
**CALIFORNIA**

HAVELSAN

SPECIALITIES

Electrical & Electronics 32%
Other 22%
Computer Sciences 46%

**# Personnel: ~1900**

# INTRODUCTION HAVELSAN

## Core Capabilities – Solutions – Services

➢ **Command & Control Information Systems**

➢ **Combat Management Systems**

➢ **Network Centric Warfare Capabilities**

➢ **Ground Support Segments**

➢ **Intelligence, Surveillance and Recognaissance**

➢ **Systems Engineering and Systems Integration**

➢ **Information Sharing**

**HAVELSAN KEY FACTS**

**TURKISH AIRBORNE EARLY WARNING & CONTROL SYSTEM**
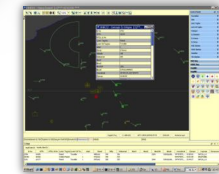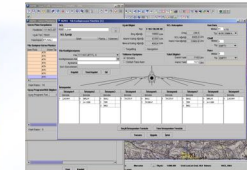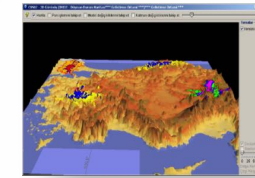
**COMBAT MANAGEMENT INFORMATION SYSTEM**

**Computer Based Training - Partial Simulators Full System Simulators - Distributed Training**

**COASTAL SURVEILLANCE RADAR SYSTEM**

**SHIP MODERNIZATION**

# VESSEL TRAFFIC SERVICES SYSTEM PROJECT

The Vessel Traffic Services System include following subsystems:
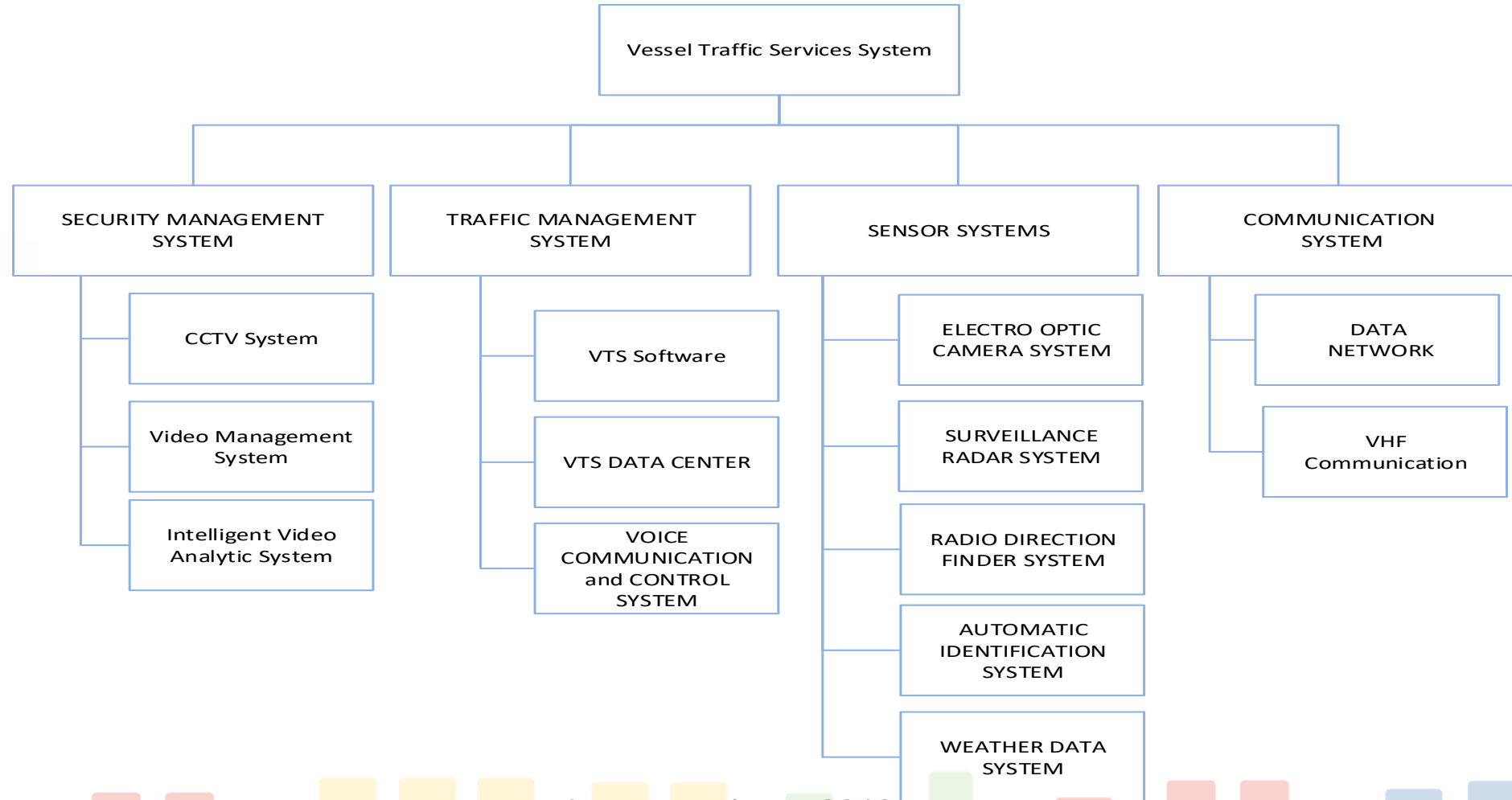
# VESSEL TRAFFIC SERVICES SYSTEM PROJECT

➢ **Traffic Management System**

Vessel traffic services deal with managing ship traffic on marine routes, suggesting best routes for a vessel and ensuring no two vessels run into each other on congested routes. The heart of the system is the VTS software and the underlying data center infrastructure.

➢ **Communication Systems**

All system equipment including sensors, operator consoles, communication equipment, recording, databases etc. are fully networked to provide the required functionality. The system network is dedicated for the VTS to avoid disturbance and is dimensioned with a capacity of at least twice the operational capacity for normal operation of the entire system.

# VESSEL TRAFFIC SERVICES SYSTEM PROJECT

➢ **Security Management System**

▪ Closed Circuit Television System (CCTV)

For the VTS centers, remote sites and towers CCTV system is installed to prevent theft and solving crime. All cameras can be controlled from the VTS centers security operators. In the placement of cameras avoiding of blind spots areas is strived as guideline.

▪ Video Management System (VMS)

Videos and Images from CCTV cameras and Surveillance EOS system is stored in a video surveillance system. Adding of new camera to the system can be done without additional configuration, export of specific event or timeline is supported.
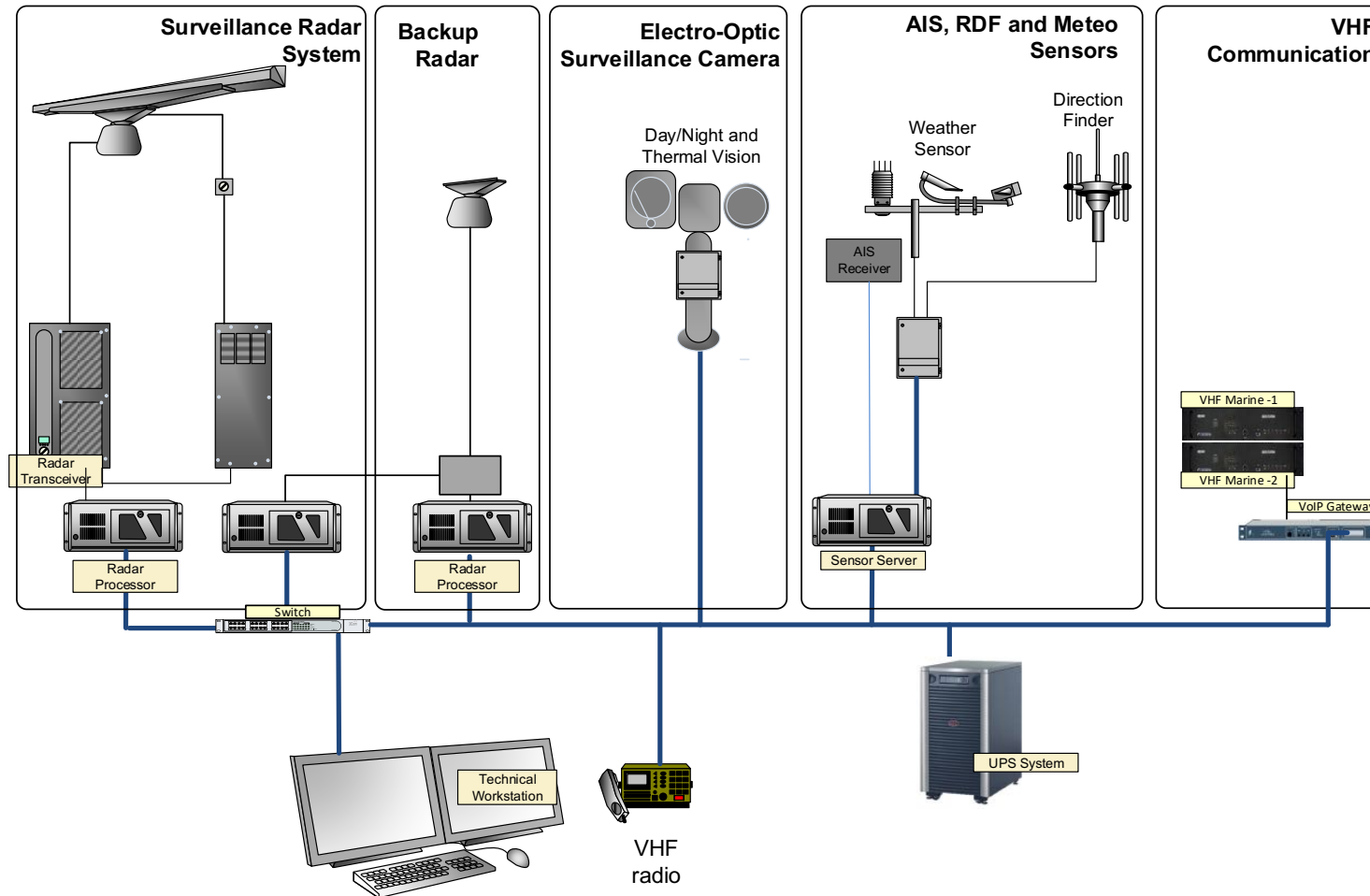
▪ Intelligent Video Analytics System (IVAS)

Intelligent Analytics such as entry into area, face detection, loitering detection, abandoned object detection functions are integrated into the system, which generate an alert to the control operator.

# VESSEL TRAFFIC SERVICES SYSTEM PROJECT

➢ **The Sensor Systems** include following elements:

# MODEL-BASED SYSTEMS ENGINEERING AND DIGITAL TWIN APPROACH

- Design/Development/Implementation of Vessel Traffic Services Project

- Complexity of internal and external interfaces with long list of software and hardware components

- MBSE Tools usage helps system designer to overlook functionality and growth

- Reducement of Design and Testing Time
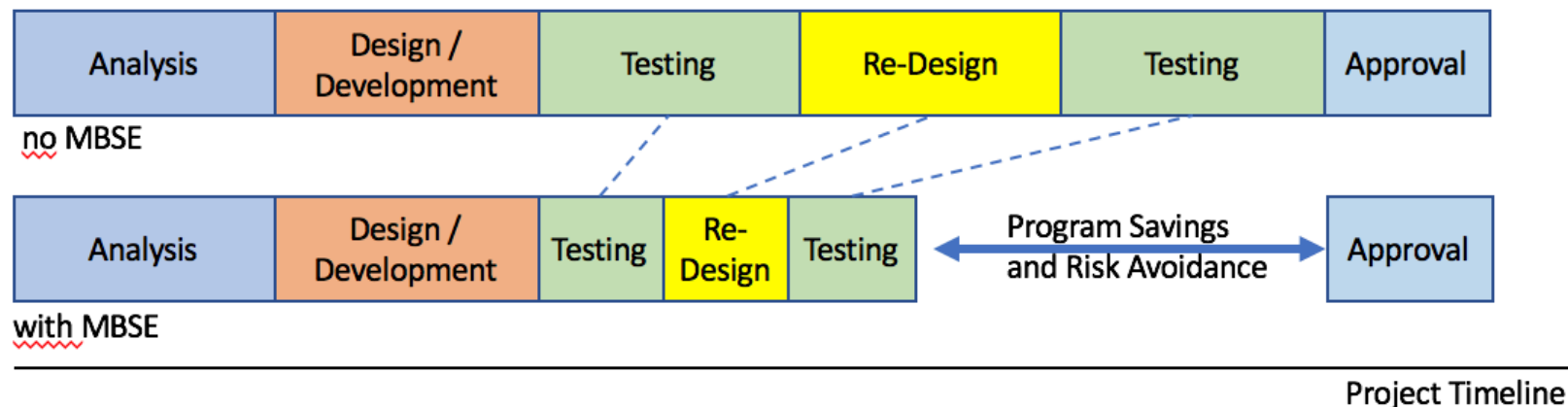
# MODEL-BASED SYSTEMS ENGINEERING AND DIGITAL TWIN APPROACH

Digital twins are offering:

- Visualizing products in use, in real-time

- Building a digital thread, connecting disparate systems and promoting traceability

- Refining assumptions
  with predictive analytics

- Managing complexities
  and linkage within systems-of-systems
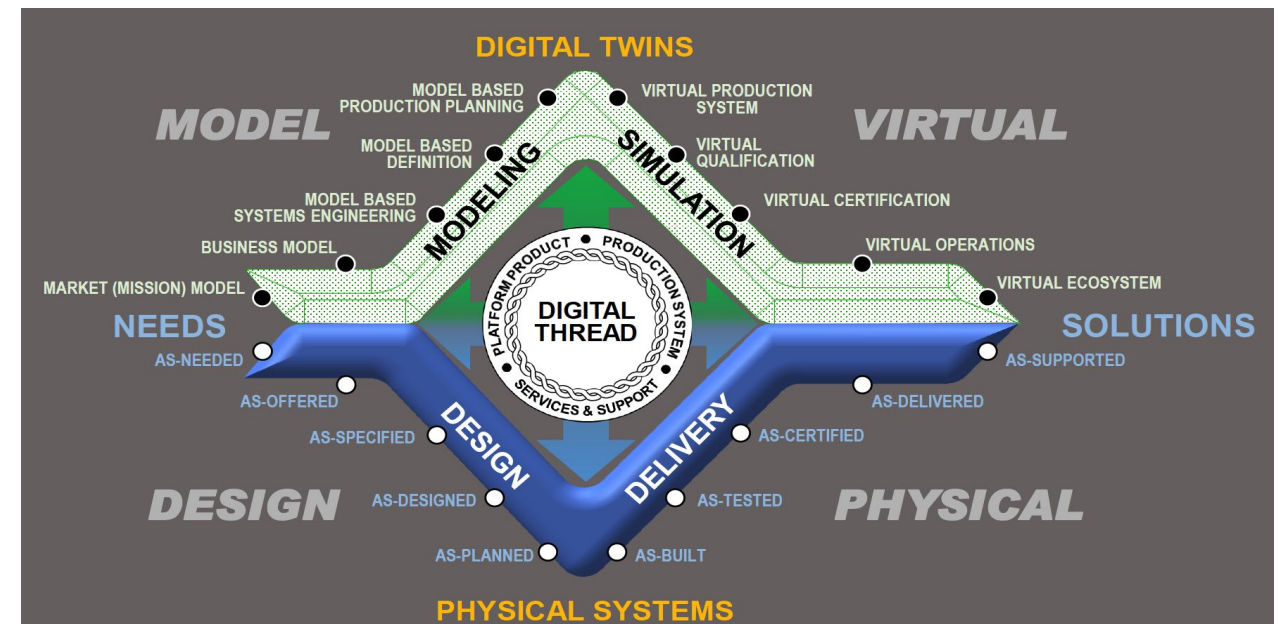


Daniel Seal, Global Product Data Interoperatibility Summit 2018

# USAGE OF MBSE AND DIGITAL TWIN IN VTS PROJECT

Operational scenarios are implemented with the SysML tool and interface descriptions developed. Specific long lead items and products with key performance which are classified as critical for the customer and system operation are setup/used as digital twin.
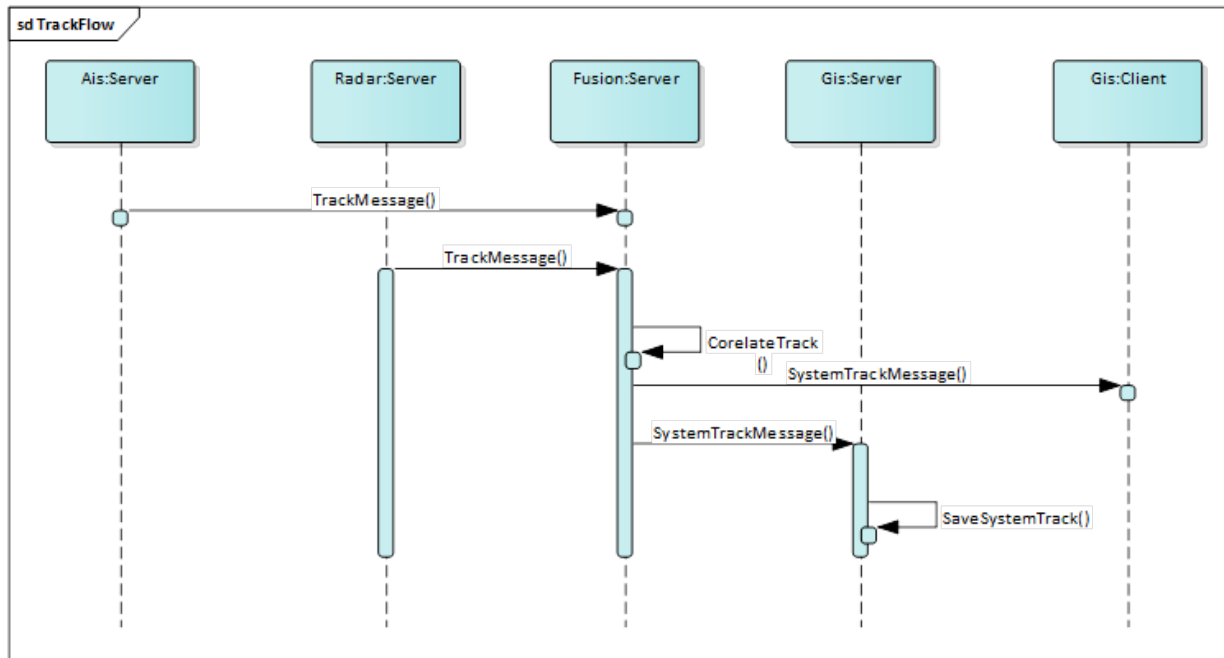


Operation scenarios has been modelled with a SysML tool to guide the developer and systems engineers for the systems interface and process management. A simple example of radar control mechanism (track fusion) is shown in Figure

# USAGE OF MBSE AND DIGITAL TWIN IN VTS PROJECT

Two main reasons lead to the usage of digital twins.
- minimize complexity in system behavior/design,
- made testing as soon as possible to avoid changes on system architecture and selected devices.

The intention was that all tests are performed on desk before installation in control centers and towers starts. Only those, which are necessary after whole installation are performed, should be done afterwards, due to improvements are costly in this phase.

Selection of sub-systems/equipments as digital twin in accordance to
- Availability of historical data from these products in previous projects
- Products with long lead items
- System critical products with relevant key performance characteristics

# USAGE OF MBSE AND DIGITAL TWIN IN VTS PROJECT

## Usage of Digital Twin in VTS Project

Identification & Tracking Center

PROCESSING DATA & VIDEO

COMMANDS

Data & Voice Equipment

DATA & VIDEO

Radar ;
Waves are detected as a track,
Electro-magnetic interferences,
Low&high operational temperature,
Radar Reflection

EOS;
Wind can affect to mast,
Fog can affect low visibility

# USAGE OF MBSE AND DIGITAL TWIN IN VTS PROJECT

**Usage of Digital Twin in VTS Project**

VTS project includes a system of system model,

which integrates several location points (tower in the coastal area).

The VTS software has a data fusion functionality for position calculation, strait precision is very critical. The AIS and radar data are fused together to get the closest real position of ship, some track information must be visualized inside the system.

Fusion process can be done two different ways

- Distributed (Location based) fusion

- Centered (Sensor based) fusion

    Both ways compared with usage of digital twins , with the result that centered fusion will be more effective.

# USAGE OF MBSE AND DIGITAL TWIN IN VTS PROJECT

In case of an IT based failure appears the challenging issue is how to handle the data synchronization between center and the application on the sites. At this point, usage of digital twins and network design which includes the router configurations are simulated as software application.



Network Failsafe Scenario
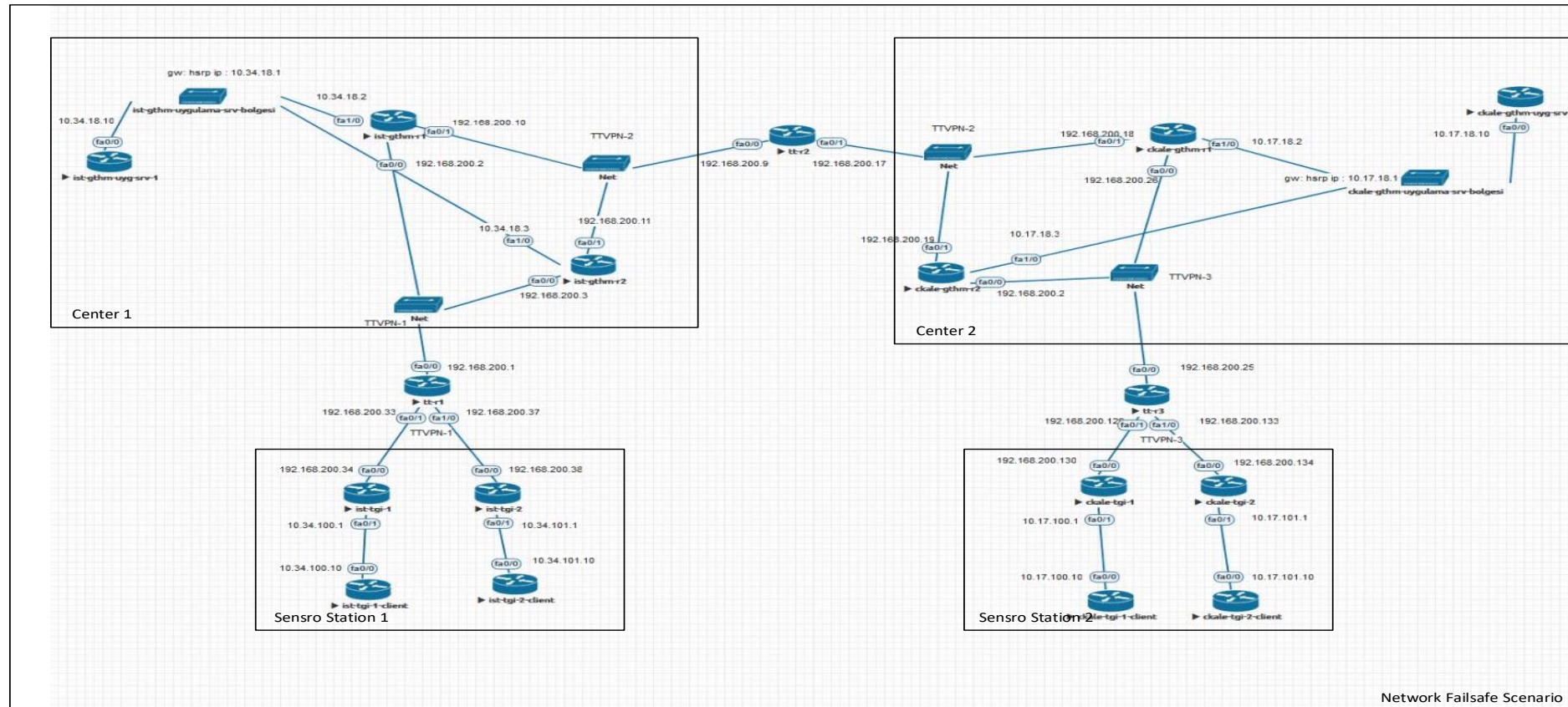
# CONCLUSION

- This modelling and simulation techniques (MBSE &Digital Twin) improves system performance, reduce installation/integration time and solve problem before occurring (evaluate as a risk mitigation).

- Workings with the models will improve all stakeholders reading, understanding and change management.

- The systems models and simulation models are valuable datas. Therefore reusability of the models are also a hot topic.

# THANKS FOR LISTENING !
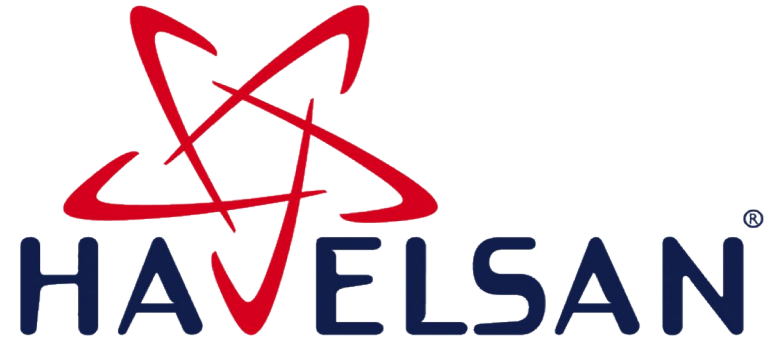
Serdar ÜZÜMCÜ,CSEP/PMP/MBA/Dipl.Ing.
System Engineering Group Lead
suzumcu@havelsan.com.tr

Abdullah Aykut MERT
Senior System Engineer
aamert@havelsan.com.tr

Fatih ATAY
Senior System Engineer
fatay@havelsan.com.tr

29th Annual **INCOSE**
international symposium

Orlando, FL, USA
July 20 - 25, 2019

www.incose.org/symp2019