A mixed-initiative advisory system for threat evaluation

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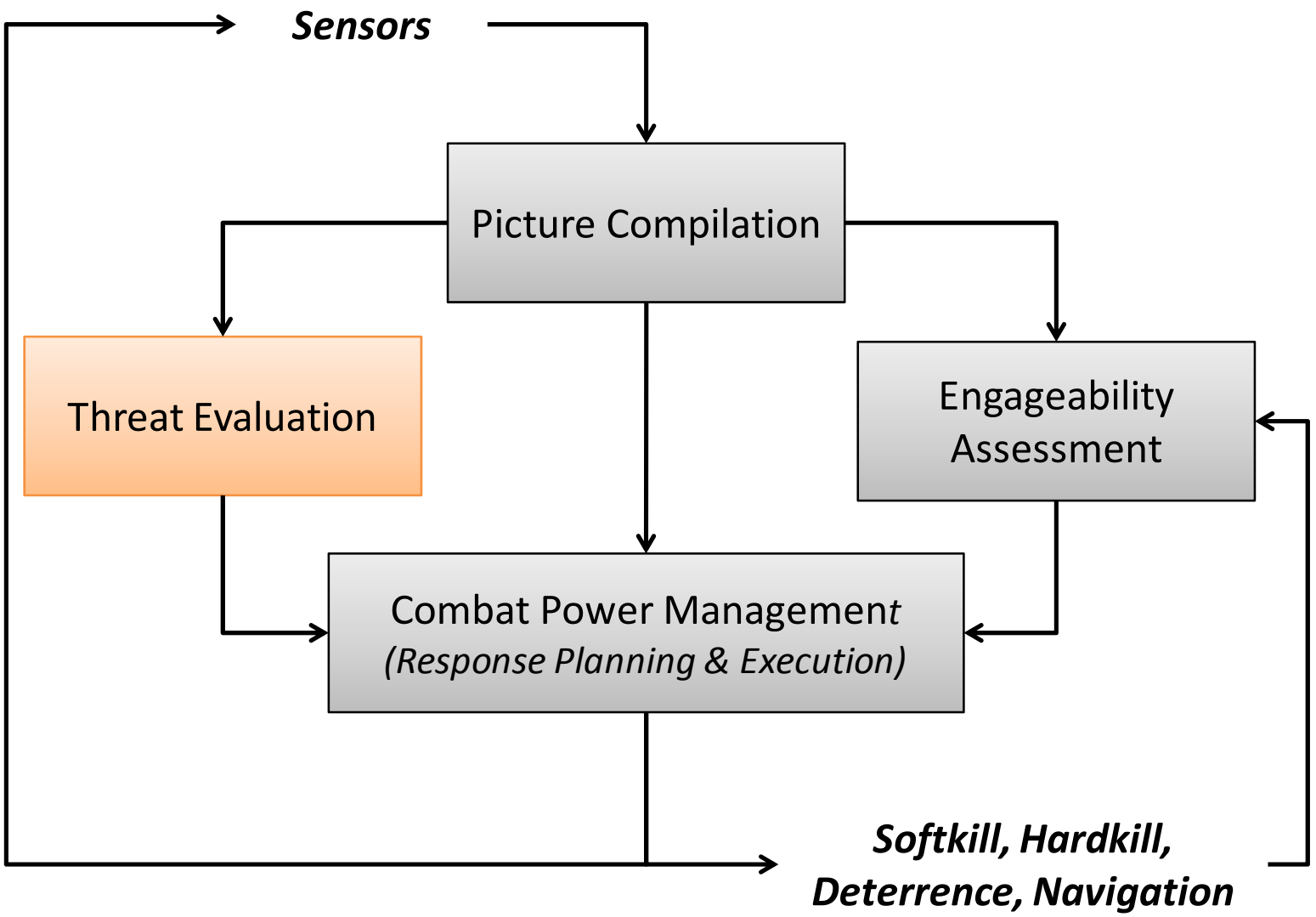
Threat Evaluation in C2

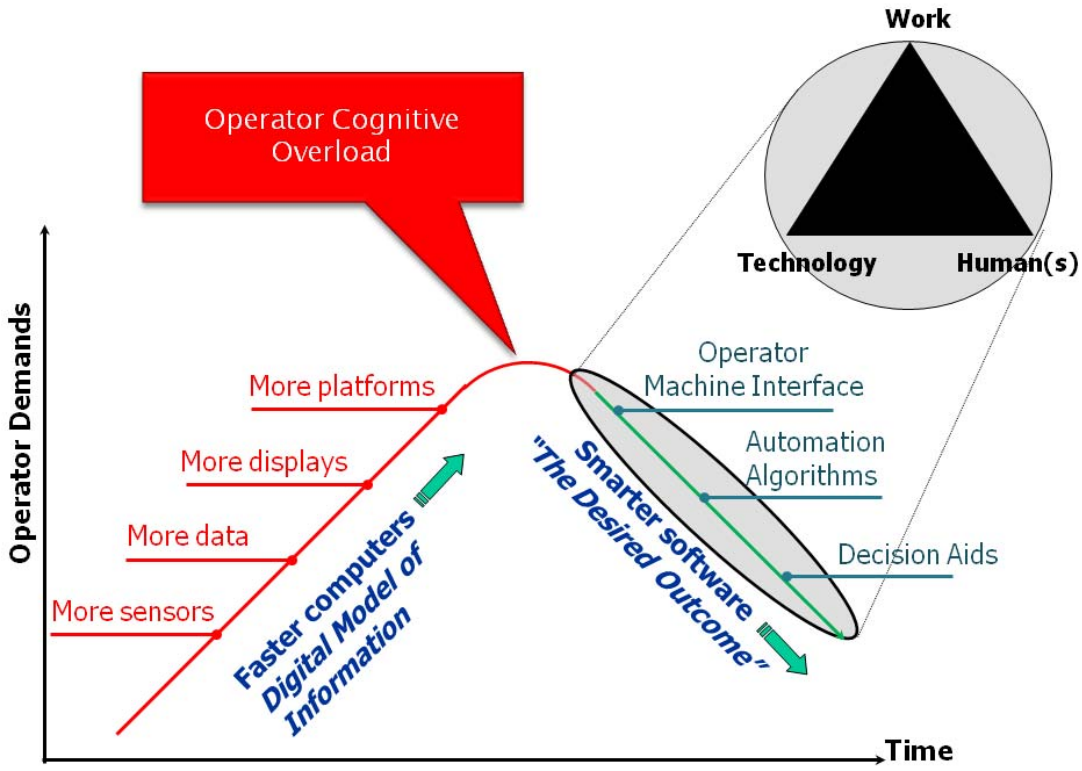


Threat Evaluation Process

- Threat evaluation is an ongoing process that determines:
  - If an entity intends to harm (intent)
  - If an entity has sufficient resources to harm (capability)
  - If the environment provides the preconditions for the entity's plan to succeed (opportunity)
- Classifies threats into categories
  - E.g., high, medium and low
- Ranks threats within each category

Cognitive Demands

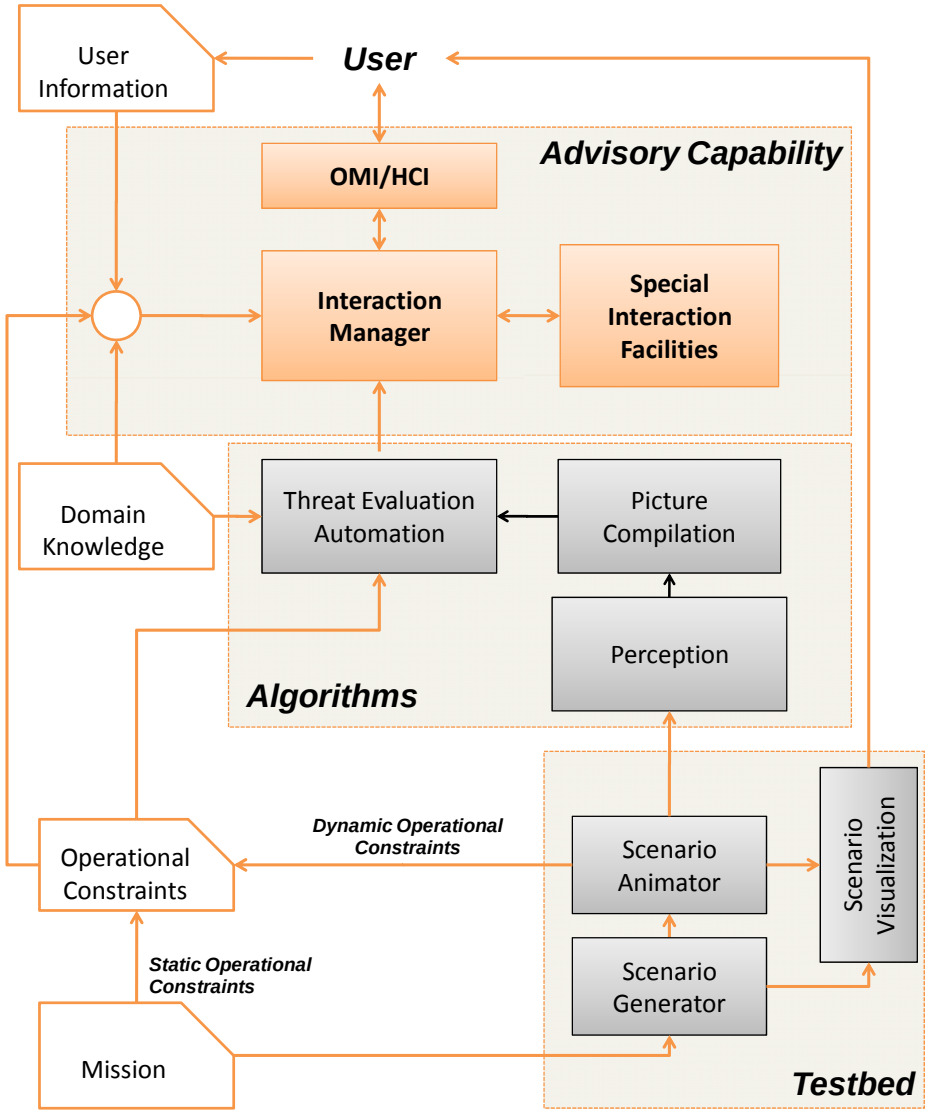
- Threat Evaluation is a highly demanding cognitive task for human operators
  - Huge amount of data to be analysed
  - Level of uncertainty characterizing the data
  - Short time available
  - Various errors can be made



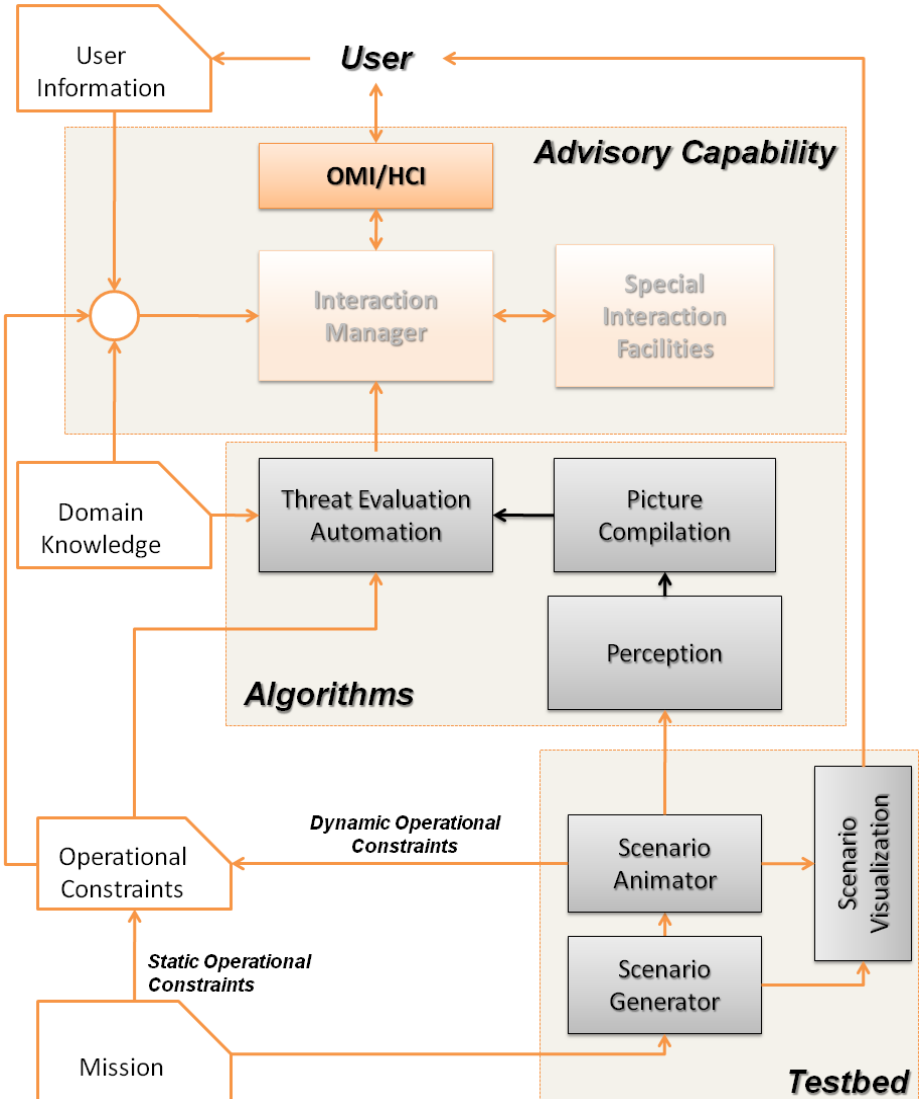
TESS Overview

- Threat Evaluation Support System (TESS) provides decision support
  - Supports for situation awareness
    - Displays useful contextual information
    - Draws operator's attention to neglected information
  - Reduces operator workload
    - Automate significant aspects of threat evaluation
  - The operator remains in charge
    - Can override or keep automated threat evaluations
  - Builds operator trust in decision support recommendations
    - Provides explanations and arguments

TESS Architecture



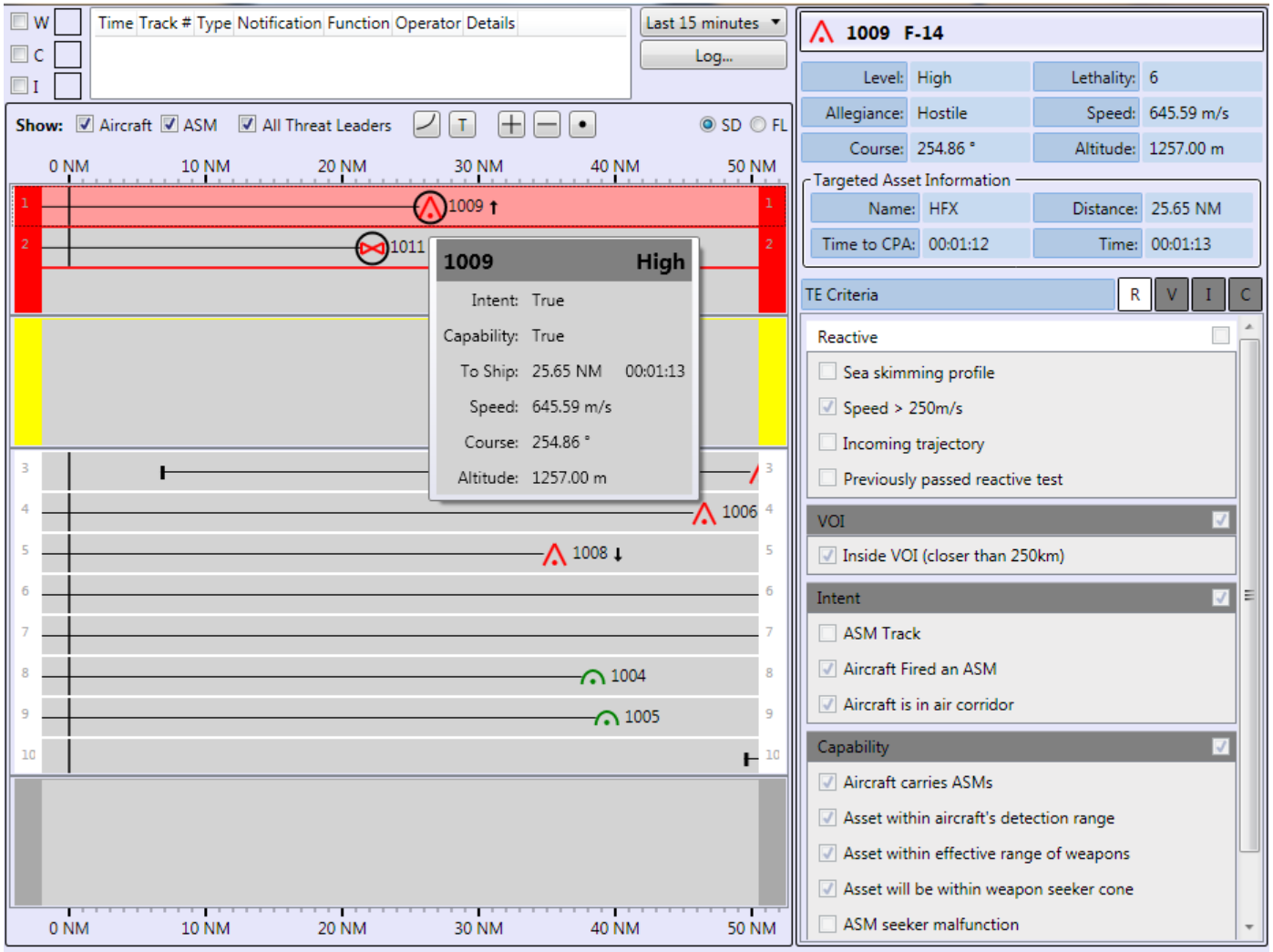
Operator-Machine Interface (OMI)



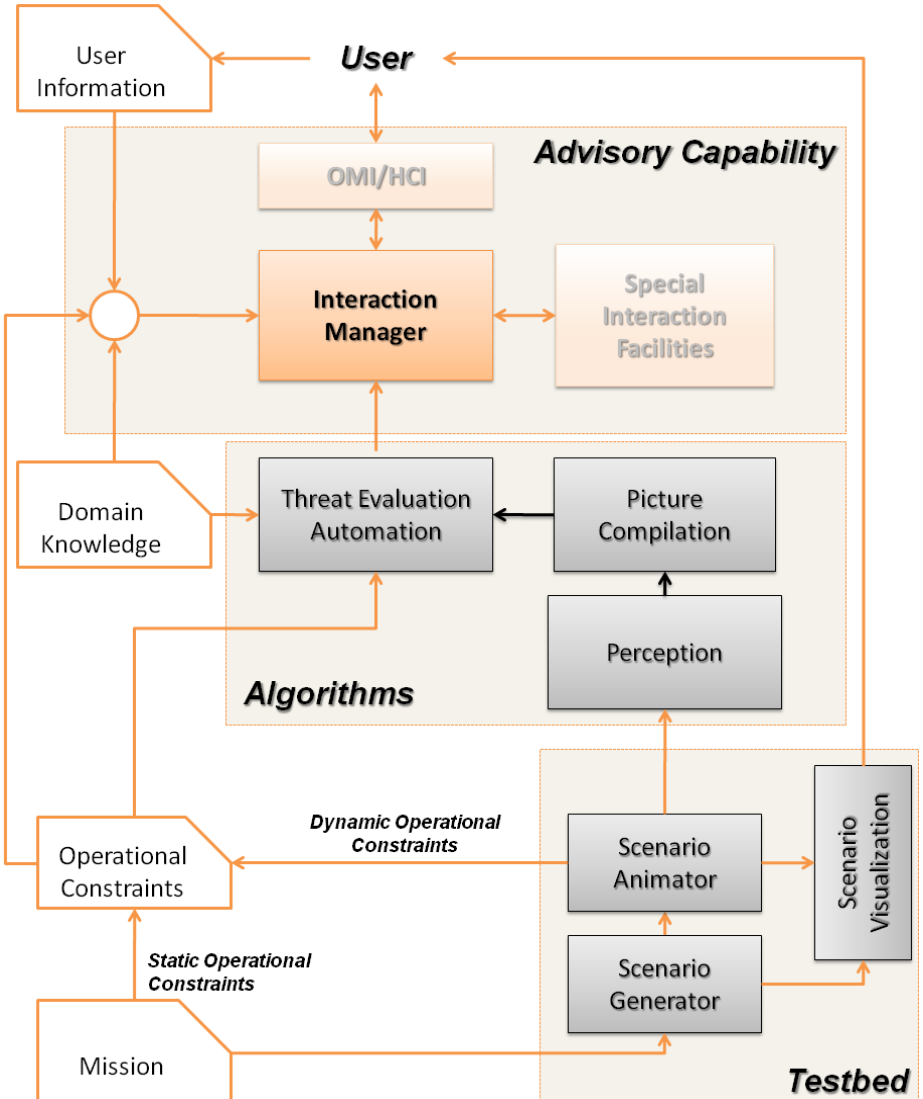
unctional Display – Design philosophy

- Help situation awareness
- Group related information together
- Provide rationale for system recommendations
- Keep operator engaged in the decision loop
- Help to address saturation and recovery phenomenon

unctional Display



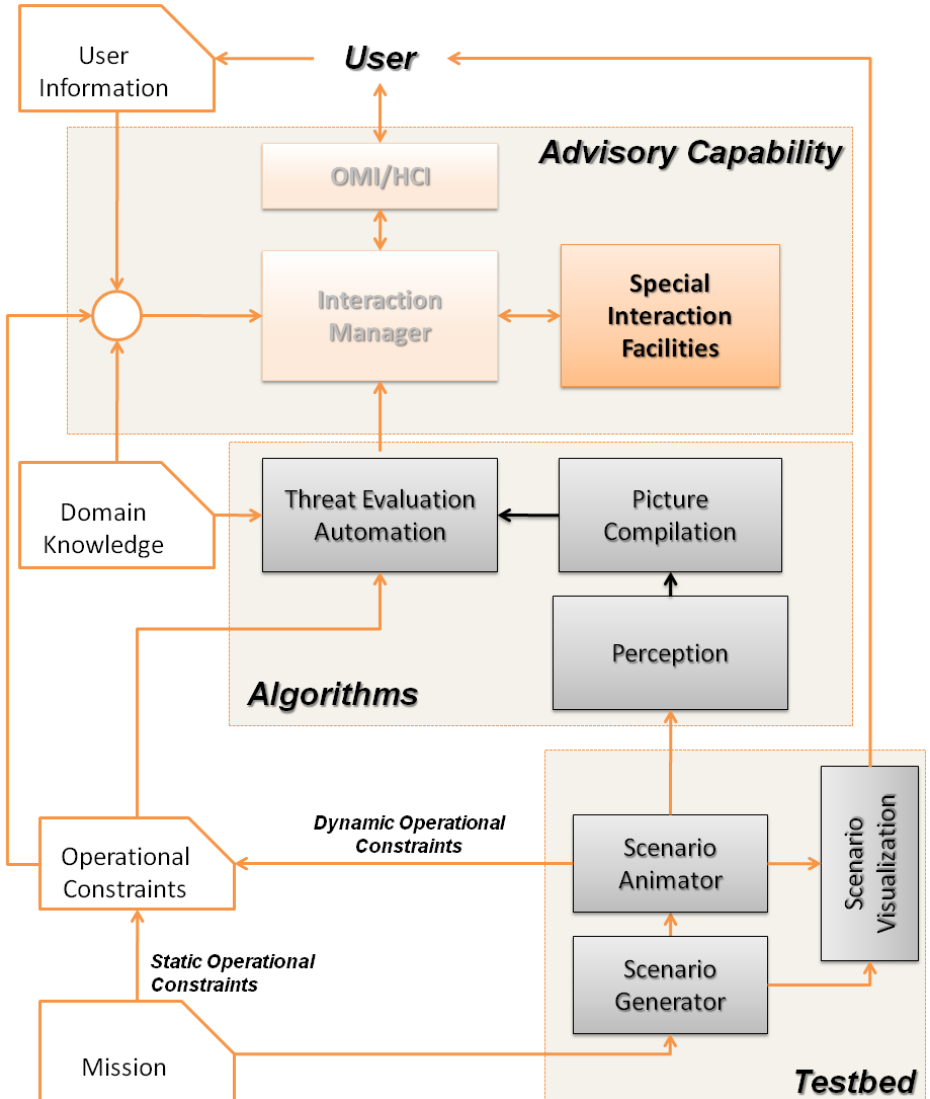
nteraction Manager



nteraction Manager

- Monitors the user and determine his needs for information
- Analyzes the user's input and hypotheses
- Analyzes the operational situation
- Evaluates the data on which the automation solution is based
- Decides on the feedback to be given to the operator

nteraction Facilities



nteraction Facilities

Used to justify the automation's assessment to the operator.

- Operator disagrees with the automation's result
- Operator wants to understand how the result was reached

Purpose is not to resist the operator, but to make sure he considered all information

- The system accommodates to operator's input, but verifies that the operator understands automation rationale first to prevent errors and biases

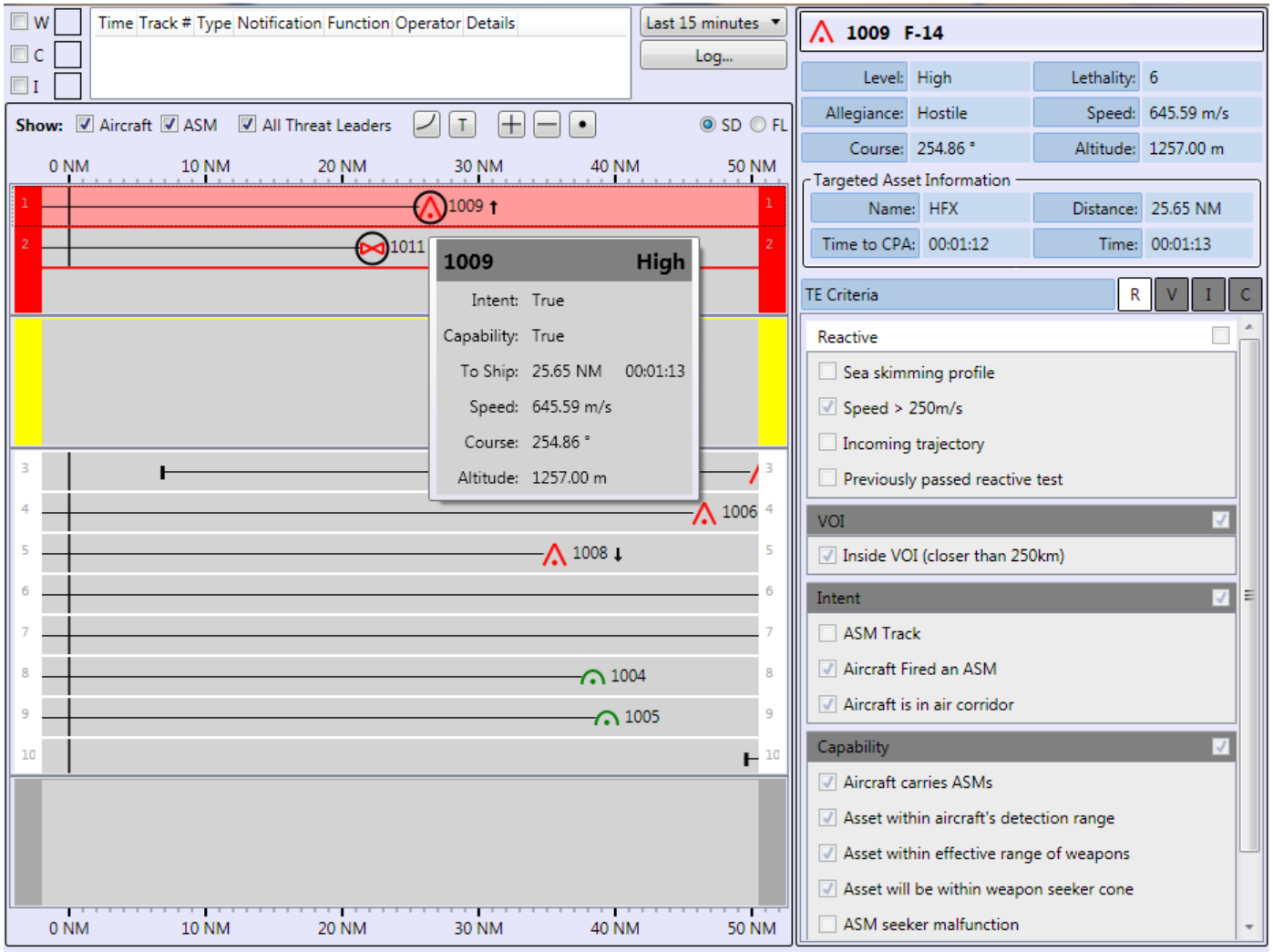
rgumentation

TESS builds argument when the system's conclusion is based on a combination of different pieces of information and needs to be presented in textual form

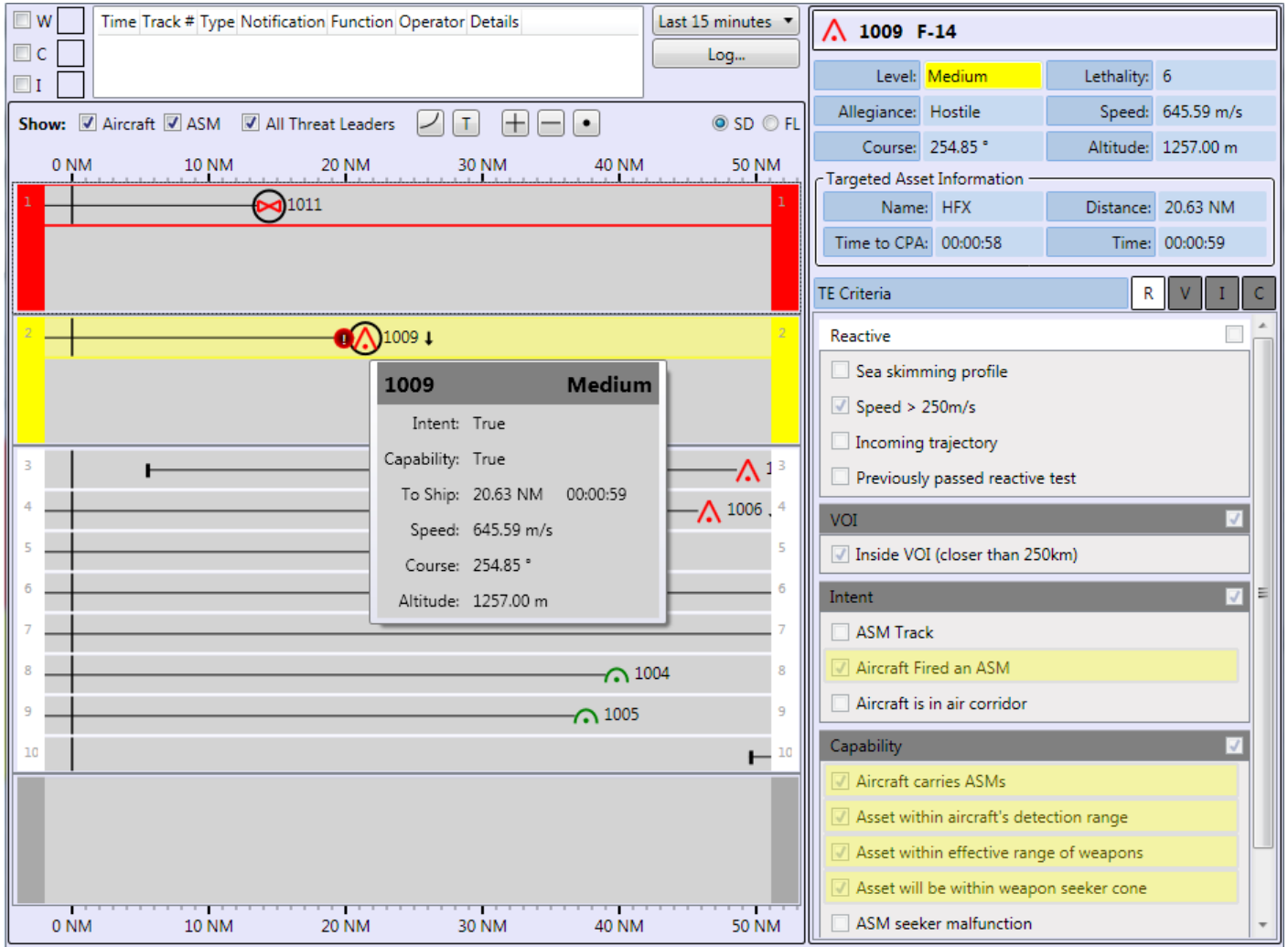
Used when the indicators are not informative enough by themselves

Built using a deductive expert system with certainty factors.

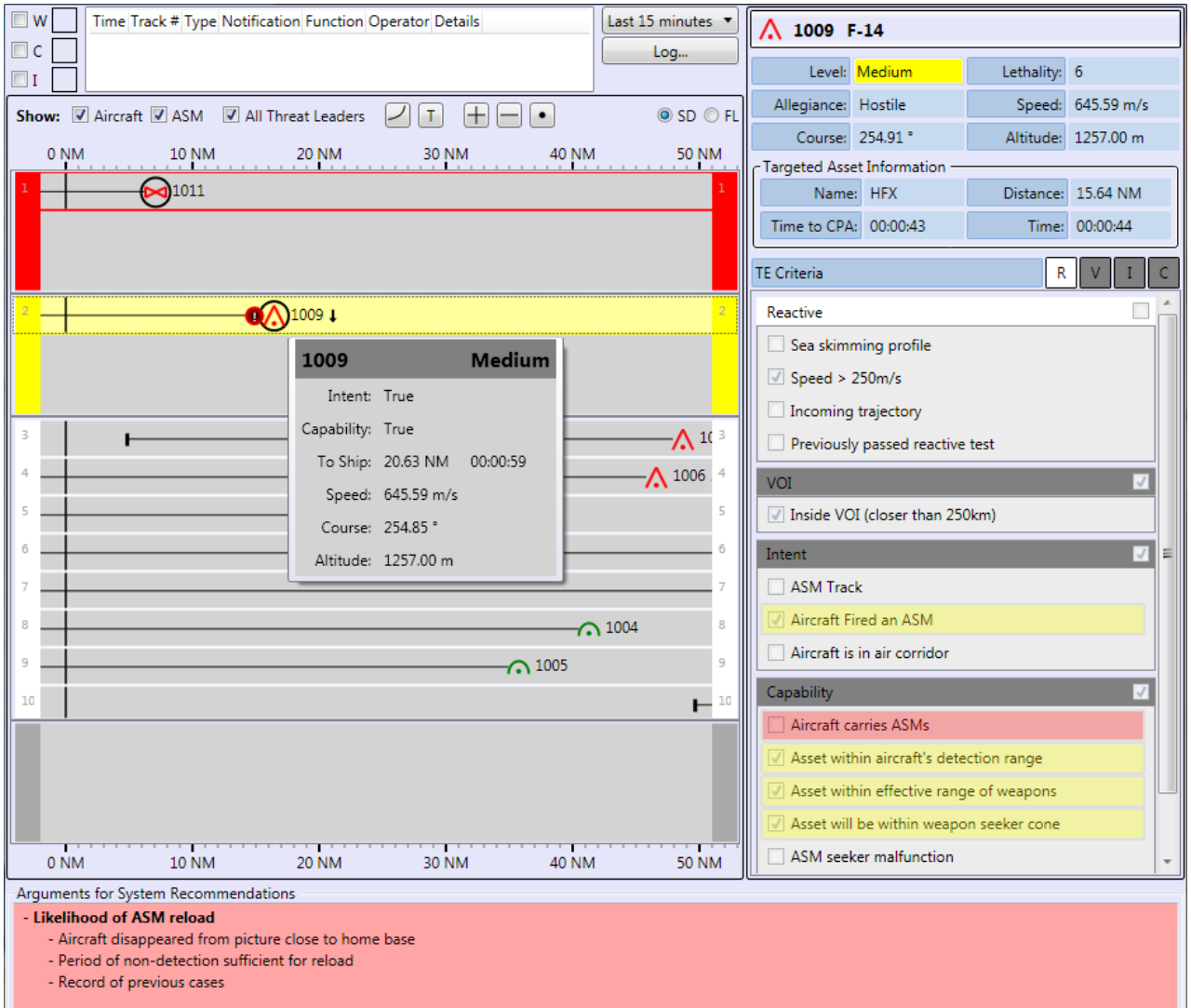
nteraction Example – System ssessment



nteraction Example – Operator Override



nteraction Example – Argument



onclusion

TESS is intended to increase operator's ability to anticipate potential threats and View details of each threat

Key features:

- Visualization of the threat environment through a functional OMI.
- Automation of aspects related to threat evaluation: Intent, capability and opportunity assessment; threat ranking
- Automation in a mixed-initiative approach: the operator is in charge; explanations are provided.

Human Factors experimentation on a previous version validated the system design, increase in situation awareness, improved decision making in threat evaluation, and easy to use.

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