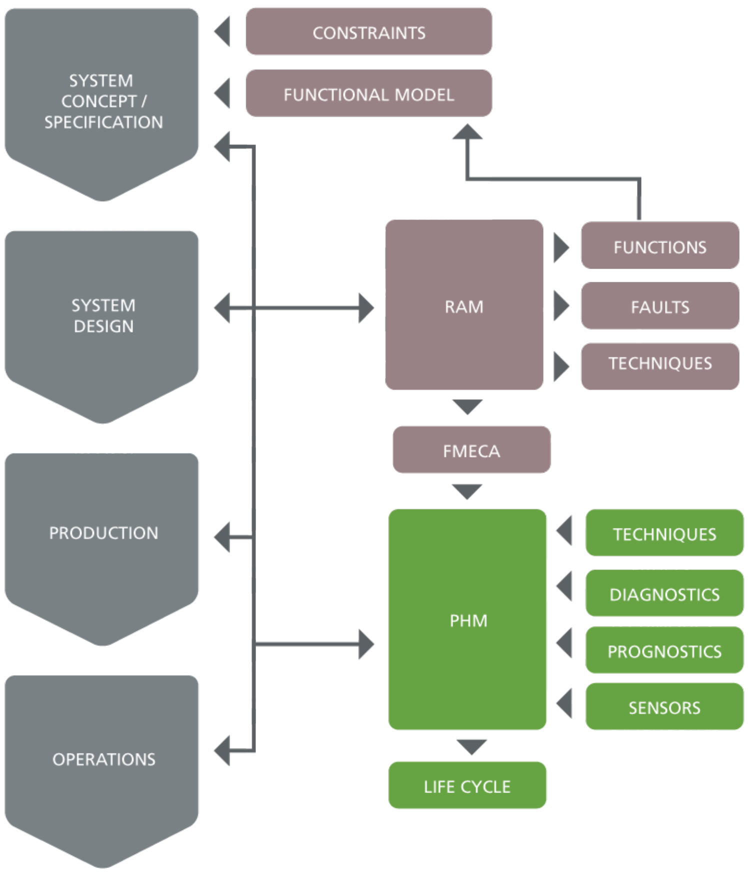
Challenges and Issues of enhancing and maturing PHM

Panel Presentation

Tuesday March 9, 2010

How does PHM fit?

- Optimal benefits offered by PHM are realized when integrated into the system development process
- PHM capability / design requires a continuous improvement process
- Direct linkages to functional silos within organisations required, including:
  - System engineers
  - Designers
  - Reliability engineering
  - Safety
  - Maintenance
  - Logistics



Key issues for PHM design

- Accurate FMECA for systems integrators as the basis for diagnostics
  - Standardised taxonomy of functional / failure concepts
  - FMECA needs to be updated as design matures and operational data becomes available
  - If the FMECA does not identify the failure modes – diagnostics can't cover it

- Diagnostics trade studies based on user defined parameters

  (cost / weight / coverage)
  - PHM capability trade-offs and system requirements to be considered during the PHM design process at all stages of the design process – concept to detailed

- Diagnostic design validation based on system model
  - Based on the FMECA / reliability data
  - Demonstrate PHM system capability to the customer

Challenges for PHM design

PHM silo has responsibility for the design, assessment and validation of diagnostic capability at the system level, but have the following constraints within the current standard industry practice:

- process gaps (data required provided late in design cycle)
- confidence gaps (quality / integrity / currency of source data [FMECA])
- legacy data (data remediation / reusability issues)
- technology gaps (PHM focused tools not previously available*)

* MADe was developed specifically to meet the requirements of PHM for the JSF program

PHM Technology

Current FMECA data sources

- data quality / consistency

  (taxonomy of functional / failure concepts – even the published standards are not consistent)

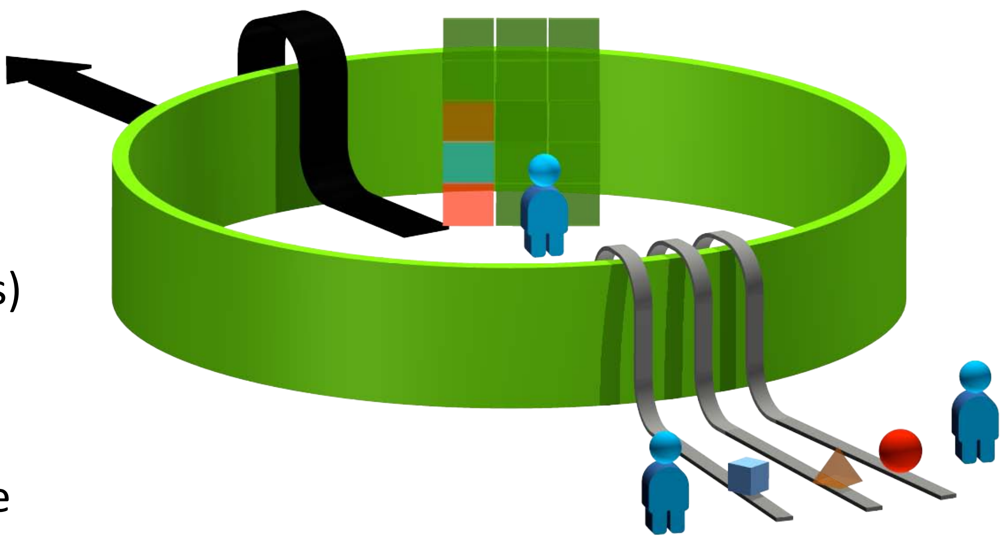
- data integrity

  (potential for human error in dependency mapping process,

  data integration issues from suppliers)

- data usability

  (system model is required that can be used multiple silos for their specific requirements)



Current PHM design process

- process gaps

  (no direct integration with related functional silos)

- confidence gaps

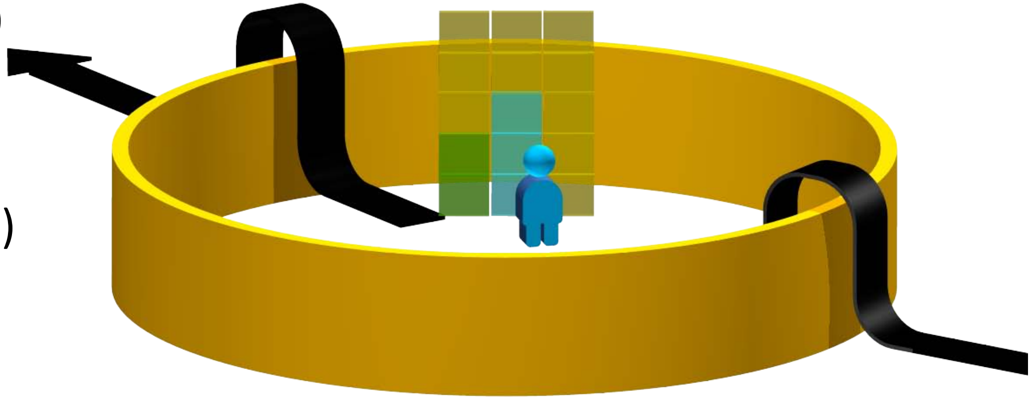
  (quality / integrity / currency of data)

- legacy data

  (data remediation / reusability issues)

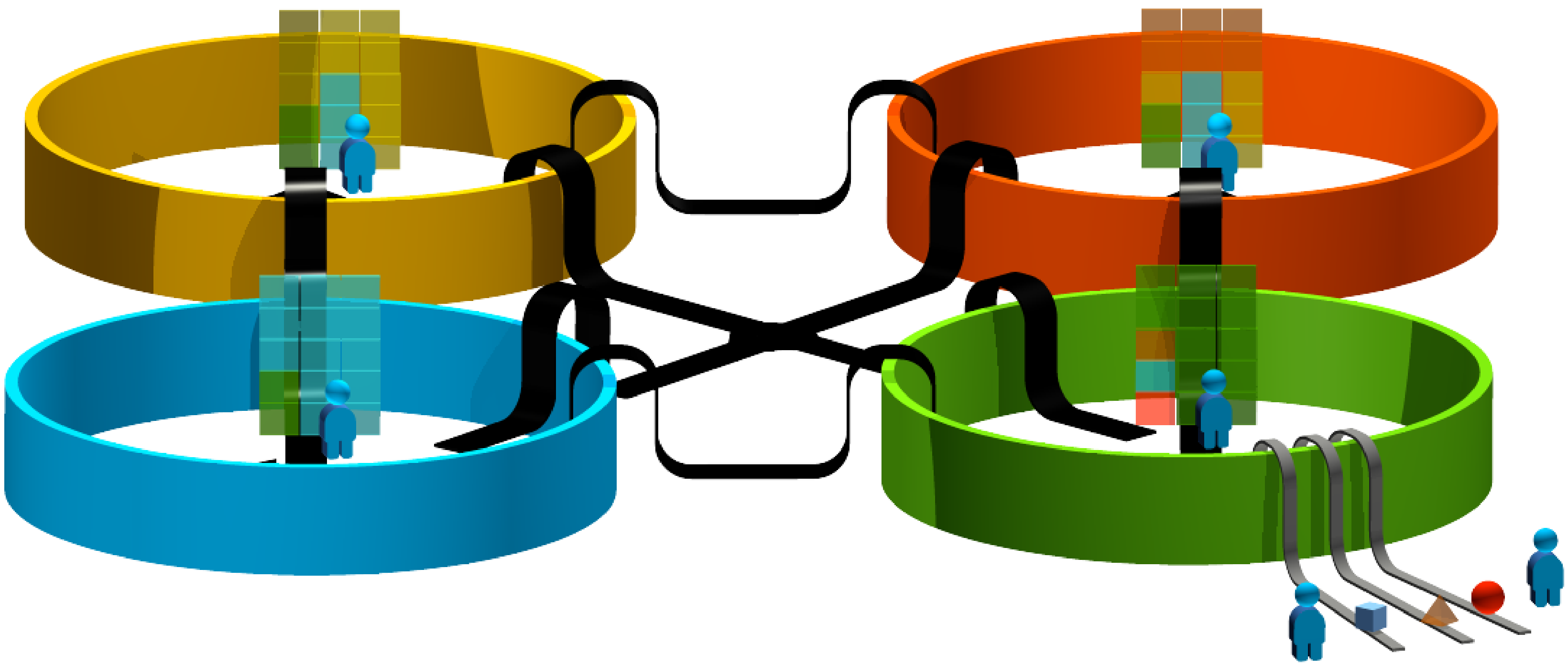
- technology gaps

  ('integrated' PHM tools that utilize a common system model are not available)



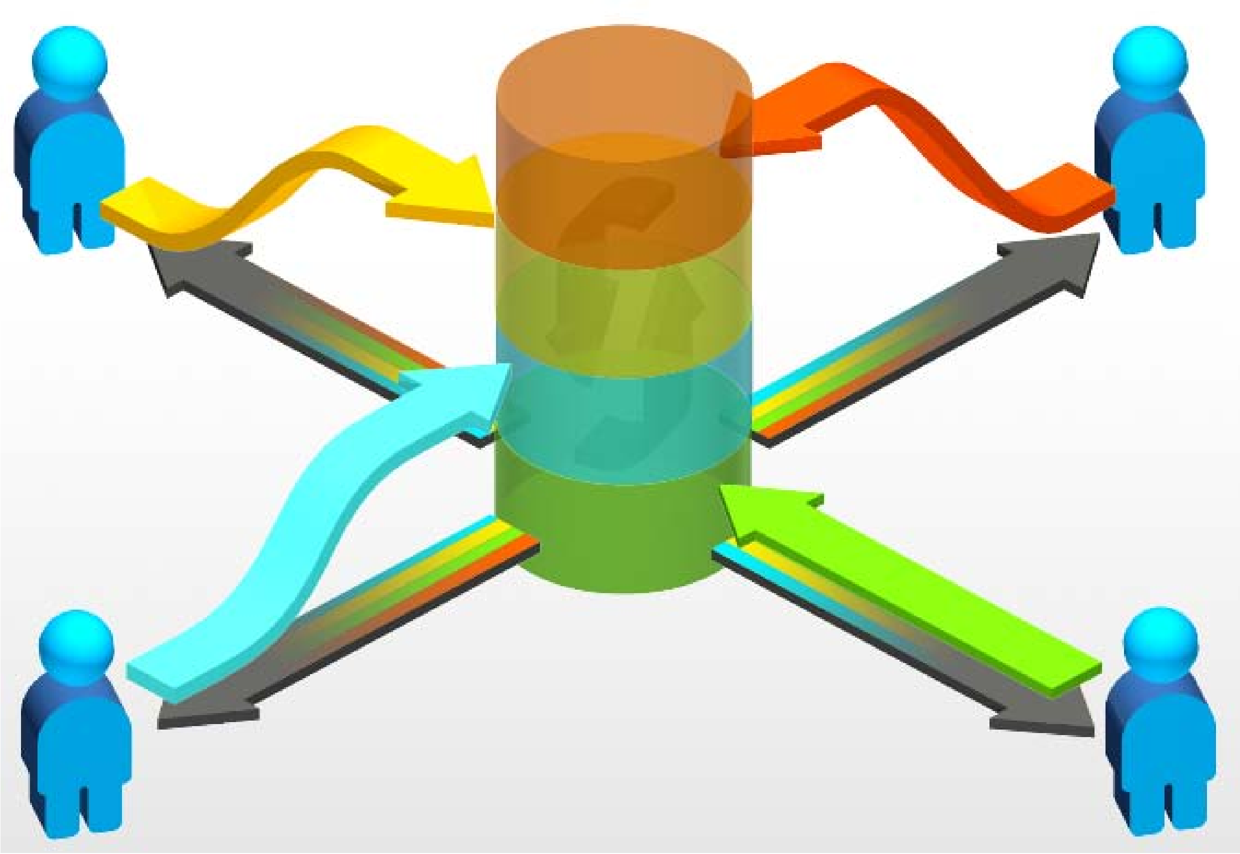
Complexity of process & data sources

Current process is not ideal and often results in the PHM design process not meeting stated goals (efficacy / cost)

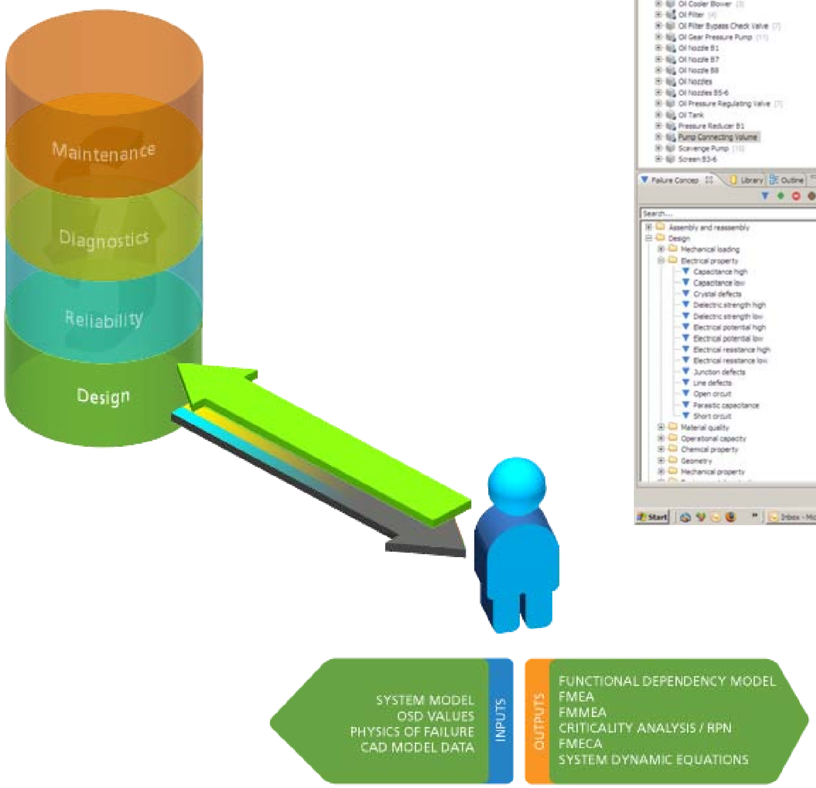


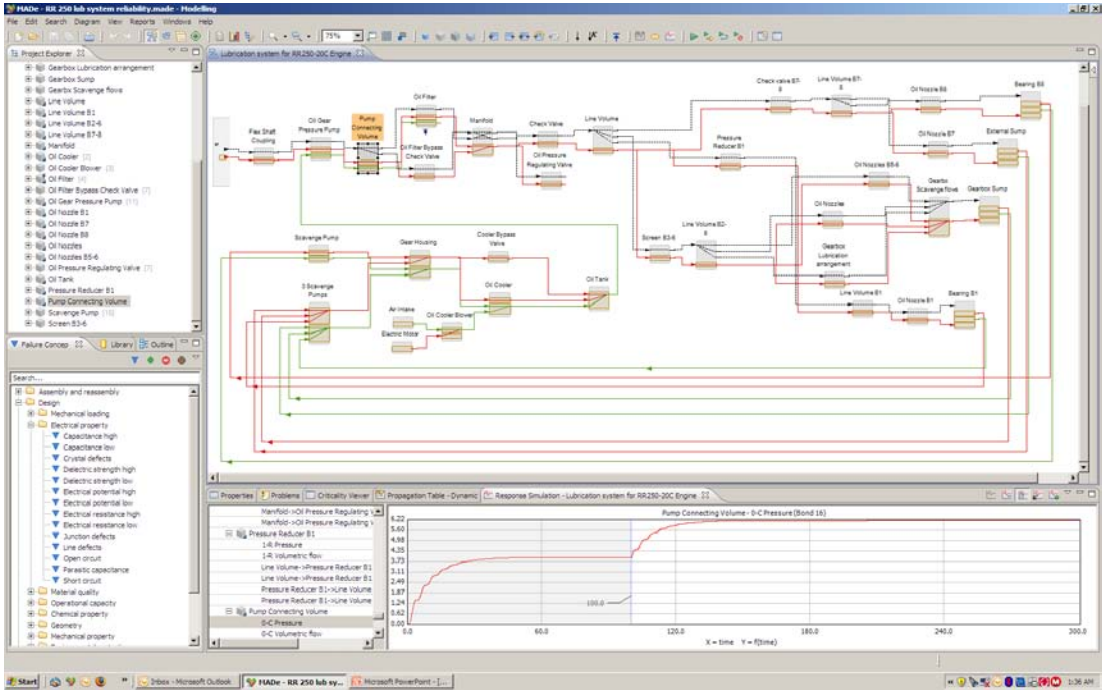
Optimal PHM design process

Using a unified system model that captures all relevant information and interfaces to all silos within the organisation offers improved design process for PHM

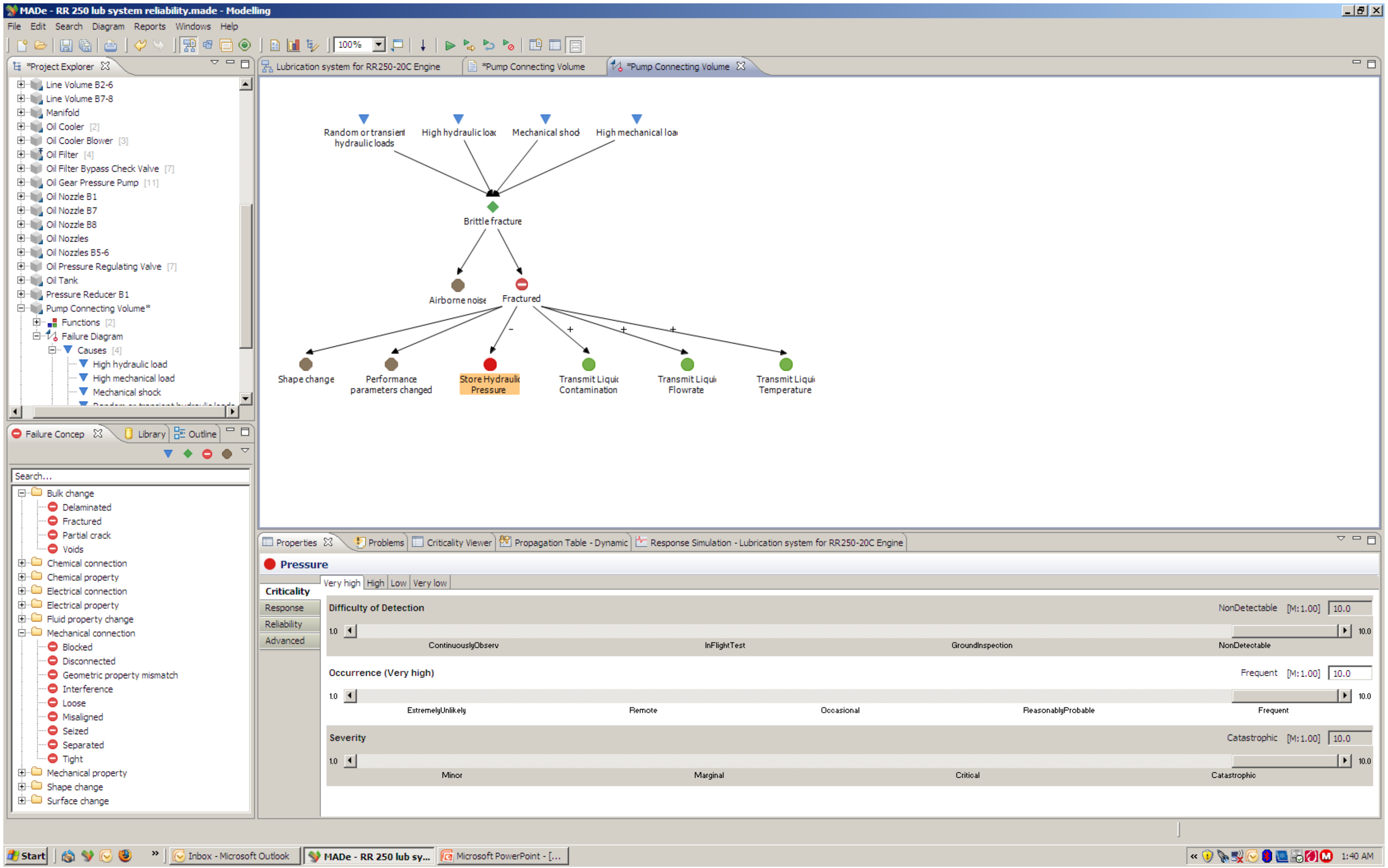


System Design and Definition

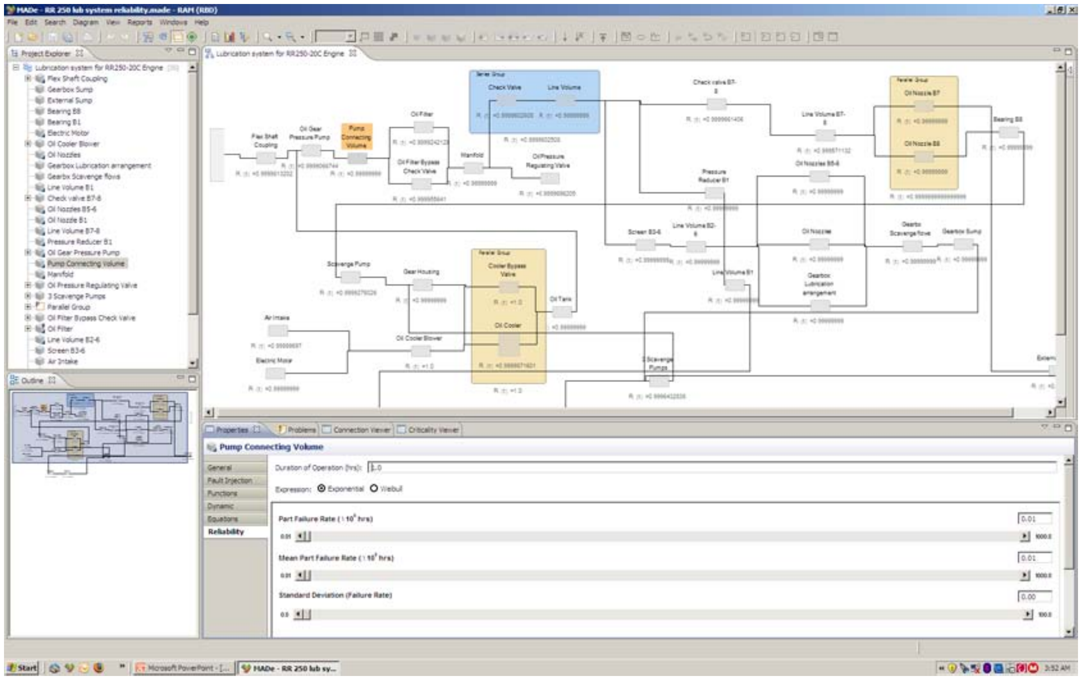


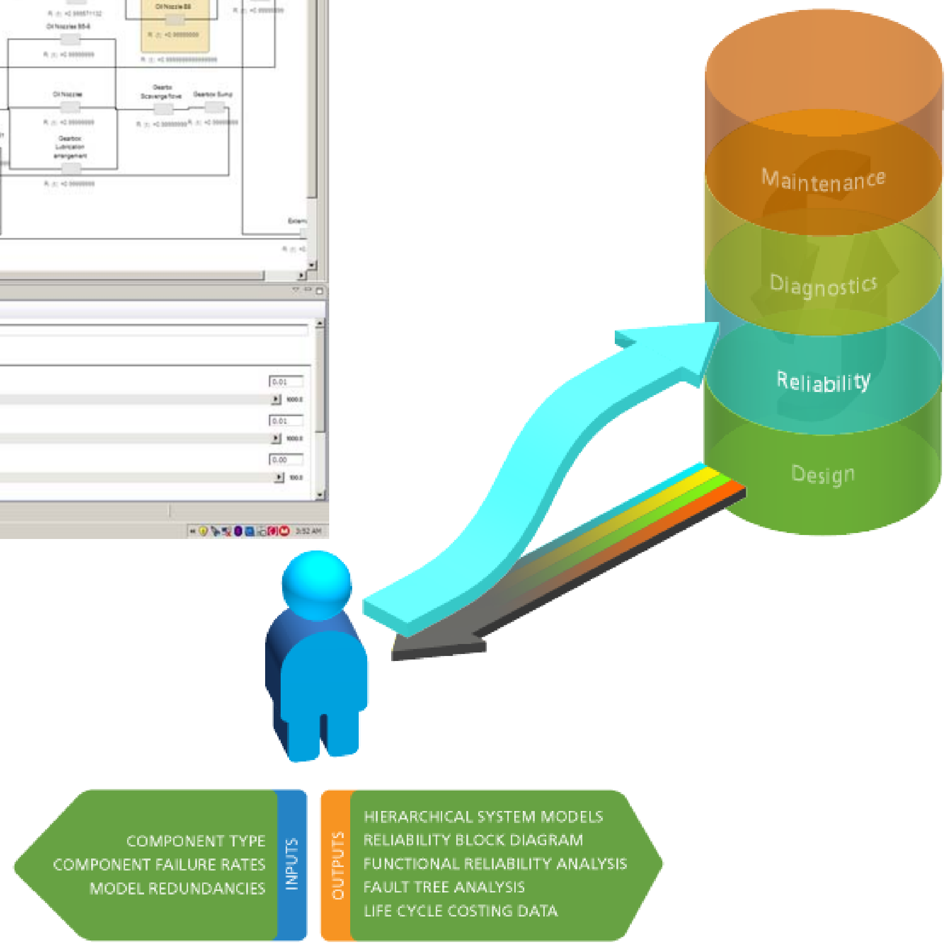


System Design and Definition

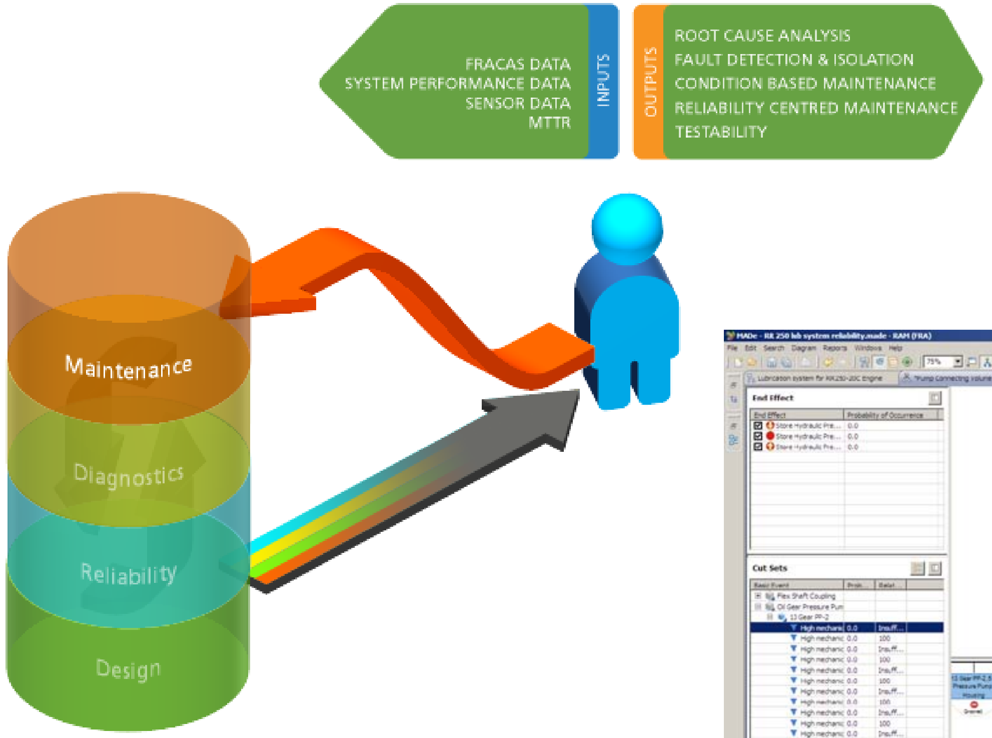


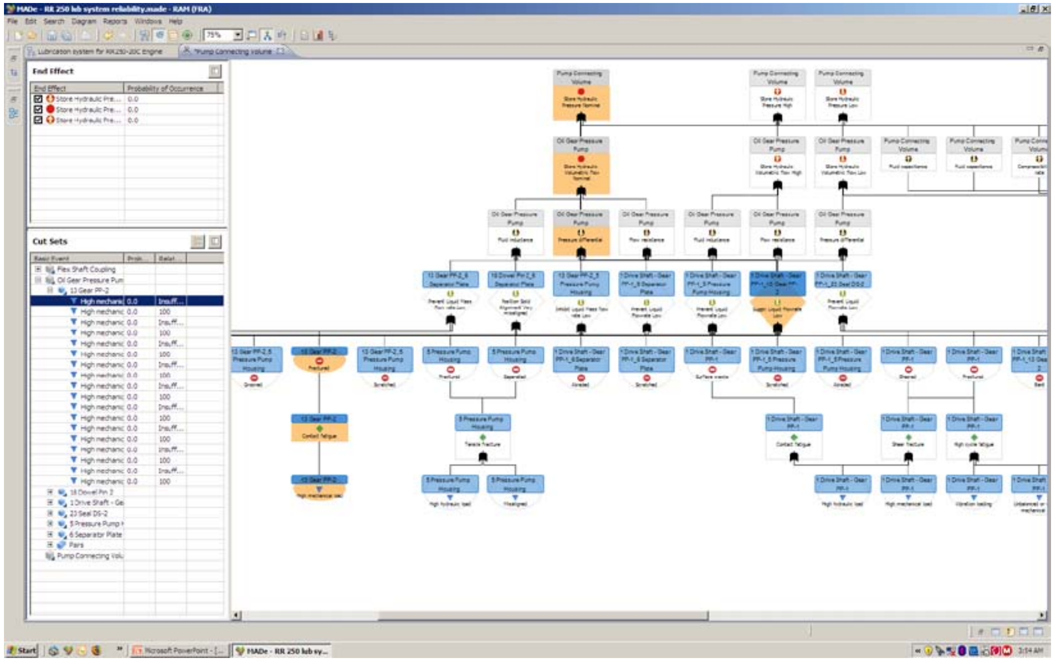
MADe RAM



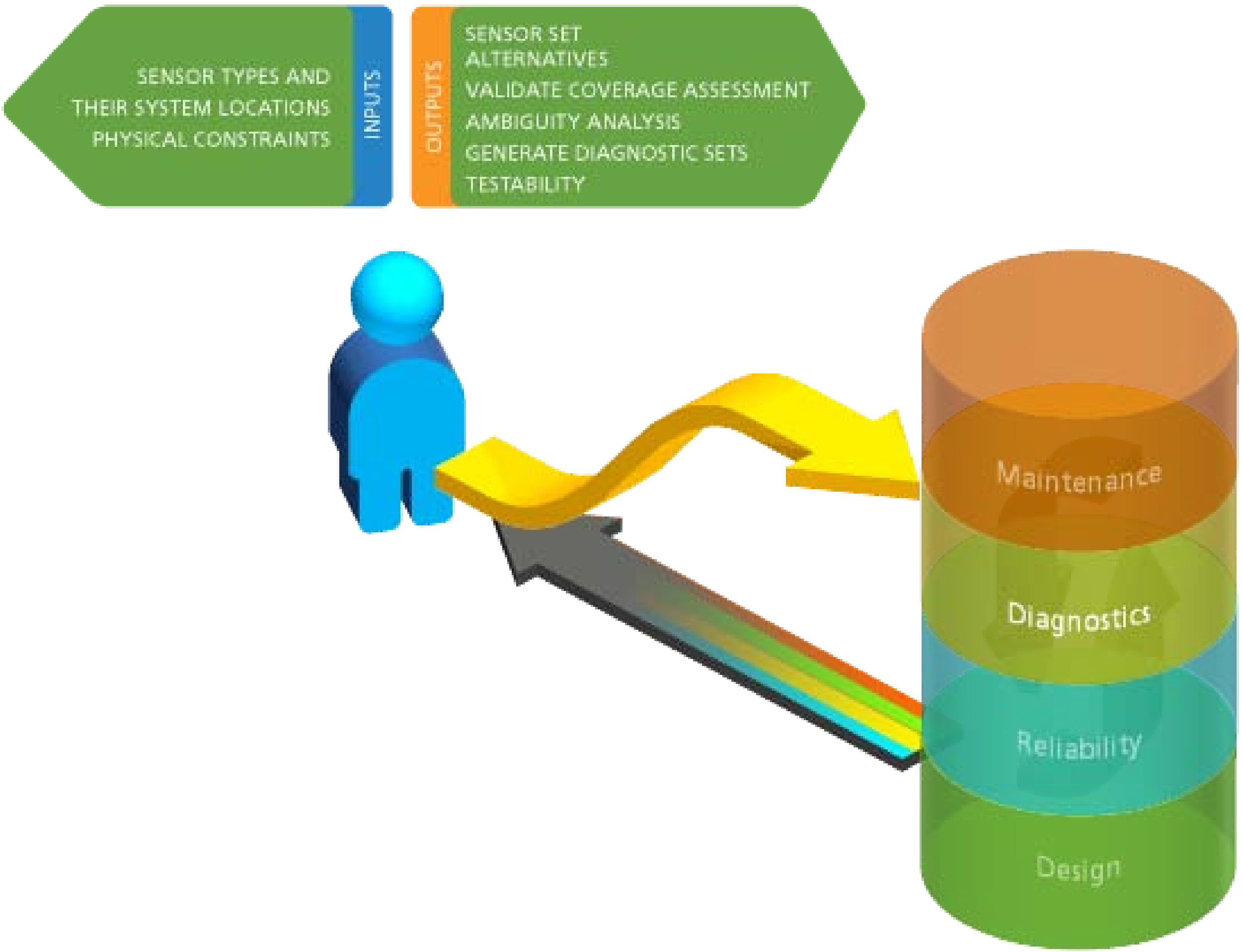

Maintenance
Diagnostics
Reliability
Design
COMPONENT TYPE
COMPONENT FAILURE RATES
MODEL REDUNDANCIES
INPUTS
OUTPUTS
HIERARCHICAL SYSTEM MODELS
RELIABILITY BLOCK DIAGRAM
FUNCTIONAL RELIABILITY ANALYSIS
FAULT TREE ANALYSIS
LIFE CYCLE COSTING DATA

MADe RAM


FRACAS DATA
SYSTEM PERFORMANCE DATA
SENSOR DATA
MTTR
INPUTS
OUTPUTS
ROOT CAUSE ANALYSIS
FAULT DETECTION & ISOLATION
CONDITION BASED MAINTENANCE
RELIABILITY CENTRED MAINTENANCE
TESTABILITY
Maintenance
Diagnostics
Reliability
Design

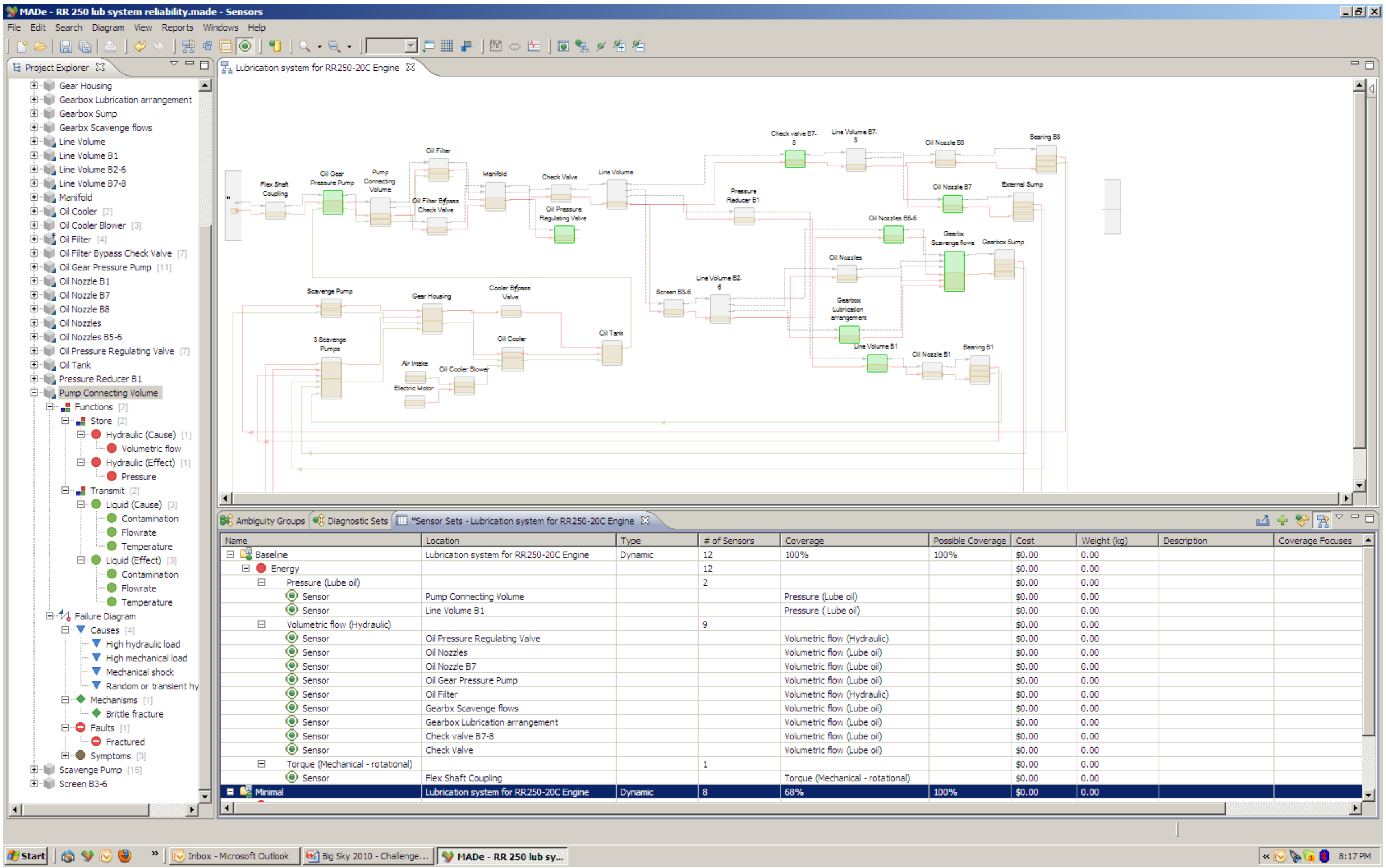

End Effect
Cut Sets

PHM Design and Validation

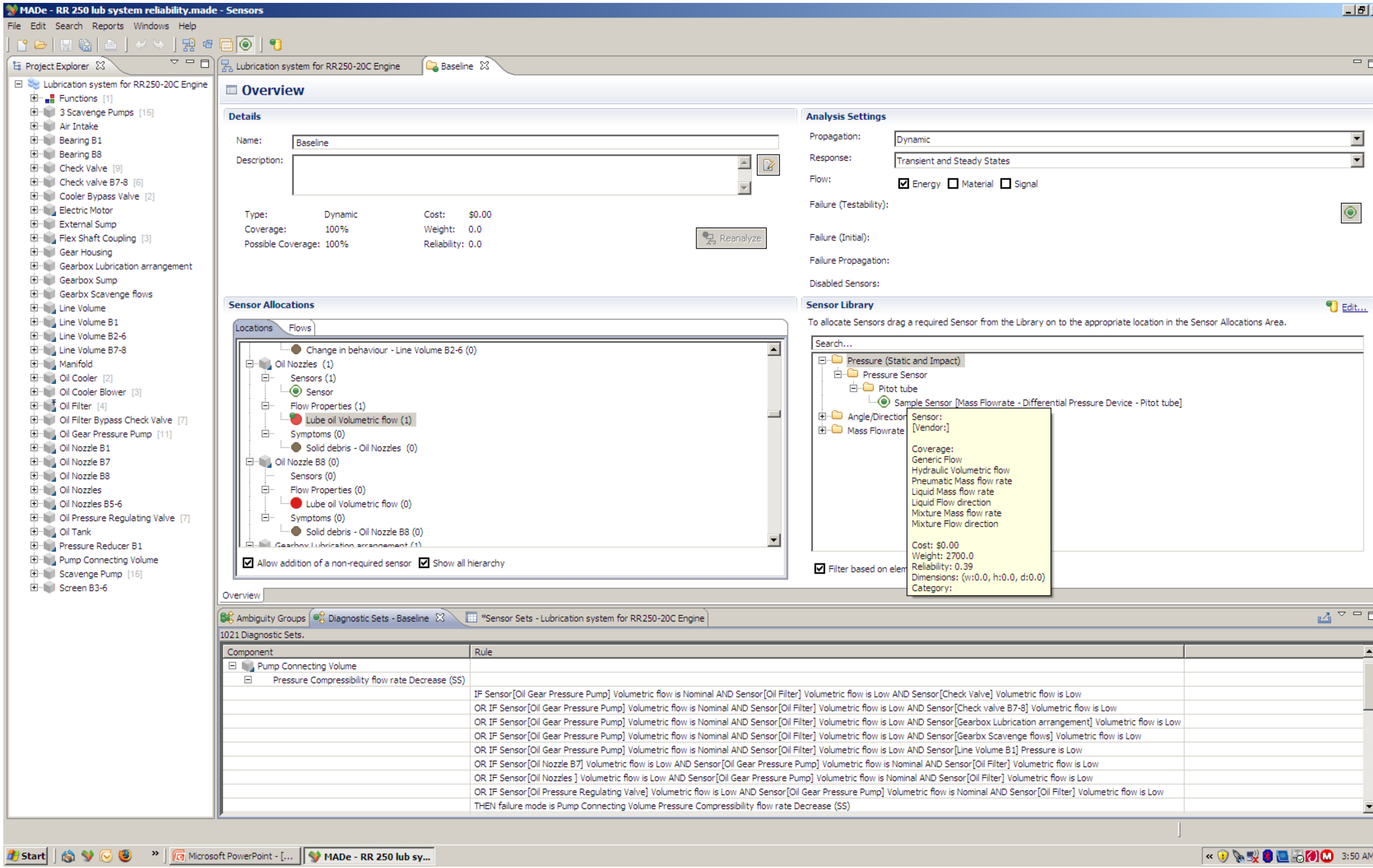


MADe - PHM system design

PHM Technology



MADe – sensor set design



PHM Technology

Questions / Comments?