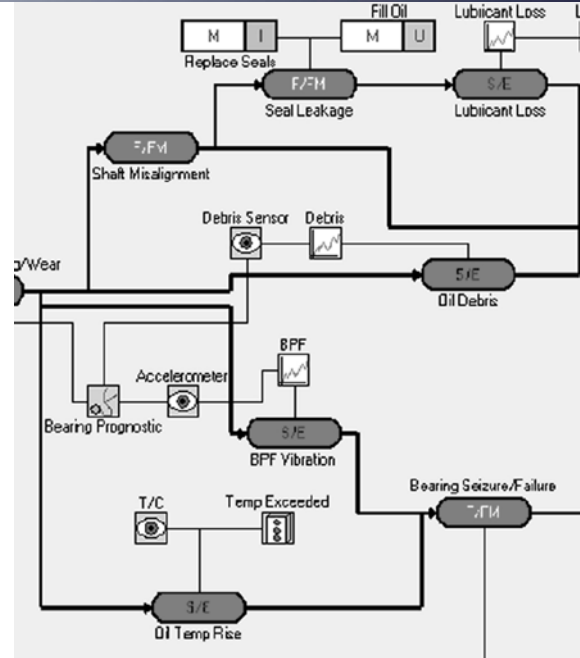


An innovative software tool focused on designing, developing, evaluating and deploying PHM or CBM systems.

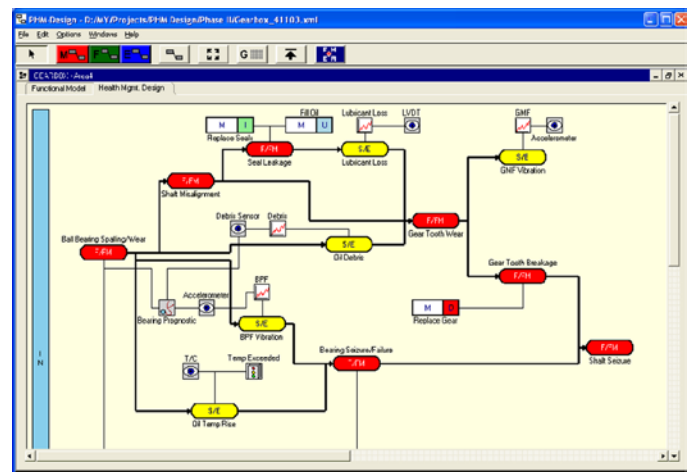
The **PHM Design** product is an innovative software tool specifically focused on designing, developing, evaluating and deploying Prognostic and Health Management (PHM) or Condition-Based Maintenance (CBM) systems. PHM Design models are constructed on a system level "Design Canvas" using sensors, algorithms (BIT, diagnostic and prognostic), failure modes, symptoms, effects, and maintenance tasks to fully represent PHM system functionality.

The software organizes the PHM information, performs metric-based analyses, and enables trade studies to answer difficult PHM or CBM design and development questions such as:

- What are the system's capabilities to accurately detect, diagnose or prognose a fault?
- Can the PHM or CBM system isolate to a root cause with minimal troubleshooting?
- Can essential sensors be used intelligently to achieve the PHM or CBM objectives or should additional sensors and/or algorithms be considered?
- How accurate must the diagnostic or prognostic algorithms perform to meet the overall PHM or CBM objectives?
- Is the PHM or CBM system being developed cost effective?



These questions and many others can all be rigorously assessed PRIOR to deployment!



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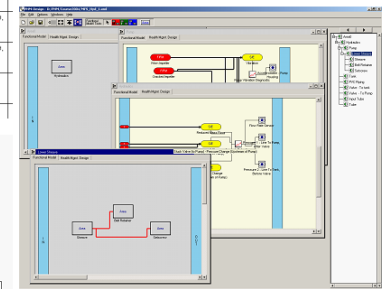
Import & Design

A PHM Design Model has an underlying XML database at its core. Utilities can be made available to autogenerate aspects of the model from existing databases. In addition, deployment of the eventual fault isolation system can be performed using the XML database at its core combined with a generic evidence-based reasoner, also available.

The modeling paradigm allows for effective visualization of PHM or CBM designs from a diagnostic/prognostic perspective, while fundamentally retaining a traditional "fault tree" feel.

1	Failure Rate	Severity	Code	Local Effect	System Effect	Means to Detect/Isolate
2	0.7	IV	T-002	Loose or broken clamp	Loss of fluid flow	Loss of fluid flow, fluid leakage
3	0.9	IV	P-004	Cracked/broken gasket	Fluid leakage, possible loss of discharge pressure	Loss of fluid pressure, fluid leakage from gasket
4	0.4	II	P-001	Cracked/broken impeller	Loss of fluid pressure	Inconsistent or weak fluid discharge pressure
5	0.7	III	P-002	Bent/angled impeller shaft	Possible impeller contact with housing	Excessive vibration from pump housing
6	0.7	IV	P-006	Cracked or broken plug	Fluid leakage, loss of fluid pressure	Loss of discharge pressure, fluid leakage from plug
7	0.2	III	P-003	Cracked/broken pump housing	Possible fluid leakage, loss of pressure	Loss of discharge pressure, fluid leakage from pump housing
8	0.15	III	P-008	Air in pump housing during pump operation	Inconsistent or weak fluid discharge pressure	Inconsistent or weak fluid discharge pressure
9	0.4	III	P-005	Cracked/broken pump housing	Loss of fluid discharge	Loss of fluid discharge

FMECA Import



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Criticality Matrix: Probability vs. Severity

	Negligible (A)	Marginal (B)	Critical (C)	Catastrophic (D)
Frequent (1)	0	1	2	3
Probable (2)	3	4	5	6
Occasional (3)	6	7	8	9
Rare (4)	9	10	11	12
Improbable (5)	12	13	14	15

High Risk (red)
B1 - Marginal, Frequent: 1

Failure/Mode	Area	Prognostic Cov. Score	Coverage
Cracked Housing	Pump	0	Alarm

C1 - Critical, Frequent: 0

Analysis Export

PHM Design has the ability to import failure modes and failure mode attributes from a FMECA and translate them into the PHM Design modeling paradigm. Customizable import tools for other model components are also possible. PHM Design will export complete MS Word reports for all analysis features such as Prognostic Coverage and Diagnosability.

Analyze

PHM Design enables the user to perform any of the following analyses on a design:

Reliability – Determine PHM candidates by identifying fault paths with the highest risk.

Prognostic Coverage – Determine the systems ability to prevent catastrophic failures.

Diagnosability – Evaluate the ability to isolate to various ambiguity group sizes both at the Replaceable Unit and Failure Mode levels.

