

Predictive maintenance maturity guideline

For asset owners, original equipment manufacturers, and service providers in the process industry








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	Level 3 Planned Condition-Based Maintenance	Required steps to reach Predictive maintenance maturity level 4				Level 4 Proactive Condition-Based Maintenance
Technology						
Description	CBM is used structurally and systematically to increase the efficiency of maintenance					CBM is proactively used to increase the reliability and productivity of assets (reliability perspective)
CM Technologies	Easy-to-learn and easy-to-use CM techniques are used structurally (proven technologies)		Experiment with more advanced data-driven CM techniques, a.o. to better predict the RUL	Investigate which (combination of) sensor(s) work the best on which asset(s)	Collaborate with sensor manufacturers to build the CM technologies into new assets	Structural research is carried out to determine the optimal (combination) of CM techniques per asset. This involves experimenting with difficult-to-develop and difficult-to-learn CM techniques
Assets	CBM is structurally applied to the assets for which maintenance can be performed more efficiently			Perform data-driven RCAs to identify reliability and productivity improvements		CBM is also structurally applied to assets for which reliability and/or productivity can be increased
Data	Financial maintenance data and inspection and instrument data from the past are also used to perform the maintenance analyses		Arrange access to the data required for the data-driven CM techniques			Process data, product data, environmental data and failure data are also used to perform reliability and risk management analyses and to develop CM techniques.
IT-infrastructure	The IT infrastructure also makes it possible to store the CM data and compare the current measurement with historical data		Enable the IT-infrastructure to link the different data for developing and using data driven CM techniques	Develop a platform to connect all CM techniques to a central system		The IT infrastructure also makes it possible to link process data, product data, environmental data and failure data, both for the development of new CM applications and for their structural use.
Organization						
Strategy & Goals	The organization has the strategy to perform maintenance more efficiently. Maintenance cost is the most important KPI	Spark curiosity/create urgency to improve the reliability and productivity of the asset(s)			Lifecycle management of existing applications	The organization has the strategy to increase the reliability and productivity of the assets and has started a CM program. The OEE, MTBF and maintenance cost are the most important KPIs
Decisions	The periodic information about the condition of assets is used for (more) maintenance decisions			Define threshold levels that automatically trigger inspection activities	Allow the triangle of production, engineering, and maintenance to make production and maintenance decisions together	The high-frequency and detailed information about the condition of assets is also used for reliability and risk management decisions
Structure	Structural monitoring is done by local, central, and external specialist CM teams/ service providers that work closely with maintenance engineers		Create a project office and the CM program	Create interdisciplinary teams to perform the projects		There is a centrally organized CM program that works closely with the internal CM teams and external specialist CM service providers. The CM teams work with reliability and process engineers
Budget & Capacity	Annual budgets & capacities have been made available for executing CM, executing CBM and managing CM technologies	Expand/realign the budget for development or purchase of new CM technologies				A CM program budget & capacity is set for the development/purchase of new CM technologies. Expanded annual budgets & capabilities to run CBM and manage CM technologies
Processes & Documentation	CBM processes are integrated into standard maintenance work. Important documentation includes (standard) inspection lists and CM reports			Create a list of all critical assets and a list of potential candidates for CM	Capture the optimal combination of CM techniques on assets in CM concepts and data concepts	Defined processes for developing and implementing new CM applications. Documentation: list of critical assets, FMEA and CM concepts from the pilots
Governance	The CM moments are recorded in a maintenance management system and the inspection reports are approved by certified inspectors		Make agreements with internal/external parties about the ownership/use of data	Make agreements with internal/external parties about the technological/organizational standards		Design includes reliability and maintenance in projects. Clear agreements with internal/external parties about the ownership/use of data and technological/organizational standards
People						
Knowledge & Skills	The maintenance teams are familiar with the basic principles of CBM, the CM teams master easy-to-learn and easy-to-use CM techniques		Employ or train data scientists, data architects, data engineers, and operation experts in IT	Organize full training program for maintenance employees to create experts that have a consulting role		Maintenance teams are familiar with the asset failure mechanisms and can perform FMEAs/RCAs. CM teams master difficult-to-learn CM techniques and can develop new CM applications
Culture	There is a bureaucratic culture, within the (maintenance) organization there is a strong need to work according to a process and plan	Engage in a reliability improvement journey		Share success stories		There's a reliability culture, increasing reliability is embraced by different teams. Also a pioneering culture, the people involved in the CM program like experimenting with new technologies

Abbreviations:

AO:	Asset Owner
CBM:	Condition-Based Maintenance
CM:	Condition Monitoring
OEE:	Overall Equipment Effectiveness
OEM:	Original Equipment Manufacturer
ROA:	Return On Assets
SP:	Service Provider
TCO:	Total Cost of Ownership
RUL:	Remaining Useful Life

Legend:

	Steps relevant to AOs, OEMs, and SPs		Following step(s)
	Steps specific to AOs		Optional step(s)
	Steps specific to OEMs & SPs		Indication of which steps result in a cross-categorization improvement
	Requirement for following step(s)		

