Predictive maintenance maturity guideline

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

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		Level 4 Proactive Condition-Based Maintenance	Required steps to reach **Predictive maintenance maturity level 5**	**Level 5** World Class Condition-Based Maintenance
	Description	*CBM is proactively used to increase the reliability and productivity of assets (reliability perspective)*		*CBM is optimally used to increase the value achieved from assets (asset management perspective)*
Technology	CM Technologies	*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*	Build the optimal combination of sensors into the existing machine Develop or purchase machine learning algorithms Create an autonomous system where no humans walk around the factory	*All successful CM techniques have been scaled up and are used structurally. We are continuously experimenting with new CM techniques*
	Assets	*CBM is also structurally applied to assets for which reliability and/or productivity can be increased*	Integrate all CM technologies in a sustainable manner to more assets	*CBM is also structurally applied to the assets for which the ROA can be increased and/or TCO can be decreased*
	Data	*Process data, product data, environmental data and failure data are also used to perform reliability and risk management analyzes and to develop CM techniques.*	Establish maximum login to the data of the clients Isolate data and connect failure modus to be 99% predictive maintenance	*Inventory and forecasts data from production planning, environmental conditions and market conditions are used to perform the production, purchasing, project and design analyzes*
	IT-infrastructure	*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.*	Enable the IT-infrastructure to link data across different systems	*The IT infrastructure is standardized, so that it is easy to connect new CM applications to it. The CM systems are linked to production planning, purchasing and process control systems*
Organization	Strategy & Goals	*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*	Make a asset management framework with the most important KPI's	*The organization has the strategy to optimize the value from the assets and is committed to a CM portfolio. ROA, TCO and LCC are the most important KPIs*
	Decisions	*The high-frequency and detailed information about the condition of assets is also used for reliability and risk management decisions*	Make decisions based on the machine learning data and the expertise of the CM team(s)	*Detailed information about the (future) asset condition is used in a range of asset management decisions, including decisions regarding projects, production, procurement and design of assets*
	Structure	*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*		*CM portfolio is centrally managed. CM teams are integrated in a network of knowledge institutes, manufacturers, specialist CM service providers and data scientists.*
	Budget & Capacity	*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*	Expand the annual budget and capacity to execute and manage CBM Set a budget for the project office to support with the CAPEX of CM implementations	*The annual budgets & capabilities for executing CBM and managing CM technologies have been expanded*
	Processes & Documentation	*Defined processes for developing and implementing new CM applications. Documentation: list of critical assets, FMEA and CM concepts from the pilots*		*Defined processes for continuously improving the CM portfolio and using information about the condition of assets in decision-making processes*
	Governance	*Design includes reliability and maintenance in projects. Clear agreements with internal/external parties about the ownership/use of data and technological/organizational standards*		*Design for monitoring is a mandatory part of projects, the organization is asset management certified and technological and organizational standards are used as much as possible*
People	Knowledge & Skills	*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*	Find optimum between machine learning and employee expertise	*Teams involved are familiar with the drag-degradation mechanisms of the assets, the effects of degradation on production and the latest innovations in CM technology*
	Culture	*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*		*An asset management culture, everyone feels a shared ownership of the assets. An analytical culture, in which people want to make decisions based on current/accurate information*

WORLD CLASS MAINTENANCE

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