Progression from RCM2™ to RCM3™ including Highlights

RCM Element	RCM2	RCM3 Highlights	Reason for additions / changes	Improvements and advantages
Operating Context	Mentions and considers the Operating Context (OC) throughout the process. Operating Context is considered when failure modes are identified and when failure management strategies are developed (Failure consequences are different when OC varies).	The Operating Context is the FIRST step required for the RCM3 process.	The Operating Context should be defined and agreed upon prior to listing functions, failed states, failure modes, failure effects and defining failure consequences. All these are influenced by and derived from the Operating Context. Risks are also directly related to the Operating Context.	This makes it the undeniable first step of the RCM process and all assumptions and decisions are based on the Operating Context. The operational risks and all the decisions made in the RCM process is directly tied to the Operating Context.
Functions	Requires the definition of Primary and Secondary Functions. • Performance standards should be defined (where possible). • Specific about the definition of functions for protective devices.	Requires the definition of Primary and Secondary Functions. • Performance standards should be defined (where possible). • Specific about the definition of functions for protective devices. • Expands the Secondary Function to include the considerations for defect elimination (proactively).	Lubrication is not treated as a separate failure management policy in RCM2/3 (as in MSG3). The reason is that in most modern designs, lubrication is designed as a dedicated separate system and as such are analysed as a separate system. Where there is still hard point lubrication required, RCM3 deals with the failure of the hard point lubrication as a separate failure mode.	Attention is drawn to the process or policy of ensuring that lubrication replenishment and / or replacement must happen under the optimum conditions to prevent contamination. Defect elimination is treated as a condition to improve reliability proactively (not as a failure management strategy).
Functional Failures	Functional failures are acknowledged as “failed states”: • General failed state, • Total failure and, • Partial failure.	Now defined as “Failed State” and acknowledges the differences between: • General failed state, • Failing state, • Failed state and • End state (as part of the failure process).	The partial failure or failed state is now clearly defined and distinguished from the end state (total failure). The RCM3 process deals with all possible failures at the appropriate level. RCM3 further defines the worst case “End State” condition (when multiple failure occurs)	Agreement between different disciplines (i.e. engineering, operations and maintenance) can be reached much faster and therefore the process to identify and define the appropriate failure management strategy is much quicker (saving time and money).
Failure Modes	Defines a Failure Mode as the event that causes the Functional Failure / Failed State. The facilitator / review group must constantly be reminded of the correct level of detail (not to describe failure effects / symptom of the failure).	Defines a Failure Mode as a “Cause” and “Mechanism” that causes the Failed State. This allows the facilitator / review group to identify “root causes” easier and at the correct level of detail. The failure mechanism also ties in with the degradation mechanisms. (Terminology used in RBI).	RCM review groups (and facilitators) have to define at least one or more failure mechanisms for each failure cause to ensure that the level of detail is sufficient (and appropriate) to develop failure management policies that are both technically feasible and worth doing.	This makes the integration with RBI practical as RBI also defines failure modes as “deterioration / degradation mechanisms”. The same terminology is used for the two recognized Risk Management Systems (RBI and RCM). “Templating” of like type equipment is streamlined and quicker to perform.

Progression from RCM2™ to RCM3™ including Highlights

Failure Effects	Failure Effect is defined as one statement (one paragraph that describes what will happen if the failure mode occurs and nothing was done to prevent it).	Similar to RCM2, Failure Effects are described if no attempt was made to prevent them but the effects are now separated in three levels: Local Effect, Next Higher Level Effect, and End Effect. RCM3 also describes Potential Worst Case Effect (where applicable). Describing failure effects are far easier and the separation allows the different disciplines in the review group (engineering, operations and maintenance) to focus on their areas of expertise and knowledge.	Separating the effect description makes it possible to distinguish more easily between the specifics of complex failure effects. Reporting on failure effects (assessing the consequences) to different levels in the organization is more granular and less time is spent during the analysis and the subsequent analysis audit meetings.	Easier and more comprehensive "templating" at equipment type level (Local effect descriptions included in the analysis template). Indicators easier to define (clear difference between what operator / maintenance personnel sees vs. what management wants to see). Potential worst case describes multiple failure conditions separate and with appropriate level of detail. The focus is on increasing the reliability of the protected function/system as a first priority
Consequences	Considers Safety / Environmental, Operational, Non-Operational and only one category of hidden failure consequences. Facilitators could by mistake treat all hidden failures the same (regardless of the actual impact).	Considers evident Safety / Environmental, Operational and Non-Operational Consequences and splits the Hidden Consequences between Hidden Safety and Environmental Consequences and Hidden Economic Consequences.	Risk and cost is managed at the appropriate level and the economic impact of failure finding (functional checks) is now be better defined and managed. The process delivers quantifiable results which will easier to defend. It further leads to less redesign considerations.	This is especially useful and applicable in higher risk environments i.e. nuclear, petroleum and petrochemical industries. Improved integrity and improved planning for testing protective devices are possible. The split places focus on the devices that could impact safety vs. operations and improves the understanding of the economic impact (of functional tests) and risk of the same.
Risk	Follows a subjective approach to risk management and addresses risk only when failures (or multiple failures) impact safety / the environment. RCM2 is a process to determine what must be done to an asset to preserve its functions (while minimizing or avoiding failure consequences).	RCM3 addresses risk directly and the risk management approach is based on the ISO 55000 and ISO 31000, Standards RCM3 is the process to determine what must be done to an asset to preserve its functions while minimizing the risks associated with failures to a tolerable level. RCM3 further considers a probabilistic risk assessment at component level when compulsory redesigns or one-time changes are required.	RCM3 methodology is directly aligned with International Management Systems for Asset Management and Risk. RCM3 now considers risk avoidance or management as a failure management strategy. More ways to proactively deal with failure management - reduce the probability (through maintenance) or reduce the severity (through redesign) all done proactively.	Inherent risks as well as revised risk calculations demonstrates the impact (risk mitigation) of the RCM3 decision process. Allows for proper and formal assessment to determine requirement for redesigns based on the relative risk (severity) as described in the failure effects. Risk is quantified (and understood) and less compulsory redesign decisions are made – this allows the review group to make more decisions (less open ended results) and it leads to a more defensible failure management program.

Progression from RCM2™ to RCM3™ including Highlights

Risk (continue)		Every reasonably likely failure mode is assessed and quantified in terms of its inherent risk. Less likely failure modes are considered based on inherent risk.	Part of formal risk assessment for physical assets and their associated failure mechanisms.	Once failure management policies have been defined for each failure mode, the revised risk is captured. This helps demonstrate the value that RCM adds by eliminating or managing risks to tolerable levels. Less likely failure modes are now considered based on the actual risk they possess.
Decision diagram	RCM2 decision diagram does not separate Hidden Functions between the ones that provide protection against safety vs. economic risks.	Incorporates additional consequence criteria to separate and identify Hidden Consequences. Separation between Safety and Economic type hidden consequences is made. Focus is placed on reliability of protected function first. Optimizes failure finding intervals through increasing reliability of the protected function (when applicable). Dependency on protective devices are reduced.	For safety type hidden consequences the tolerable risk criteria determines the failure finding intervals. For economical type hidden consequences the cost of doing failure finding is compared to the cost of the multiple failure when determining the optimal failure finding interval. “Functional checks” for evident failures are now considered (where applicable).	The criteria in the Hidden Consequence leg for economic type multiple failures determines the optimum interval for failure finding (providing highest availability) at the lowest cost. The cost of the task must still be acceptable to the user, otherwise a one-time change may be considered to reduce the overall cost of multiple failure (where possible). Improved integrity through “functional testing” of evident failures (based on risk strategy).
Decision diagram (continue)	For any proactive maintenance task (PM) to be considered, the PM must be both technically feasible (according to the failure characteristics) and worth doing (reduces the consequences to an acceptable level).	The “worth doing” criteria for different consequences criteria is significantly different from the RCM2 decision logic since it considers physical risks in all criteria. Safety / Environmental Consequences – Risk should be reduced to a tolerable level. Economic Consequences – Economic Risks are also considered (first) and not cost only. The PM should reduce	The focus in RCM2 could be (and has been) misinterpreted as being bias towards the protective devices present in the system (especially standby and redundant equipment), which resulted in “No Scheduled Maintenance” decision for the protected function / system. This meant that the risk to the organisation is drastically increased during repair time when the protected function / system failed (multiple failure), as the process operates	The RCM3 decision diagram criteria for “worth doing” allows for the optimisation of the availability and reliability of the protected function as a first priority. The need for a protective device / redundancy (or failure finding interval) is only considered AFTER the improved availability and reliability of the protected function is taken into account (in order to manage multiple failures).

		the operational risk (now quantified) in order to be considered.	without any protection / standby / redundancy during this period.	These decisions are all risk based.
SAE JA 1011/2 International RCM Standard	RCM2 complies fully with the minimum requirements of the SAE RCM standard.	RCM3 complies fully with the minimum requirements of the SAE RCM Standards and goes beyond these requirements. RCM3 aligns with ISO 55000 and ISO 31000 Management Systems.	To align and integrate RCM with recognized and adopted International Management Systems. To mainstream RCM with International Asset Management Systems.	RCM3 now aligns with new and emerging standards making the results easier to defend. International standards and management systems are rarely challenged. RCM3 will become the new standard.