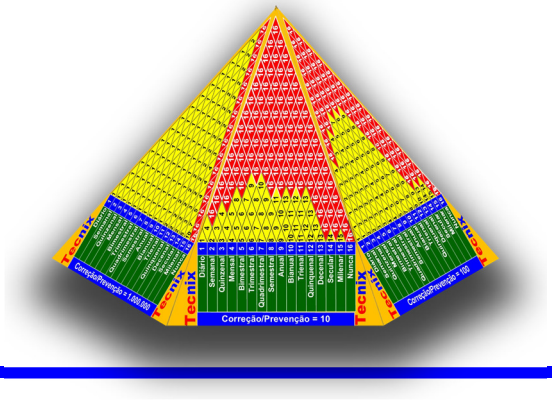
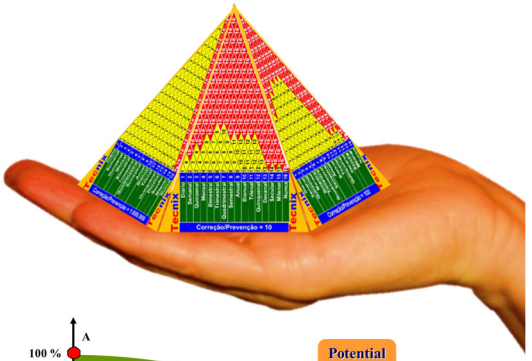
TECNIX IMCC

A practical way to optimize RCM
Reliability-Centered Maintenance



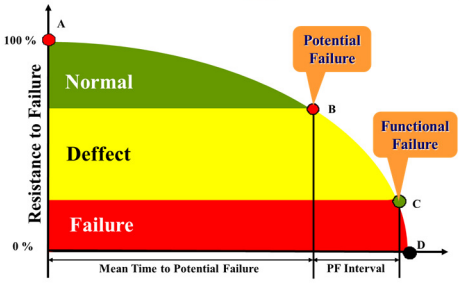
Description

TECNIX IMCC is a three-dimensional tool, implemented as a handheld hexagonal pyramid, to help maintenance managers, engineers and technicians to take the two main decisions of RCM, the Reliability-Centered Maintenance. The first refers to the selection of the ideal type of maintenance based on the failure behavior of the asset. The second is the ideal maintenance interval that optimizes the return of maintenance to stakeholders. The tool is independent of the type of asset or specific measure of return, be it in cost, revenue, reliability, availability, net income, etc.



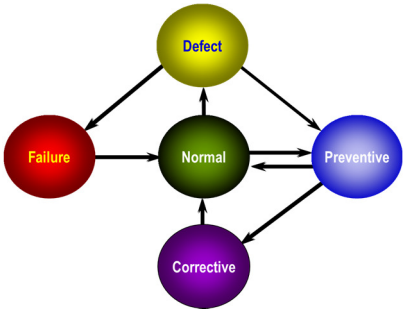
Resistance to Failure

The tool is based on the traditional curve adopted by RCM to represent degradation of the resistance to failure of an asset with calendar or operating time. Three states are clearly defined in this model: normal, defect and failure state. The last two are also called potential and functional failure states in RCM, respectively. In this model, two parameter are identified, for each asset and maintenance activity, as the Mean Time to Potential Failure, and the PF Interval, as shown in the picture. These parameters are usually estimated from maintenance historical data, or from empiric judgment from maintenance experts.



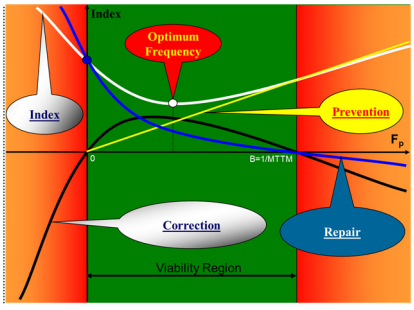
Mathematical Model

Based on these states, a Markovian network is built by adding maintenance states to represent the preventive and corrective activities performed on the asset, linked by the possible transitions. The net can be parameterized to simulate the behavior of any type of asset subject to any kind of RCM activity, including condition-based maintenance, failure finding maintenance, hard-time maintenance or functional repair after failure.



Optimization Model

A mathematical optimization model is built from the Markovian network to reflect the preferences expressed by the stakeholders or decision makers and to define the best maintenance frequency for each activity and asset. The model is capable to simulate the impact of asset failures and maintenance on any performance index defined by the decision maker, partitioned in preventive, corrective and repair parcels. Simulating the long term return, expressed in non-dimensional or relative units, allows the model to select the best maintenance frequency that minimizes or maximizes the selected performance index for a given activity on the asset. The model is capable also to identify the cases where the best decision is to leave the asset run-to-failure, with no preventive maintenance, and repair it after failure. This is clearly shown by feasibility regions on the optimization graph, and on the three dimensional abacus by red cells on the lateral faces.



More Information

For acquisition or more information, please contact Tecnix Engineering and Architecture Ltd., or access the company website by capturing the attached QR-Code, or through the addresses below.

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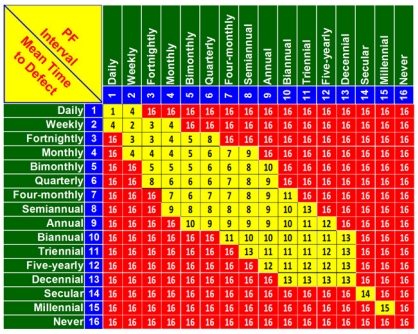
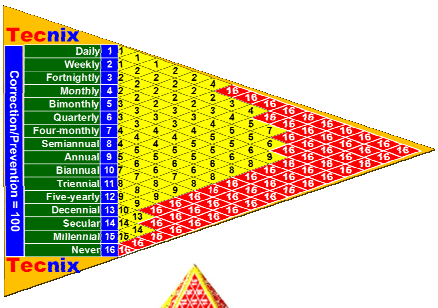
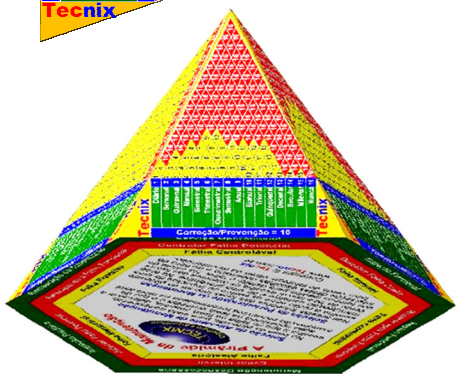
TECNIX IMCC Implementation







Selection of Maintenance Activity

The base of the pyramid contains the instructions to use the abacus. Three colored bands at the border of the hexagon summarize the RCM rules to select maintenance activities based on the failure behavior of the asset. First select the type of failure mechanism in the yellow band, based on the standardized behaviors defined by RCM, then determine the necessary action in the red band and finally the type of preventive or corrective activity in the green band. The selected maintenance is based on the six standard activities proposed by RCM, among condition-based Predictive Inspections, Operational Services, failure-finding Functional Inspections, overhaul or Functional Repairs, Unnecessary Maintenance, and hard-time Restoration or Replacements. Note that Functional Repairs are suggested for the unfeasibility bands defined by the optimization model, while Unnecessary Maintenance is reserved for random failures.

Selection of Maintenance Periodicity

The lateral triangular faces contain six tables to select the best or optimum maintenance frequency for the selected activity. The tables summarize the result of the model simulation for different scenarios, with distinct return rates for each maintenance activity, preventive and corrective, based on the performance index defined by the decision maker. Only the ratio between the return or impact produced by each preventive and corrective action on the asset is necessary, as long as they are expressed by the same performance index and dimensional unit. This can be measured in cost, revenue, availability, net income, or whatever index is selected by the decision maker. At the border of each lateral face there are 16 selectable ranges for the Mean Time to Defect and the PF Interval. named as Daily, Weekly, Fortnightly, Monthly, Bimonthly, Quarterly, Four-monthly, Semiannual, Annual, Triennial, Five-yearly, Decennial, Secular, Millennial, and Never. These ranges define the asset frequency of failures for each impact scenario in the planning horizon.

Selection of the Impact Scenario

Based on the mathematical model of the Markovian network, a symmetrical table can be built that relates the best maintenance period based on the Mean Time to Defect and PF Interval, for every return ratio of the performance index for each corrective and preventive maintenance. The yellow cells on this table show the feasible part of the maintenance period, while the red cells indicate the unfeasible part, where preventive maintenance should never be done, only run-to-failure and functional repairs. Six scenarios are available based on a return ratio of 10, 100, 1,000, 10,000, 100,000 and 1,000,000 between corrective and preventive maintenances. Each scenario is depicted in a lateral face of the pyramid. To find the best maintenance frequency for a given scenario, in the lower edge of the lateral side of the pyramid select the ratio between the return or impacts of a corrective and preventive maintenance, expressed in a chosen performance index. In the green area of the lateral side select the track numbers for the average Mean Time do Defect and PF Interval. At the intersection of these tracks on the triangular matrix, determine the cell number in the green band for the optimal interval.

Animated Video

For an animated video featuring this 3D abacus please access the video channel TecnixOnLine at Youtube, or capture the attached QR-Code.

More Information

For more information about this tool, please access the link to Tecnix products on the company website, or contact us in the following addresses.

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