

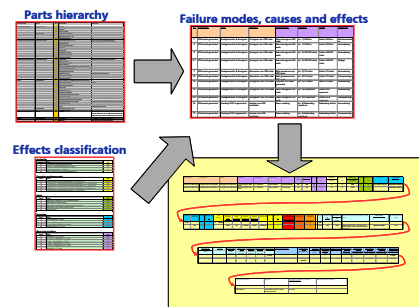
# Maintenance concepts

A goal of maintenance is to guarantee the performance of rail infrastructure objects. The activities involved were traditionally prescribed in regulations and then adapted to the local situation. Contract forms have changed over the years, and are now focused more on output, higher efficiency, more stringent safety instructions and a reduction of the number of breakdowns and function recovery times. These changes have prompted a different way of determining the maintenance required.

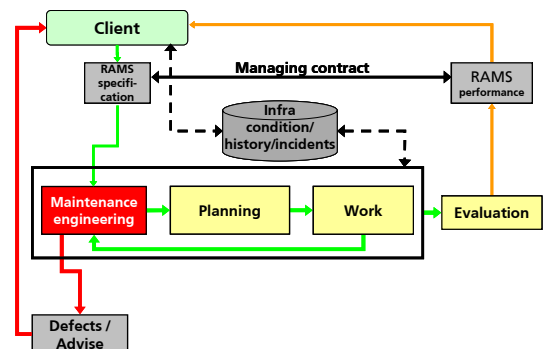
Strukton Rail is accordingly devoting increasing attention to getting maintenance right. A good maintenance concept is a set of maintenance activities for controlling identified risks. The maintenance activities are matched to the customer's business objectives: Reliability, Availability, Maintainability and Safety (RAMS). State-dependent maintenance then becomes possible, which means maintenance achieves the minimum specifications of the customer, but above all is consistent with the local circumstances of the object.

## Risk analysis FMECA

Risk analysis allows us to quantify and qualify the maintenance. One tool used in achieving this aim is a failure mode effect and criticality analysis (FMECA).



If a component fails, all combinations of cause, condition, form of failure and component are mapped out together with the breakdown duration and time to repair. A classification based on the above data or the failure distribution may be made to determine the type of maintenance. If a disruption occurs randomly, the only option may be to wait for the component to fail. This approach is known as breakdown-dependent maintenance. If it is necessary to prevent a breakdown (e.g. because of the costs or the breakdown duration involved), alternatives are state-dependent maintenance, possibly with follow-on actions, or operational life-dependent maintenance.



## Business objectives RAMS

The maintenance concept takes shape only when the relationship between the identified actions and the envisaged business objectives have been established. The business objectives are usually oriented to reliability, availability, maintainability and safety (RAMS), as they relate to the infrastructure object.

### Control based on risk figures and budget

Choices have to be made based on the budget available. The choices are made by referring to defined risk figures. Risk figures are produced by classifying and weighing up RAMS data (i.e. information on availability, train safety, breakdown duration and corrective maintenance costs).

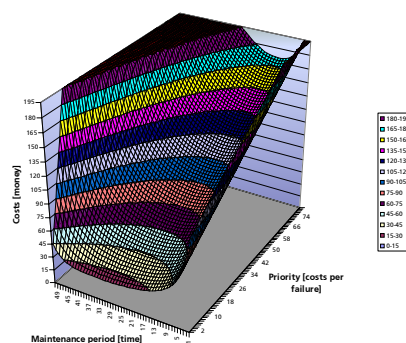
### Making the local specific

Generic maintenance concepts are specified locally by taking the local circumstances into consideration. Depending, for example, on the substrate, or the quality of the ballast, a maintenance activity on a given type of points can be performed more often, less often, more intensively, or less intensively.

### Maintenance concept based on a predictive model for points

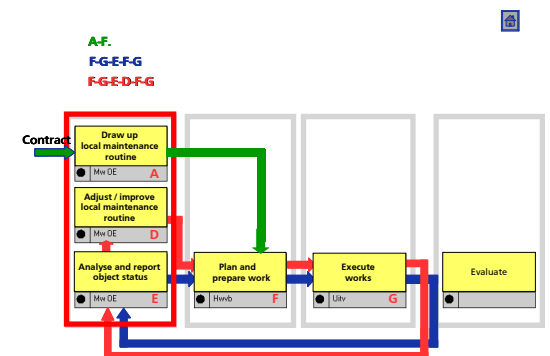
The best possible maintenance frequency can be determined using a predictive model for points. The model is based on data on passing trains, the costs of breakdowns and of preventive maintenance. The model factors in the higher consequential loss attributable to relatively important points.

Costs at different maintenance periods and different priorities



### Improvements through circles of control

Maintenance concepts have to be assessed continuously. Strukton Rail has incorporated circles of control into its business processes in order to perform this evaluation. After overall and detailed planning, maintenance engineers examine the delivery data from operations, together with inspection data, information from survey trains and breakdown data.



If the quality measured does not meet the agreed CPIs (Critical Performance Indicators), we recommend modifications and amendments to the maintenance concept based on the maintenance engineering processes. Precise analysis tools make the delivered quality demonstrable.

### Optimum price-performance ratio

The above method means that budgets can be expended on activities tailored to the object, taking into consideration the local circumstances and the customer's business objectives. The maintenance concept that emerges has an optimum price-performance ratio.