Risk-based asset management of a navigation network

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Summary

In the Netherlands the State Public Works is responsible for the main waterway network (~3.300 km), where locks are the decisive bottlenecks in navigation corridors (see figure 1). In the last decade the State Public Works has changed from a technical oriented maintenance organization mainly focussed at the component and asset level to a user oriented service provider at the corridor and network level, while the more technical activities at the basis are brought to the market. But this radical change will only be successful if the relations between the technical conditions of components at the basis are known and can be explicitly linked to economically based requirements at the network level in terms of availability, etc.

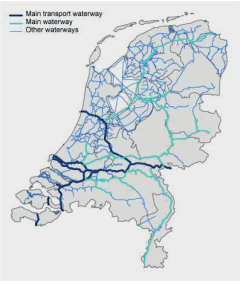

Fig. 1: Dutch waterway network

To work this out, a restricted amount of locks (around twenty) are carefully inspected and bottom-up analysed to assess their present state and to find these vertical relations. Next a set of more generalized findings based on key performance indicators will be rolled out across the whole network in order to rank the risk of the different (sub)systems and prioritize inspection and maintenance activities.

Keywords: Waterway network; service provider; asset manager; risk based; inspection; maintenance; reassessment; availability; reliability; key performance indicators.

1. Risk based approach

Unavailability and unreliability at the top of a system will most of the time originate from foreseen, but what is more worse also from unforeseen or still unknown (combinations of) basic events at the component level (see figure 2). Several ageing mechanisms could lead to loss of strength and at the same time there could be a growth in loading conditions, by bigger vessels, etc. Also (hidden) human failures or unforeseen heavy natural boundary conditions could play a role. If time dependent basic events and their consequences for the behaviour of the structure were not recognized during inspection, so not repaired by preventive

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maintenance actions, they could lead to unforeseen failure at the component level and dependent of the build in redundancy, also at the system or even macro-system level. Together with the time to repair in case of unplanned maintenance, this will result in certain unavailability. But even if these basic events were known, well recognized during inspection and consequences for the behaviour of the structure may not be neglected, they could lead to preventive maintenance actions and so to a certain planned unavailability of the subsystem or dependent of the redundancy even at the system or macro-system level.

Though basic events stands at the basis of failure trees, it is a hard job to physically model all relevant basic events for all components and next their possible effects on different subsystems, etc. At this moment a direct and explicit relation between a specific basic event and the consequences at higher system-levels could only be modelled if there is a dominant mechanism. But in other more complex cases, a more generic approach is followed (see figure 2). So unavailability and unreliability at the subsystem-level (so called IH-deel) are considered as the lowest detail level. The assumption will be that there are certain generalized relations with a set of key performance indicators given by experts, partly based on experience and partly on theoretical models. These relations may be derived from the group of well inspected and reassessed assets (twenty locks) and used to predict other subsystems.

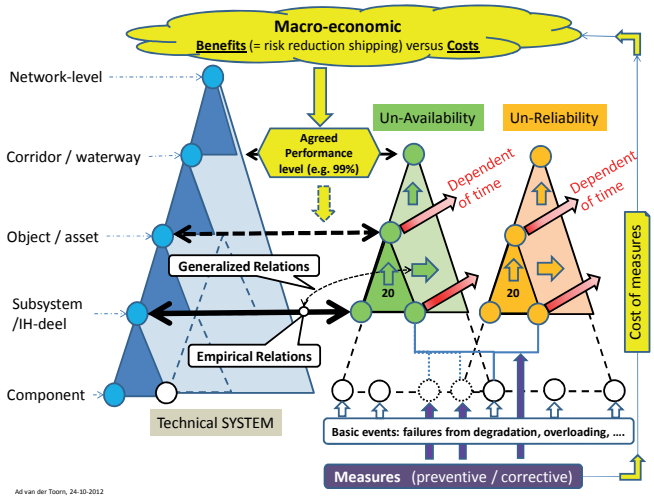

Fig. 2: How economically based requirements meet technically based performance

2. Conclusions and Discussion

The radical change from technical oriented maintenance managers to service providers at the network level is not only a matter of renaming the organization, but it also gives a boost to a fundamental other way of asset management. The project is now in full swing and should be supported by a good mix of 'new' conceptual theory and 'old' practical experience, however the organization is already in transition and people are on the move.