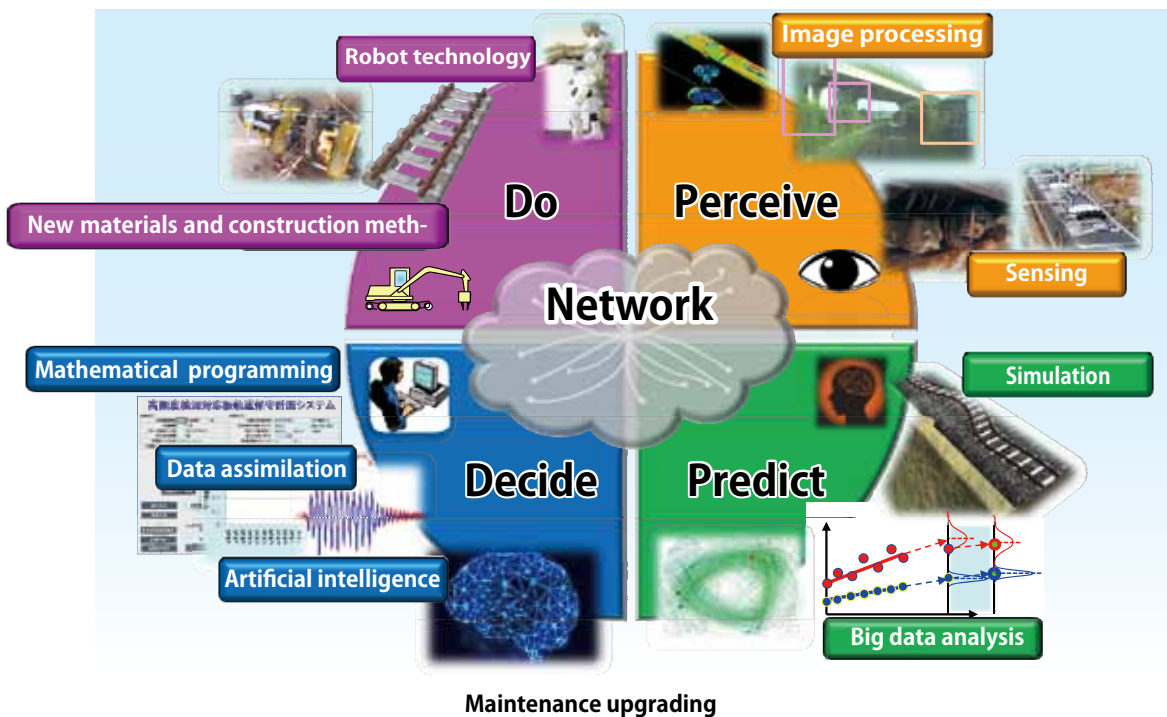


Digital Technologies Will Change Maintenance Work

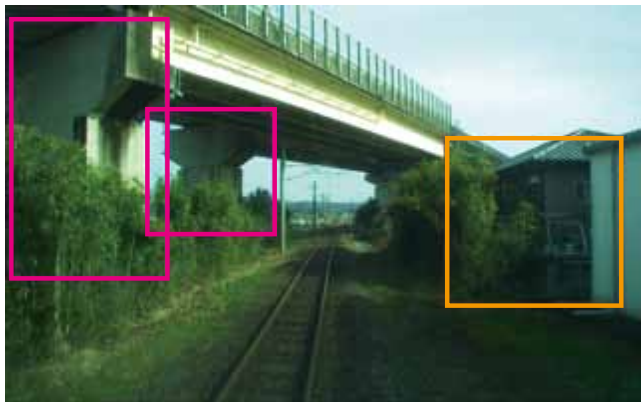


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 Director
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Preface

The issues in maintenance can be separated into three subjects: “labor-saving”, “cost reduction”, and “quality improvement”. Which of the three should be stressed depends on the railway operator and circumstances of the country. In a country where there is declining birthrate and aging population, “labor-saving” is promoted in preparation for future shortage of maintenance personnel. For a regional railway with a low transport revenue, however, “cost reduction” may take precedence. In a developing country where serious railway accidents still frequently occur, “quality improvement” of

maintenance is an urgent issue. In Japan, the issue was “quality improvement” of maintenance at first because it was directly linked to safety. After privatization of JNR, the priority issue became “cost reduction” for sound management, and then “labor saving” in recent years when the declining birthrate and aging population have become serious concerns. Of course, all the issues are still under research and development performed by RTRI. Moreover, using ICT (Information & Communication Technology) that has been developing rapidly in recent years may make it possible to upgrade railway maintenance and solve all the three issues at once.



Wayside obstacles



Public (persons and cars)

Automatic extraction of hazards in the environment surrounding tracks

Maintenance upgrading and digital technologies

Upgrading of maintenance refers to

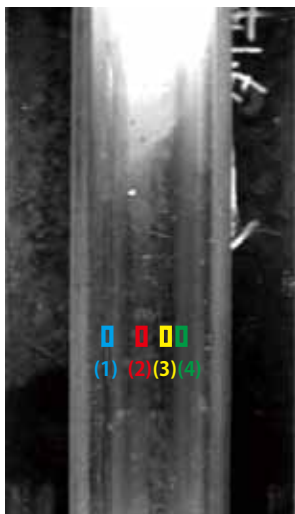
- 1) Digitizing all the maintenance information,
- 2) Classifying the maintenance into four phases: "Perceive," "Predict," "Decide," and "Do", and automating and sophisticating these phases using ICT, and
- 3) Exchanging maintenance information

between phases over the network, as close to real-time as possible.

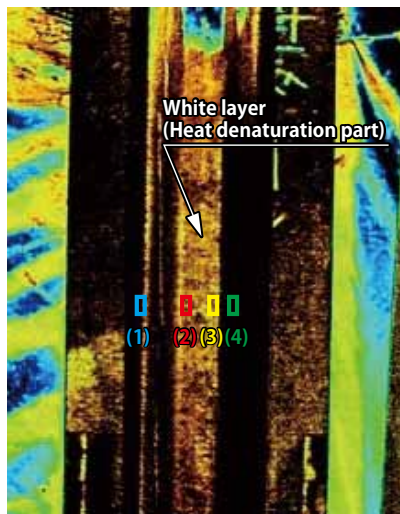
The most important thing in this case is that all the maintenance information is digitized, which means that the "Perceive" phase for acquiring information is the most important.

So far, dynamic sensors, such as displacement gauges and load meters, are commonly used to obtain maintenance information. However,

subjective information from human visual inspection can now be easily digitized using a combination of image processing, machine learning, etc. Therefore, RTRI is focusing on image-based sensing to upgrade the "Perceive" phase. At present, RTRI is developing basic image sensing technologies, such as those for automatically extracting hazards in the environment surrounding tracks, and identifying the state of rail deterioration from the spectral information in images.



Rail image



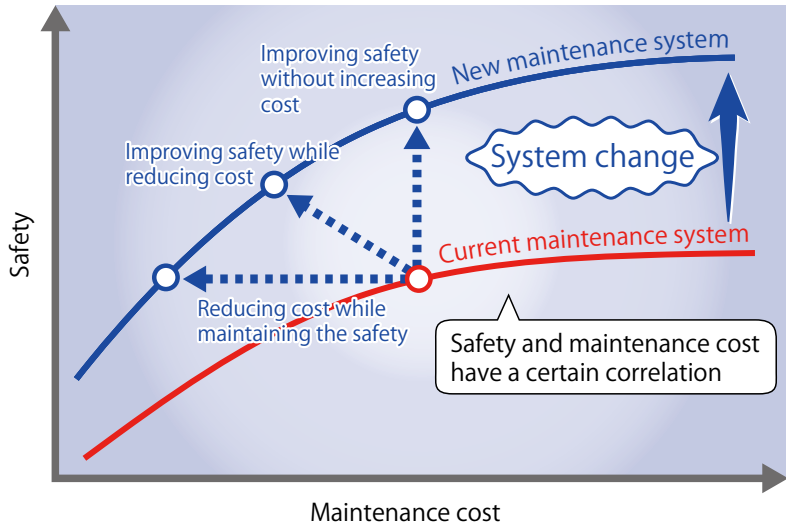
Spectral analysis image

Rail deterioration judgment through image spectral analysis

Maintenance system changes

Maintenance upgrading will accelerate the solution of the issues of “labor-saving”, “cost reduction”, and “quality improvement” in the current maintenance system. However, these issues have factors contradictory to each other, and it is sometimes difficult to solve them simultaneously in a single maintenance system. There is obviously a certain correlation between safety and maintenance cost. As cost reduction is promoted, lowering of safety to a certain degree may sometimes be tolerated. Although circumstances differ between railway operators, the ideal is to reduce cost without sacrificing safety. This requires changes in the maintenance system, i.e., “system changes”.

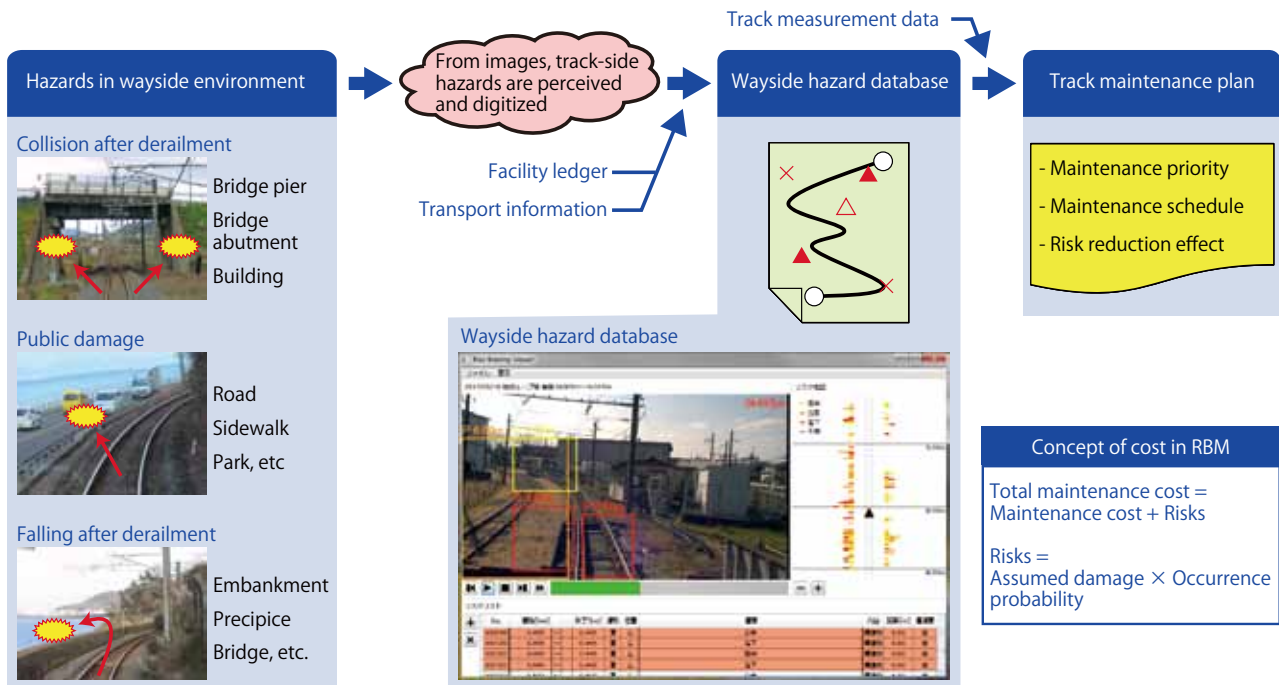
RTRI is investigating RBM (Risk Based Maintenance) in which the total maintenance cost is obtained by adding



Safety and maintenance cost

the maintenance cost to risks that are calculated on the assumption of post-accident scenarios from railway hazards. RBM, when combined with CBM (Condition Based Maintenance), may achieve

safety improvement and cost reduction simultaneously. When realized, it will bring about drastic system changes in track maintenance.



Risk Base Maintenance (RBM) on tracks