CSIC
Cambridge Centre for Smart Infrastructure and Construction

Transforming asset management

Assessing a London Underground tunnel

Value-based tunnel repair strategy for London Underground
CSIC with Industry Partner London Underground

The project

CSIC's Asset Management team assessed London Underground (LU) tunnels where seepages have occurred. LU carries approximately 1.2 billion passengers per year and the capital's contribution to the national economy significantly depends on the delivery of this capacity. With parts of the tunnel network now more than 150 years old, maintenance is essential to realise value from the infrastructure.

The challenge

Ground water seepage is the most common maintenance concern in many railway tunnel systems, particularly in older tunnels not built to modern waterproofing standards. The precise location of seepages can be hard to predict, making effective maintenance planning difficult.

Uncontrolled seepage results in corrosion of track and structures, disruption to signalling and other electrical systems and general deterioration of surfaces. Untreated, these issues can lead to reliability issues and an unsightly appearance in public areas.

London Underground has invested in trials of materials and methods to treat these issues. These have established a palette of remedial solutions together with published guidance on the design and implementation of grouting to control individual seepages.

The approach

CSIC's Value Mapping Tool identified the optimal repair option for seepage problems in LU tunnels

to achieve the best value for money and least disruption to business.

To achieve this CSIC developed and applied a value-based approach to determine the stakeholders for an LU tunnel, including LU operations, LU maintenance, customers, Mayor of London, and employees. The requirements of the different stakeholders were translated into a number of measurable value drivers and associated metrics. This marks the first time a structured approach for value-based decision making has been developed and applied.

A value map was developed which showed how different deterioration and failure modes of the tunnels could directly or indirectly (through interactions with other assets in the tunnel, e.g. signalling system and tracks) affect the value drivers.

The value map was then translated into a mathematical optimisation model that considered a 50-year horizon to find the optimal repair option for a given location in the underground tunnel network. This approach reduces disruption to the London Underground service by structured identification of repairs and minimisation of risks.

The benefits

CSIC's Value Mapping Tool enhances value to the organisation by providing a standard systematic approach for making asset management decisions. There are considerable cost savings to be made by making informed choices on the type and timing of repairs that strike the right value-vs-cost balance.

The value map can aid asset owners in a better understanding of the dependencies that need to be considered for a particular asset when making asset management decisions. It can also enable organisations to understand the information requirements for asset management decision making.

The value map can be used to develop innovative ways for managing assets, such as enhancing inspection reports for information gathering purpose, which in turn can be used for learning and modelling of asset deterioration. CSIC's Value Mapping Tool can be adapted to apply to a range of assets and asset management programmes.

Impact

"The Underground has recently made good progress in developing methods for treating condition issues such as seepages in our tunnels. To achieve best value in future, our challenge now is to select the most beneficial of these techniques for each situation. CSIC's asset management tool offers an opportunity to assess systematically what we should value in each case and guide the decision making accordingly."

Keith Bowers, Principal Tunnel Engineer at London Underground, Transport for London

CSIC contacts:
Dr Ajith Parlikad E: aknp2@cam.ac.uk
Dr Raj Srinivasan E: rs538@cam.ac.uk

For further CSIC Asset Management case studies see **www.centreforsmartinfrastructure.com**

Asset Management