

Abstract

The construction of railway infrastructure networks requires heavy investment, long planning and execution times and extended life cycles.

An important family of projects in Railway Engineering are the Maintenance, Renewal and Improvement (MR&I) projects. They are critical to maintaining railway infrastructures in good condition and to adapt them to environmental changes and new operating conditions and needs. MR&I action plans have a great impact in the short term because they affect the performance of operating facilities. A critical issue for public infrastructure managers and planners is the effective allocation of the scarce resources available for maintenance and repair of railway infrastructures. Obsolescence and lack of adequate maintenance and repair of the railway network affect productivity and lead to increased costs over time.

Every year the Manager of a rail network area is faced with different MR&I needs. This involves different projects to be executed with different levels of urgency, different levels of investment and different improvement measures and action plans on the railway network. Therefore, the Manager has a portfolio of MR&I projects and a limited budget. The main problem that the manager faces is setting priorities among the projects to decide which ones will be executed first. It is a complex problem due to the number of different projects and criteria to be considered.

Classical approaches are based upon the Cost Benefit analysis (CBA) but there are great uncertainties and variations between the economic values used in different models and the results

are heavily dependent on the specific methodology adopted. Methods based upon Multiple Criteria Decision Analysis (MCDA) allow mixing quantitative and qualitative criteria, aggregate multiple experts evaluations and, in general, obtain more robust project rankings than CBA. There is little evidence in the scientific literature of the use of MCDA to similar cases.

Research conducted in this thesis studies the decision-making process to choose MR&I projects in a railway network. Technicians and managers are given a methodological tool to help them establish a priority between all the projects in the MR&I portfolio. The problem is addressed as a Multi criteria decision making (MCDM) problem in which three different ANP models have been used, comparing the results obtained with all of them: Analytic Hierarchical Process (AHP), Analytic Network Process with subnetworks for Benefits and Costs (ANP-BC) and the Analytic Network Process with subnetworks for Costs, Benefits, Opportunities and Risks (ANP-BOCR)

The main contributions of this works are:

- Deep analysis of the decision criteria.
- Design of a procedure for evaluating many different alternative projects.
- A decision making process which is both systematic and strict has been obtained. It can be generalized to other areas of the railway infrastructure management company.

Thanks to the results the budget can be used in the best-valued projects according to the criteria established by the decision maker. The prioritization is then obtained in a transparent and documented way.

