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Life cycle costs for railway condition monitoring

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Abstract

The European Commission has estimated that by 2020 passenger traffic will double and freight traffic will triple compared with current volumes. Over the same period a reduction of 30% in the life cycle costs (LCC) of trackside assets is desired. Remote condition monitoring (RCM) can help to achieve increases in Reliability, Availability, Maintainability and Safety (RAMS) of trackside assets such as points (switches) and level crossings. Nonetheless, the application of a LCC model to RCM has hitherto been overlooked. Using a real case study, the objective of this paper is to illustrate how the cost–benefit of RCM can be evaluated.

Keywords: Life cycle cost; Condition monitoring system; Point mechanisms

1. Introduction

In 2002/2003, Network Rail, Britain's railway infrastructure operator, was responsible for 14 million minutes of train delays which made up approximately 55% of all delays experienced by rail passengers. The average penalty payment per train delay minute in Britain is of the order of 40 GBP, and the highest in excess of 100 GBP. The main cause of train delays was point actuator failures, with in excess of 10,000 incidents (Corporate Responsibility Report, 2005).

Numerous research projects have considered the application of remote condition monitoring (RCM) in order to reduce delays (e.g. Redeker, 2006; Roden, 2005). This previous work has helped to improve the reliability of point actuators through the use of predictive rather than corrective maintenance. However, in producing a business case for RCM, it is important to understand the life cycle costs (LCC) associated with applying such new technology. Four main cost categories must be considered in any investment appraisal:

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hazard costs; investment costs; maintenance and operating costs; and delay costs, sometimes referred to as deferred production costs (Proctor, 2000).

The LCC model described in this paper was inspired by work carried out at a railway junction in the United Kingdom where Network Rail had recently installed a point actuator condition monitoring system, and it was considered desirable to understand the true LCC and hence financial cost–benefit of installing the system prior to further installations taking place.

2. Life cycle cost

In general terms, LCC is the overall estimated cost for a particular solution considered over the whole life of the solution. LCC should include direct and indirect initial costs plus any periodic or continuing costs for operation and maintenance (Life Cycle Costing Guideline, 2004). The LCC of a system can simply be considered as the total cost that is incurred between requirement specification and disposal (SINTEF, 1998) as shown in Fig. 1.

The interest rate used to calculate an investor's time value of money is called the discount rate (Stephen and Dell'Isola, 1995) and the National Institute of Standards and Technology (NIST) recognises two types: the nominal discount rate (which takes inflation into account) and the real discount rate (which does not). The International Electrotechnical Commission (IEC) – the leading International Organization for Worldwide Standardization (ISO) – suggests breaking LCC down into two broad categories (IEC 300-3-3, 1996):

1. Investment (or acquisition) cost, i.e. the initial costs that will be incurred prior to operation. It is not usually necessary to discount them because they are incurred in the first (base) year.
2. Cost of ownership, or life support cost once operational, i.e. operating cost, and the costs of maintenance and repair (but not replacements). These need to be discounted to their present value since they arise in subsequent years.

As for the objective behind calculating LCC in general terms, this is typically to assess whether or not to invest in some *primary* piece of equipment or infrastructure. However, the main contribution of this paper to

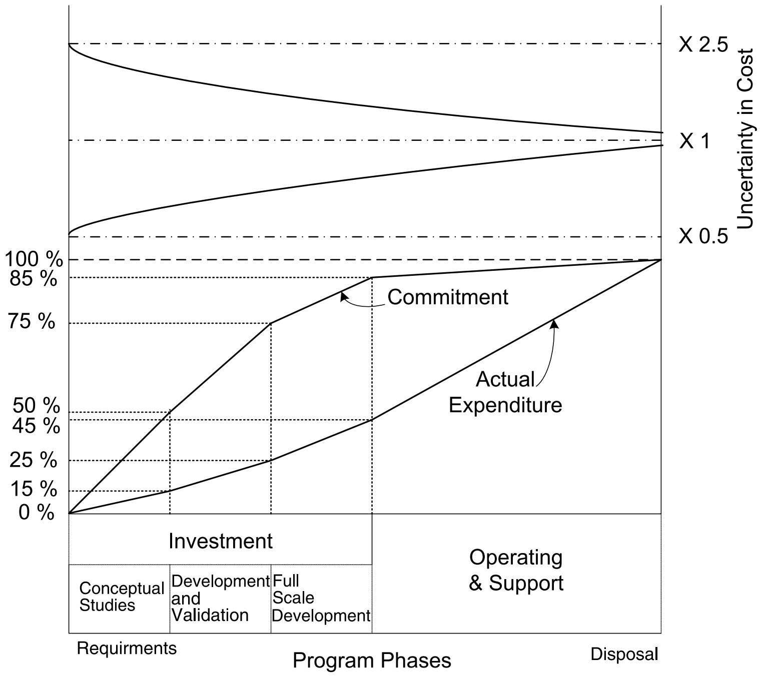

Fig. 1. Cumulative cost in LCC (ANSI/SAE ARP 4293, 1992).