NRA Pavement Cost Model – model development and data issues

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Abstract

This report documents a number of issues that were encountered during the development of a pavement cost model for the National Roads Authority, Ireland. These issues were primarily brought about because the data was being used for new purposes in predicting maintenance on the Irish network. The issues are highlighted in this report so that any future development of a pavement cost model on this, or any network, can take them on board at the design stage.
1 Introduction

During the development of the National Roads Authority (NRA) Pavement Cost Model (referred to as “the model”) a number of issues with the data were raised. Primarily these became apparent because the data was being used for new purposes, notably the modelling of the pavement network for maintenance prediction. This document discusses the issues encountered so that the future development of a Pavement Management System (PMS) can learn from these experiences.

The issues discussed in this document relate to:

- Import process;
- Network definitions;
- Defect table names;
- Data trending;
- Treatment data;
- Works costs.

2 Import process

The model uses NRA network data (inventory, condition, traffic etc.) to model the pavement network and predict the future maintenance needs, based on a set of input parameters. There is no guarantee that any data sources (tables) or field names will not change in the future. If the model used these data sources or field names directly and they changed it would have meant that the model becomes unusable.

In order to mitigate this risk an import routine was developed for the model which takes the NRA input data and processes it into a set format required by the model. Within this pre-processing, the import process allows the user to manually select the table names required (the required table names at the time of development are shown in Appendix A of the ‘User Guide’ document (Buckland, 2011b)). Therefore as long as the field names remain consistent within the tables then this flexibility should limit any problems with the table names changing in the future.

By building in this pre-processing stage, if there are any future changes to the NRA data only the import process would need to be adapted. As long as the output from the import process is a database containing the NRA data in a format required by the model then the model will continue to function as designed.

Therefore, if there are any future changes to the NRA data then any user of the model will need to be aware that it might require the import process to be updated.

3 Network definition

In developing the model one of the first tasks was to determine a set definition of the network. This was accomplished using the inventory tables provided but within the different inventory and condition tables there were differences in the route length for all routes. This would be expected because the survey length would change slightly each year but it might be a useful addition to the data to hold a set lookup table of the
network and route lengths. Other data sources could then be stretched or shrunk to fit those lengths as required.

One of the key NRA requirements was to be able to model the primary and secondary networks separately and configure them differently where appropriate (e.g. deterioration rates). However, the definition of the primary and secondary network was not available in the data and so a lookup table was created to hold this information for use in the model. It might be beneficial to set the definition of these network classes centrally, through the use of a flag in one of the inventory data tables, so that if the definition does change in the future then it can be update centrally.

4 Defect table names

During development of the import process it was decided to allow the user to select the table names that contain the required data. The process was designed in this manner to limit the need for a programmer to make any future changes if the NRA table names change.

The condition defect data is stored in a separate table for each year; however the process for importing the condition data assumes that the table names for each year are of the same format, except with a change in the suffix of the table, which represents the year of the data.

One of the condition tables (2008) had a naming convention that was different to all the others, ‘NM_Defects2008’ as opposed to ‘nra_sde_NRA_GIS_NM_Defectsyyyy’ for all the other years, where yyyy is the year. Therefore, the table name for the 2008 table was manually changed to be consistent with all previous years.

If there are any differences in the condition defect tables in future snapshots of NRA data then the user may need to manually alter the defect table names so they are consistent.

5 Data trending

One of the key elements within the development of the model was to be able to take NRA condition data and deteriorate it for future years through the use of deterioration rules.

However, due to the previous survey frequencies (where the same direction on the network was surveyed every four years) it meant that in the eight years of available data only a very small proportion of the network had three or more data points. Therefore there was very little data from which to validate deterioration models within the literature, and all of the data centred very heavily on zero rates of change. Examples of the rutting and texture trends visible in the data are shown in Figure 1 and Figure 2.

To overcome the shortage of trends in the condition data the model was developed to allow the user to input their own deterioration rates for the different classes and carriageways on the network, providing flexibility in the future when more data becomes available. As the survey frequency on the network increases and these surveys are loaded onto the NRA systems it is recommended that a separate exercise should be undertaken to investigate the additional data for any apparent trends.
Figure 1: Positive rutting trends from NRA condition data

Figure 2: Negative texture trends from NRA condition data
6 Treatment data

The model is developed to predict future maintenance on the network when the condition merits such interventions. In order for that to work the model requires treatments and associated trigger values for the different condition defects. The need for NRA specific treatments and triggers was discussed during the development of the model but there is currently no readily available default data for treatments. Therefore, standard generic treatments that would be carried out on the network were agreed with the project sponsor and set up as default options within the model. The user also has the functionality to enter treatments of their choice.

There are no standard NRA condition triggers for the various treatments discussed, primarily due to the current ongoing procurement of a PMS system which will address some of these issues. The current design guidance for the NRA (NRA, 2009) does not contain any documented pavement assessment levels and states that the UK standard HD 29/08 (Highways Agency, 2008) is not applicable for the Irish network. However, in lieu of any default trigger values for the condition parameters, intervention levels from HD 29/08 were used for the parameters of rutting and texture. The user is free to override these values with intervention thresholds of their choice during the setup of an analysis.

It is recommended that as the development of the PMS proceeds, these values are revised to reflect the values used in the PMS.

7 Works costs

To translate the maintenance predicted by the model into costs there needs to be unit rates associated with all the treatments. The current unit costs in the default data of the model were collated centrally from the Department of Transport following discussions with a Principal Advisor. These costs correlate with information collected by NRA from past maintenance schemes, although the cost ranges across all the NRA schemes does vary significantly.

Currently the costs in the model are the same for all carriageways but it is recommended that if NRA know of any carriageway variation in unit costs (e.g. efficiency savings with multiple lanes) then these should be reflected in an update of the unit rates.
8 Acknowledgements
The work described in this report was carried out in the Asset Management group of the Transport Research Laboratory. The author is grateful to V Ramdas who carried out the technical review and auditing of this report.

9 References
Highways Agency et al. (2008). *HD 29/08: Data for Pavement Assessment, Design Manual for Roads and Bridges (DMRB 7.3.2).* London: TSO.
This report documents a number of issues that were encountered during the development of a pavement cost model for the National Roads Authority, Ireland. These issues were primarily brought about because the data was being used for new purposes in predicting maintenance on the Irish network. The issues are highlighted in this report so that any future development of a pavement cost model on this, or any network, can take them on board at the design stage.

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