G Deficiency database and prioritisation process

Contents

G.1 Deficiency database and prioritisation processes

Background

Developing a safety deficiency database will be a major component for many RCAs of their implementation delivery plan. However, most RCAs will already be recording a lot of the information that could be placed in such a database through existing safety audits, safety inspections and reports from contractors.

In mid-2005 Land Transport NZ, in partnership with the Ministry of Transport (MoT) and 10 RCAs and consultant engineers undertook a project examining what the key attributes of any database and prioritisation process should be and assessing existing systems. The following information is provided to assist RCAs develop/upgrade their safety deficiency database based on current best practice. As more knowledge becomes available, this will be made available by Land Transport NZ safety management system co-ordinators.

Overview

Deficiency databases allow deficiencies on a road network to be logged with sufficient information and tracked from a variety of sources, including:

- public notification/complaints
- contractors
- staff
- safety inspections
- safety audits
- emergency services.

Provided a consistent level of information for each deficiency is recorded, the data sorted within the database can be further interrogated to provide an indication of which deficiencies pose the highest risk and should therefore be examined for treatment first.

Interrogation of the database will also quantify the deficiencies that exist on the network as a whole or on a specific road or section.

The key benefits of a safety deficiency database are:

- as a repository of deficiencies on an RCA's network
- as a tool to measure tracking of responses
- as a mechanism to check contract intervention levels are being met
- the ability to interrogate data to assist with asset management
- the ability to identify the deficiencies on the network which present the highest risk if left untreated, which thus provides an order of programme for treatment investigation.

G.1 Deficiency database and prioritisation processes, continued

Overview, continued

The key benefits of a prioritisation process are:

- facilitates best risk reduction/ safety benefits for money spent
- allows programming and budgeting of safety improvement works
- assists with future maintenance or upgrade work programming where safety improvements can be added on or incorporated into work programmes at a lower cost than as stand-alone projects
- provides a prioritisation for treatment of deficiencies based on an understandable process to assist in consultation with politicians and ratepayers
- provides a consistent process for defence against litigation.

Although there is still further work to be undertaken on the project, the decision has been made to release a summary of the information from the project to date and the associated checklists to enable RCAs to progress their deficiency databases. Copies of the full report can be obtained via Land Transport NZ safety management system co-ordinators.

The project explored a cross-section of existing deficiency database and prioritisation process systems ranging in complexity from simple Excel spreadsheets developed in-house by the RCAs or their consultants, to more complex systems developed by third parties. An overview of some overseas systems was also provided within the report.

Input fields

To assist with delivery planning RCAs should consider the process that forms a safety deficiency database, including a current list of all sources of input information ie, safety deficiency identification. A suggested minimum list of inputs fields for such a database is as follows:

- deficiency number recorded in the system
- road name
- direction of travel
- side of road
- RAMM route position of side road
- distance from side road
- left or right on road
- type of hazard
- operating speed at hazard
- comments (ie, text)
- annual average daily traffic
- proposed treatment
- treatment cost.

G.1 Deficiency database and prioritisation processes, continued

Input fields, continued

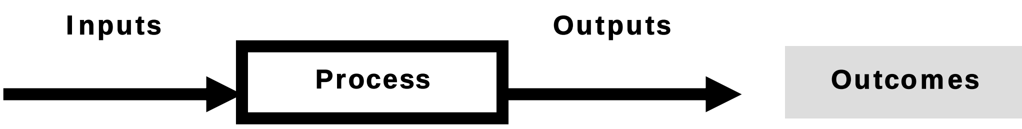
Further consideration may also be given to providing:

- images of the location/hazards, particularly if the assessor doesn't have good local knowledge of the area
- indication of speed limit/advisory speed
- approach speed of traffic
- the length of hazard
- where relevant, indication of proportion of commercial vehicles could help as ARRB's road safety risk manager allows for this for certain road types
- characteristics of the site such as lane width, shoulder width (sealed and unsealed), available clear zone, hazard severity, type of terrain, horizontal alignment, delineation, overtaking provision, left and right turn provision, sight distance, intersection or road section type
- indication of ongoing treatment costs and treatment life
- street address.

Deficiency database process attributes

One output from the Land Transport NZ/MoT project was to define a list of attributes that should be considered by an RCA investing in a deficiency database and prioritisation process. This is shown in the following figure.

Figure 1 Process flow diagram



Using the components of the above diagram to define what various stages to consider, the following paragraphs define the attributes that should be examined:

- Data INPUT process attributes
  - The system must be user friendly ie, simple to use and easy to access.
  - The system should not require the use of engineering judgement when data is being entered ie, while an RCA engineer might be involved in the collection and identification of data, the system must be simple enough to ensure that data entered into the system could be done by administrative staff.
  - The system should allow for both electronic and manual transfer of data from one system to another.

G.1 Deficiency database and prioritisation processes, continued

Deficiency database process attributes, continued

- PROCESS design attributes
  - The system must be able to generate responses quite rapidly – real-time responses are expected.
  - The system must be able to store, analyse and prioritise the safety deficiencies identified.
  - The system could be hosted internally or externally or via the internet so it can be accessed as and when required. Large RCAs might wish to host and own the system, whereas small RCAs might wish to have the system hosted and owned by an external consultant.
  - Contractors and consultants should be able to use the system. In some cases, they may own the system and use it to deliver services to RCAs.
  - The system will be used as a tool to assist RCAs in their analysis of safety issues and safety expenditure – the amount of decision-making capability that the system should have must be flexible.
    - At one extreme, the system could provide an analysis of different safety deficiencies eg, it could provide 'what if' options when identifying solutions and the outcomes and costs of those solutions.
    - At the other extreme, the system could simply be used as a data repository, where pertinent details of safety deficiencies are recorded.
- The system must be designed to facilitate and process, where it adds value, the input of data into the system from different sources eg, RAMM, CAS.
- While the system might require the use of engineering judgement at the output stage to understand the results, the process to produce the outputs must be transparent and understandable to the lay person.
- It is important to appreciate that any system used by an RCA must meet the IT requirements of the RCA, as these requirements will have a significant impact on how the system is hosted, used and operated.
- The system needs to capture new data on existing deficiencies and be able to use this data to update the value of the existing deficiencies.
- The system should rank and prioritise the safety deficiencies on a range of different criteria eg, safety concerns, mitigation costs, high risk deficiencies.
- The system should allow the RCA to prioritise their projects by use of a safety return criteria.
- The range and depth of safety deficiencies that the system is able to record should be flexible – to facilitate the capture of deficiencies identified on an RCA's network.
- Any system used must be simple, robust, accurate and secure.

G.1 Deficiency database and prioritisation processes, continued

Deficiency database process attributes, continued

- OUTPUT attributes
  - The information outputs of the system must achieve a sufficient level of quality to enable RCAs to obtain maximum value for money with respect to safety expenditure.
  - The documentation produced by the system should provide a clear line for auditing.
  - The system should ideally be able to provide specific reports for key areas or issues to be addressed.
  - The information produced by the system needs to be in a format that enables it to be exported/imported into other generic software programmes eg, MS Excel, MS Word, LTP online.
  - The information produced by the system must be able to support engineering judgement when decisions are made with respect to solutions to manage the risks being analysed.
  - It must be clearly identifiable when and why engineering judgement is used in the analysis process and any or all assumptions made through out the process are recorded.
  - The system should be able to produce reports of varying levels of complexity and detail, to meet the user's level of technical capability.
  - The final reports from the system must be understandable to a wide range of people ie, easy to read by a wide audience, easy to understand and easy to defend and justify, although interim outputs could require engineering judgement to understand.
  - The system should be able to provide ranked lists of all safety deficiencies identified and stored within the system.
  - The system should be able to produce a range of outputs eg, text reports, graphical, pictorial representations.
  - Reports produced on a micro level might be used by contractors as action lists to rectify deficiencies.
  - Reports produced on a macro level might be used by RCA engineers, management and politicians to analyse trends, develop strategies and policies.
  - While the system would be developed to meet safety issues and concerns, it should be adaptable in the future, to be able to capture and address information for a range of possible outcomes, such as environmental sustainability.

G.1 Deficiency database and prioritisation processes, continued

Deficiency database process attributes, continued

- OUTCOME attributes
  - A dynamic record of all safety deficiencies are noted and identified on the network.
  - The safety deficiency database is at the heart of the SMS, in that all information on network deficiencies feed into the system.
  - The use of such a system should provide the RCA with a defendable position, in that it will show that the RCA has been able to identify and prioritise actions to address or mitigate the identified risks and hazards.
  - The information produced should quantify all deferred risks, allowing the RCA to better manage their funding allocation.
  - The information produced must be used by the RCA to allow it to determine whether they are able to obtain value for money with respect to safety spending.
  - The use of the information produced from such a system should identify the consequences of politically-driven decisions and as such increase the potential effectiveness of an SMS.
  - Information produced by the system must be able to be used to analyse and address deficiencies to allow the RCA to better manage their SMS.
  - The system must only be used as a tool to assist the RCA to determine how it will manage its safety deficiencies – it is not the panacea, but a key tool to allow the RCA to meet it's SMS obligations.
  - The use of the information produced by the system should allow the RCA to track and measure its safety performance.
  - The system should be able to produce information that could be used on a national level by Land Transport NZ to identify national concerns and issues.

These attributes allow the identification and stimulation of thought on what the characteristics of a database that an RCA should consider when starting out.

G.2 Deficiency database and prioritisation process checklist

Another output from the Land Transport NZ/MoT project was a checklist for a database and prioritisation process, which provides a mechanism for an RCA to methodically check the components of the system they are developing and/or investing in, thereby ensuring that any such system will meet good practice. This checklist is as follows.

Input characteristics

Data characteristic	**Essential characteristics**
Deficiency location	Tick ✓
Use RAAM method of identification Key information required • Road name • Section of road • District, ward • Physical location • Side of road • Direction of travel	

G.2 Deficiency database and prioritisation process checklist, continued

Input characteristics, continued

Data characteristic	**Essential characteristics**
Deficiency information	Tick ✓
Deficiency number Date identified Data sources • Safety inspections • Crash reports • Analysis of RAMM • CAS analysis • Black-spots, Grey-spots, Hot-spots • Crash site monitoring • Stakeholder queries • Public queries • Crash reduction studies • Corridor management plans • Safety studies • Safety audits • Contractor information Identified by who Description of deficiency • Type of deficiency • Size of deficiency Crash data recorded • Number of crashes • Type of crashes • Seriousness of crashes Comments (text)	

G.2 Deficiency database and prioritisation process checklist, continued

Input characteristics, continued

Data characteristic	**Essential characteristics**
Deficiency category	Tick ✓
Category of treatment • Scheduled maintenance • Unscheduled maintenance – Urgent – Non-urgent Minor safety • Capital project (Project feasibility study) Who is responsible for deficiency	
Deficiency programming	Tick ✓
Is the deficiency to be assessed Is the deficiency to be treated Date treatment was implemented Treatment solution to address deficiency Person responsible for developing solution Person responsible for implementing solution Status of solution implementation Cost to develop solution • Estimate/provisional sum Cost to implement solution • Estimate/provisional sum Funding source • RCA and Transit NZ amounts • RCA accounting code/s	

G.2 Deficiency database and prioritisation process checklist, continued

System characteristics

System characteristic	**Essential characteristics**
System use	Tick ✓
Frequency of data entry • Daily • Weekly • Monthly • Periodically Skill required for those entering data • Administration – skilled in use of system • Technician – skilled in use of system • Engineer – skilled in use of system Entry method • Manual data • Importing electronic data	
Information storage	Tick ✓
Years • 1 – 2 • 2 – 3 • 3 – 4 • 4 – 5 • > 5 Track deficiency treatments over time	
System familiarity	Tick ✓
Systems to use common software features	
System 'terminology'	Tick ✓
Terminology to be common NZ-wide	

G.2 Deficiency database and prioritisation process checklist, continued

Process characteristics

Data characteristic	**Essential characteristics**
Criteria used to assess risks	Tick ✓
Factors considered for treatment • Cost • Risk − Frequency − Severity − Exposure • Benefits • Location • Extent of problem • If future works are programmed at site Crashes • History • Seriousness Vulnerable road users Vulnerable road user crashes Police concern Public concern Other agencies concern – Land Transport NZ, Transit NZ, etc. Is it a key item in road safety strategy Traffic volume annual average daily traffic (AADT)	
Risk assessment	Tick ✓
Risk before treatment • Likelihood value • Exposure value • Severity value • Result in a risk score	

G.2 Deficiency database and prioritisation process checklist, continued

Process characteristics, continued

Data characteristic	**Essential characteristics**
Risk assessment, continued	Tick ✓
Risk after treatment • Likelihood value • Exposure value • Severity • Result in a risk score Risk reduction of treatment • Risk reduction score/percentage • Cost-benefit score/percentage Ability to evaluate multiple treatment solutions Date assessment carried out	
Prioritisation process	Tick ✓
Criteria • Pre-treatment risk • Risk reduction ratio • Treatment cost • Benefit/cost ratio Complexity of risk model • Simple assessment – qualitative • Simple assessment – crash data Process response time • Short time – 2 to 4 minutes	
Use of engineering judgement	Tick ✓
When data is entered into system When risks are prioritised by system • Analyse the likelihood • Analyse the consequences • Calculate the risk (score)	

G.2 Deficiency database and prioritisation process checklist, continued

Process characteristics, continued

Data characteristic	**Essential characteristics**
Use of engineering judgement, continued	Tick ✓
When risks treatments are identified When risks treatments are proposed When impact of treatment is assessed When output is reviewed by engineer	
Treatment development	Tick ✓
Developed by RCA engineer Treatments developed one-at-a-time	
Decision making capability	Tick ✓
Analysis of individual deficiencies Analysis of treatments for each deficiency	
System location	Tick ✓
Hosted internally by RCA Accessible by consultants	

G.2 Deficiency database and prioritisation process checklist, continued

Output characteristics

Data characteristic	**Essential characteristics**
Course of action	Tick ✓
Deficiency assigned appropriate action Deficiency assigned to right person Note if further investigation is required Mode of treatment • Safety works programme • Existing maintenance contract • New maintenance contract Dates of action • Date action has been completed	
Output media	Tick ✓
Hard copy Export • MS Word • MS Excel Report format • Text	
Reports produced	Tick ✓
Sort by • Date deficiency entered • Date deficiency assessed • Date deficiency treated • Status of treatments • Deficiency ranking/priority • Risk ranking pre-treatment • Risk ranking post-treatment • Amount risk reduced • Treatment cost • Benefit/cost ratio	

G.2 Deficiency database and prioritisation process checklist, continued

Output characteristics, continued

Data characteristic	Essential characteristics
Reports produced, continued	Tick ✓
• Deficiencies treated • Deficiencies to be treated • Deficiencies per maintenance area • Deficiencies per maintenance contract • Deficiencies per contractor • Contractor per maintenance area • Type of deficiency per network • All deficiencies per network • Type of treatment options • Type of treatment solutions Provide clear line for auditing	
Users of reports (system outputs)	Tick ✓
RCA engineers RCA politicians RCA management Land Transport NZ	

G.2 Deficiency database and prioritisation process checklist, continued

Outcome characteristics

System characteristic	**Essential characteristics**
Value of system to RCA	Tick ✓
System to capture deficiencies • All deficiencies on network • New deficiencies on network • Existing deficiencies on network Formal system • To prioritise or rank deficiencies • To prioritise minor safety projects Decision making tool to assist RCA • To prioritise or rank deficiencies • To prioritise minor safety projects Reason for use of system • Decision-making tool • Provide formal process • Provide hard facts • Provide solutions to deficiencies Holistic approach to managing safety issues More proactive response to safety projects Enhanced strategic knowledge of RCA's assets More focused efforts to achieve 2010 targets Greater value for safety expenditure Provide legal protection	

G.3 Simplified process

The safety deficiency database

A database is simply a list, in this case, a means of listing the deficiencies that occur on the RCA's network. Some of the deficiencies in the list will be items that form part of the maintenance contractors scheduled maintenance and thus the system needs to be able to show when the deficiency was identified and when the maintenance contractor was informed of the deficiency. Ideally the system would have a means of providing a closed loop such as notification from the maintenance contractor that the deficiency repair has been programmed and actioned.

The prioritisation process

Other safety deficiencies will form either unscheduled maintenance or additional safety deficiencies which fall outside the maintenance contracts. These need to be assessed for risk to the road user and/or asset deterioration, and appropriate treatment costs to eliminate, isolate or mitigate the hazard.

To undertake this process will require the person doing the work to have a good understanding of the application of risk in this environment and be able to identify the most appropriate treatment for the hazard.

In its simplest form prioritisation could be considered as follows:

1 Provide a risk score for the deficiency identified based on a combination of exposure, likelihood and severity. This step will provide an initial indication to the RCA of the deficiencies that should be looked at first in terms of treatment as they pose the greatest risk on the RCA's network.

2 Match a treatment against the deficiency that will either eliminate the risk or reduce it to an acceptable level and provide a rough cost for the treatment.

3 Provide a risk score for the treated deficiency as in step 1.

4 Subtract the treated deficiency risk score (step 3) from the deficiency risk score (step 1) to give the risk reduction achieved by the treatment.

5 Divide the risk reduction (step 4) by the treatment cost (step 2) to give the risk reduction per dollar spent.

6 Prioritise the deficiencies based on the greatest risk reduction per dollar spent.

The above provides a simple prioritisation of deficiencies. Land Transport NZ engineering staff involved with SMSs can provide an example of a simple matrix that could be used for the above process; alternatively the Land Transport NZ/MoT report discusses a number of systems currently in use within New Zealand.

G.3 Simplified process

The next step

Firstly:

- what the RCA's needs are with respect to a deficiency database should be determined. Consideration must be made of what use the deficiency information will be put to within the RCA. For many RCAs there will simply be a process of initiating the gathering of information to provide a picture of what issues/deficiencies there are on the network and to quantify the extent of those issues/deficiencies.

Then the RCA needs to:

- review this section of the guidelines and the Land Transport NZ/MoT report to get a feel of what an safety deficiency database can do and decide
- determine what the best path forward should be for them and what support they need.

As a starting suggestion most of the smaller RCAs could commence with a simple spreadsheet to capture information (ie, the deficiencies) and then work (possibly with a consultant) to get these reviewed and prioritised periodically throughout the year, either using a simple matrix or a more complex commercial product.