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Risk-based prioritization and its application to inspection of valves in the water sector

David R. Marlow, David J. Beale, John S. Mashford

Commonwealth Scientific and Industrial Research Organization (CSIRO), Land and Water, Victoria, Australia

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Abstract

Isolation valves facilitate the effective operation and maintenance of water supply networks, but their sheer number presents a significant asset management challenge. If left unmanaged, valve reliability issues can become widespread. Inspections provide a means of increasing reliability, but a survey of industry practices indicated that some utilities did not have such a program in place. To improve asset management and reduce business risk exposure, such utilities need an effective means of commencing inspection programs. From a theoretical perspective, risk concepts provide a means of optimizing maintenance effort. However, in the face of poor data on reliability or condition, pragmatic approaches to risk-based prioritization are needed. One such approach, risk indexing, is considered in this paper. Background on the research is presented, including the application of risk-based inspection concepts within the water sector. The development of a risk indexing scheme is then investigated, drawing on two industry workshops in which the analytical hierarchy process was used to set relative weights. It is concluded that risk indexing provides the basis for a rational prioritization process in the absence of data on valve reliability or condition.

Highlights

► Importance of valve inspections to water network reliability. ► Theoretical perspective of risk concepts that provide a means of optimizing inspection programs. ► Pragmatic approaches to prioritization in light of poor valve data. ► Development and assessment of a risk index scheme. ► Use of the analytical hierarchy process to set relative weights of risk factors.

Keywords

Valves; Water pipeline; Risk-based inspection; Analytical hierarchy process

Figures and tables from this article:

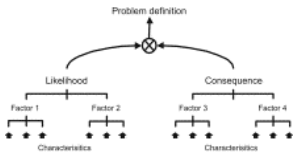

Fig. 1. Decomposition of risk hierarchy.

Figure options

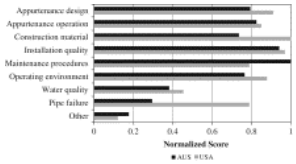

Fig. 2. Relative importance of factors influencing service life.

Figure options

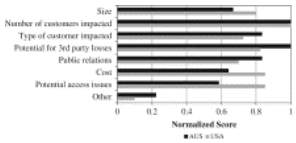

Fig. 3. Relative importance of factors influencing failure consequence.

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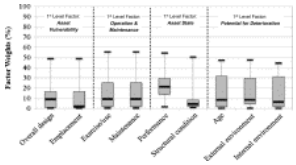

Fig. 4. Weighted consequence factors.

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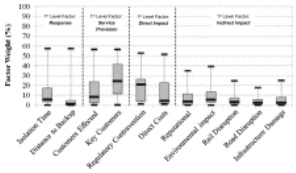

Fig. 5. Weighted likelihood factors.

Figure options

Table 1. Extract of the risk hierarchy.

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Table 2. Scoring for the analytical hierarchy process.

Note: Where the judgement is reversed (i.e., Factor 2 is more important), the score is allocated as 1/3, 1/5 etc.

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Table 3. Likelihood weights.

Note: the judgements from 13 individuals from the workshops were used out of a possible 24.

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Table 4. Consequence weights.

Note: the judgements from 13 individuals from the workshops were used out of a possible 24.

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Table 5. Risk ranking of two valves—an example.

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Table 6. Likelihood risk indexing scores: Valve 1.

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Table 7. Consequence risk indexing scores: Valve 2.

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Table 8. On-going prioritization using inspection data.

Note: valves at similar levels of risk are grouped in like-shaded cells, with higher risk cells represented by the darker shade. The highest risk valves were subject to corrective interventions; the next risk band were inspected annually (work queued as high priority); the next were inspected every three years; with the lowest risk band being subject to opportunistic inspections only.

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Correspondence to: Sustainable Infrastructure Asset Management, CSIRO Land and Water, P.O. Box 56, Highett, VIC 3190, Australia. Tel.: +61 3 9252 6614; fax: +61 3 9252 6244.