Transportation Association of Canada

Performance-Based Decision Making for Asset Management:

Lessons Learned and Practitioner Toolkit

October 2021

Table of contents

1. Introduction 1

1.1 Study background and need 1
1.2 Study objectives 2
1.3 Study methods 3
1.4 Report organization 5

Part A: Technical knowledge base 7

A.1 Fundamentals of performance-based decision making 9

A.1.1 What is performance-based decision making? 9
A.1.2 Elements of performance-based decision making 9
A.1.3 Benefits and challenges of performance-based decision making 15

A.2 Asset management and performance-based decision making 17

A.2.1 Application of performance-based decision making for asset management 17
A.2.2 Performance measures for asset management 18
A.2.3 Issues in performance-based asset management 20
A.2.4 Optimization methods in asset management for resource allocation 26

A.3 Implementation of performance-based decision making for asset management 35

A.3.1 State of practice in Canada 35
A.3.2 Case studies 46
A.3.3 State of practice in the United States 64

A.4 Lessons learned 67

A.4.1 Fundamentals of performance-based decision making 67
A.4.2 Asset management and performance-based decision making 68
A.4.3 Optimization methods in asset management 70
A.4.4 Implementation of performance-based decision making for asset management 71

Part B: Practitioner toolkit 75

B.1 Data management tools 81

B.1.1 Data governance 83
B.1.2 Quality assurance 87
B.1.3 Data collection planning 93
B.1.4 Data warehousing, storage and access 95
B.1.5 GIS tools 100

B.2 Analysis and evaluation tools 103
B.2.1 Life-cycle cost analysis 105
B.2.2 Present worth 107
B.2.3 Internal rate of return on investment 109
B.2.4 Incremental benefit-cost and cost-effectiveness 110
B.2.5 Risk assessment and risk management 112
B.2.6 Cross-asset optimization 115
B.2.7 Multi-objective optimization 118
B.3 Communication tools 121
B.3.1 Dashboards 123
B.3.2 Report cards 125
Bibliography 127
Appendix A – Survey questionnaire 135

List of figures

Figure 1: Performance management framework 11
Figure 2: Extent of use of asset management programs 36
Figure 3: Agency satisfaction with asset management practices and procedures 37
Figure 4: Average satisfaction by attribute for each asset class 39
Figure 5: Combination of asset classes in cross-asset programs 41
Figure 6: Optimization techniques used for managing assets 42
Figure 7: Level of satisfaction with asset management optimization techniques 43
Figure 8: Level of impact each performance objective has on asset management decisions 44
Figure 9: How beneficial different tools are for performance-based decision making 45
Figure 10: York Region 48
Figure 11: Condition grade of York Region assets 52
Figure 12: Key elements of TransLink's Corporate Asset Management Strategy 59
Figure 13: Asset management process for state of good repair 60
Figure 14: Pavement preservation treatment toolbox 62
Figure 15: Annual maintenance planning cycle business process 63
Figure 16: Practitioner toolkit framework 79
Figure 17: Hierarchical data governance structure 85
Figure 18: Example template for a transportation agency’s data domains and sub-domains 86
Figure 19: Components of quality assurance 88
Figure 20: Elements of a data collection plan 93
Figure 21: Schematic of common data warehousing architecture 96

List of tables

Table 1: Agencies responding to the online survey 4
Table 2: Agencies selected for interviews 5
Table 3: Activities and issues for benchmarking – Asset management and transit agency performance 14
Table 4: Benefits and associated challenges of performance-based decision making 15
Table 5: Multi-objective optimization methods applicable to transportation asset management 31
Table 6: Non-traditional or intangible asset classes included in asset management programs 40
Table 7: Tools used to support asset management programs 41
Table 8: Performance measure types measured by agencies 44
Table 9: Service areas in York Region's corporate asset management plan 48
Table 10: York Region's condition grading system 51
Table 11: Performance of roads service area by regional criteria 52
Table 12: TransLink's components of corporate priorities for 2019 58
Table 13: Core data principles 84
Table 14: Principles for managing information in performance-based transportation programs 88
Table 15: Data quality quick-assessment checklist 89
Table 16: Comparison of in-house and commercial off-the-shelf (COTS) database tools 99