

WINTER ROAD MAINTENANCE – A COMPARISON OF ALTERNATIVE PERFORMANCE MEASURES AND SERVICE STANDARDS

Liping Fu^a, Johnny Cao^a, Tae J. Kwon^a, Lalita Thakali^a, Max S. Perchanok^b and Heather McClintock^b

alnnovative Transportation System Solution (iTSS) Lab, Department of Civil & Environmental Engineering, University of Waterloo. bOntario Ministry of Transportation.



Introduction

Background

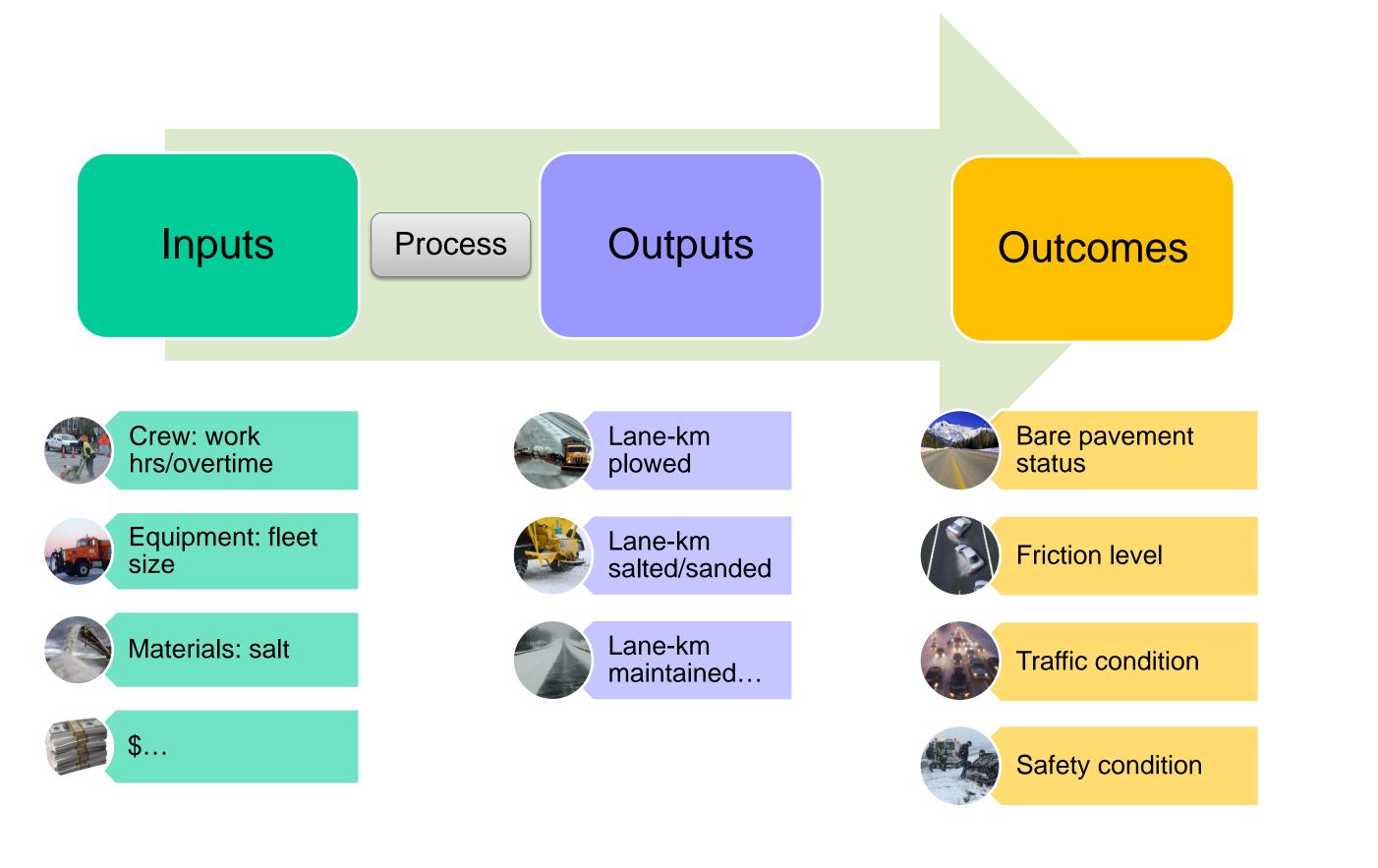
For transportation departments responsible for winter road (WRM), performance measurement maintenance establishment of service standards are the essential ingredients for their ensured success. This has become even more so recently due to increased privatization of winter maintenance work and increased public concerns over the detrimental effects of road salt on the environment, the infrastructure, and the vehicles. However, there are two particular challenges in establishing appropriate WRM performance measures and First, the main determinant of winter service standards. maintenance efforts and outcomes is the snow storms which vary over space and time considerably, which makes it difficult to conduct some of the common performance measurement tasks such as performance benchmarking and trend analysis. Secondly, the relationships between the outcomes of maintenance operations (e.g., safety and mobility), outputs (e.g., bare pavement recovery time and pavement friction), and inputs (e.g., amount of salt used and hours of operations) are confounded by many uncontrollable variables such as storm severity, road characteristics, and traffic conditions, making it difficult to develop performance measures and service standards that are both outcome oriented (attributable) and controllable. Therefore, WRM remains to be a sector that lacks uniform performance measures and service standards.

Why Measure Performance?

To tell a convincing story, we must use numbers with meanings, i.e., performance indicators. We can use these performance indicators to tell

- how well we are doing
- how well we are meeting our goals
- are our customers satisfied
- are our processes in control
- where could we improve

Performance Measurement Framework



Current Practice

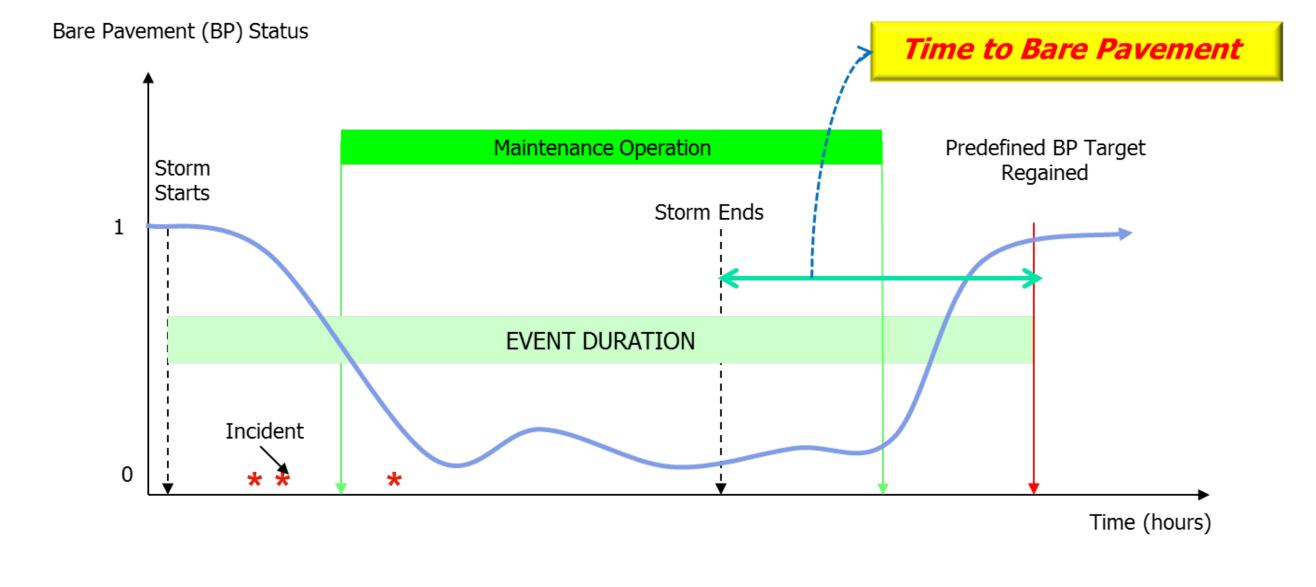
Performance Measures

Effectiveness Measures • Bare pavement regain time • Traffic • Accidents

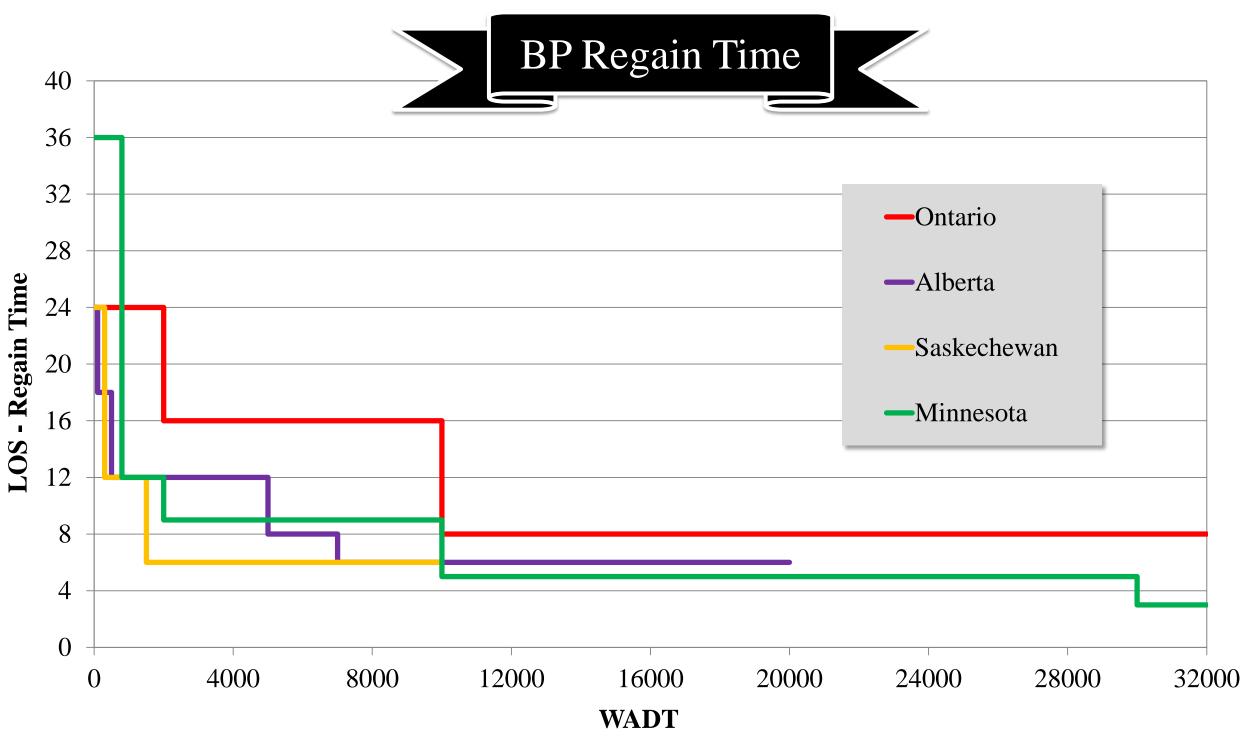


- Efficiency Measures
- Cost per lane kmSalt per lane km
- SaltSalt
 - Environmental Impact Measures

 Salt per lane km
 - Salt per lane km
 - Salt per season



Maintenance Service Standards

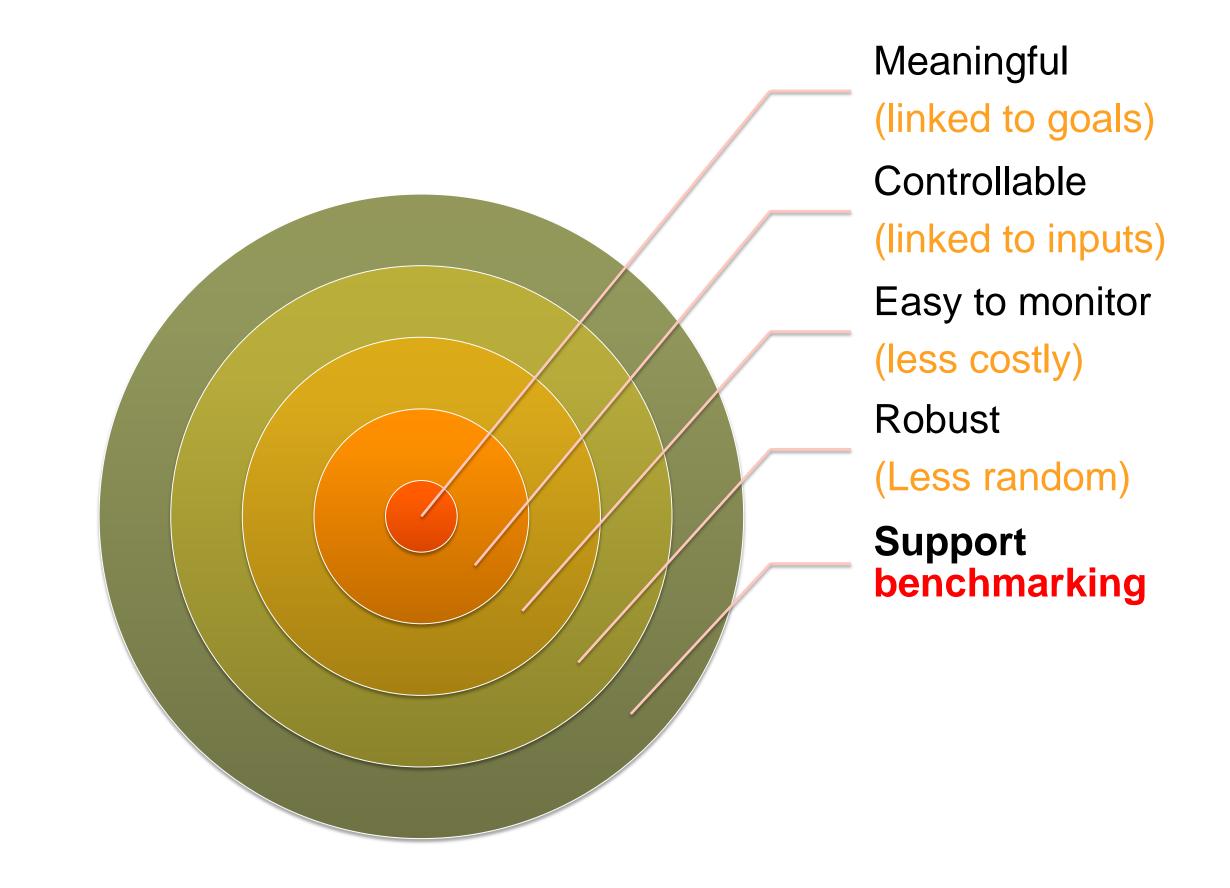


Other standards

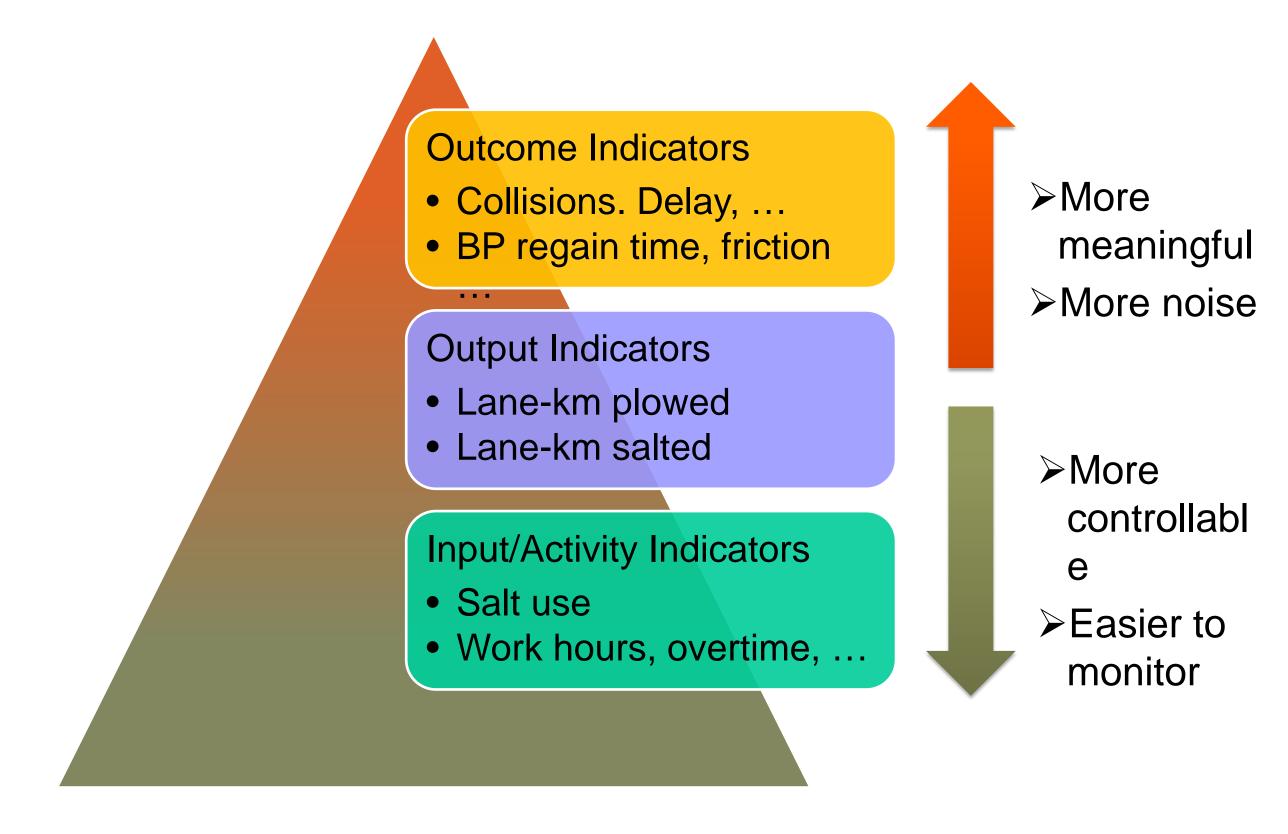
- Snow depth
- Circuit time
- Response time
- Salt usage

Alternative Performance Measures

Goodness of Performance Measures



Trade-Off of Best Performance Measures



A Rating Matrix of Performance Measures

Goodness of PM PM	Meaningful	Controllable	Easy to Monitor	Robust	Support Benchmarking
Average Collision Rate	Н	L	Н	L	L
BP Regain Time	Н	M	Н	М	М
Friction Level	Н	M	L	М	М
Traffic Speed Recovery Time	Н	L	M	L	М
Average Speed	Н	L	M	L	М
Lane-km plowed	M	M	Н	Н	L
Lane-km salted	M	M	Н	Н	L
Total Cost per lane km	M	M	Н	Н	L
Total Salt Usage	L	Н	Н	Н	L
Work hours	L	Ι	Н	Н	L

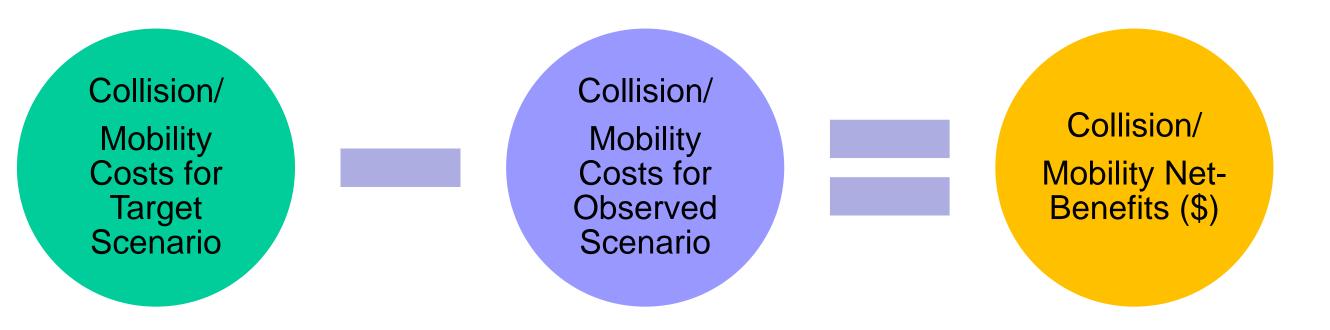
H: High, M: Median, L: Low

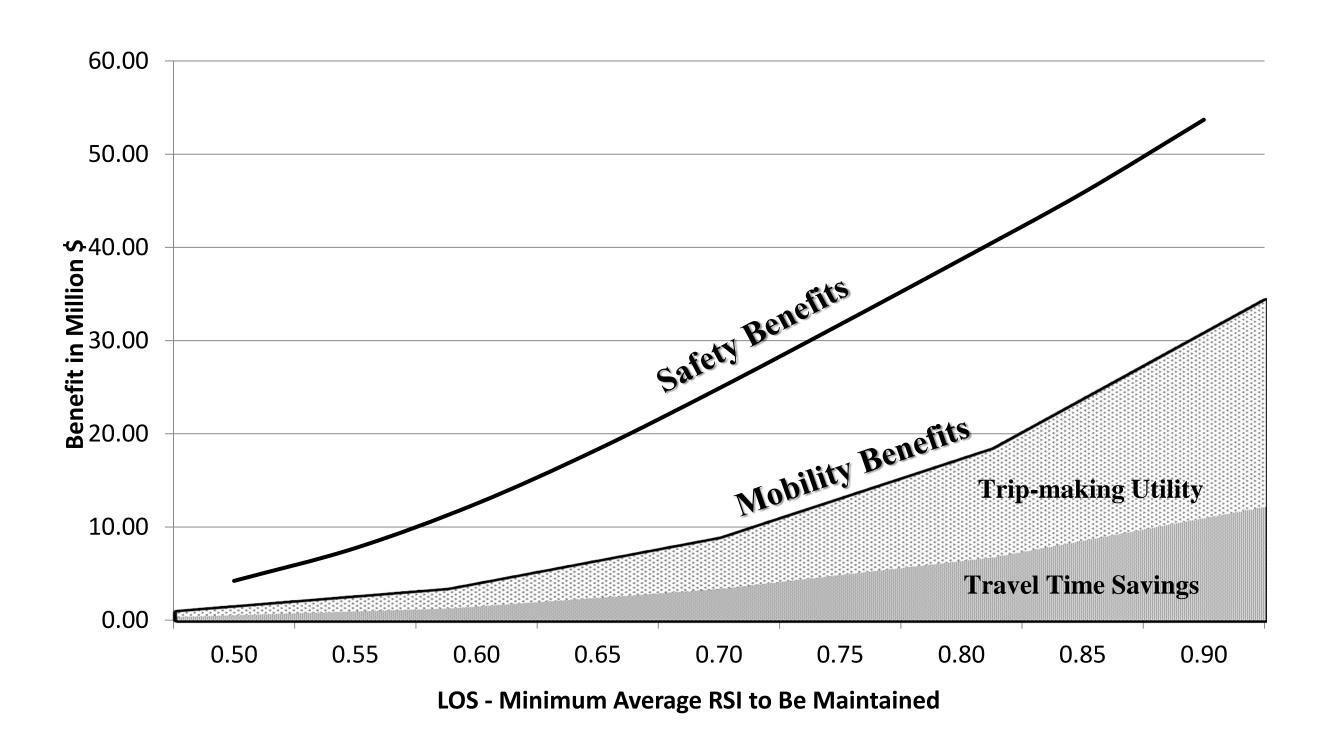
Case Study – Ontario Highway Network

Safety & Mobility Benefits of Alternative LOS

Collision Frequency and Severity Models (31 patrol routes, years 2000-2006)

Trip-making utility and travel time savings Models (21 patrol routes, years 2000-2006)





Relation between Collision Frequency and RSI

Optimum level of service from safety perspective can be identified by investigating nonlinear relationship between collision frequency and road surface index through nonparametric modeling.

