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Integrated Infrastructure Asset Management Software Solutions

Quantitative Target Setting

for

Pavement Management Data Quality

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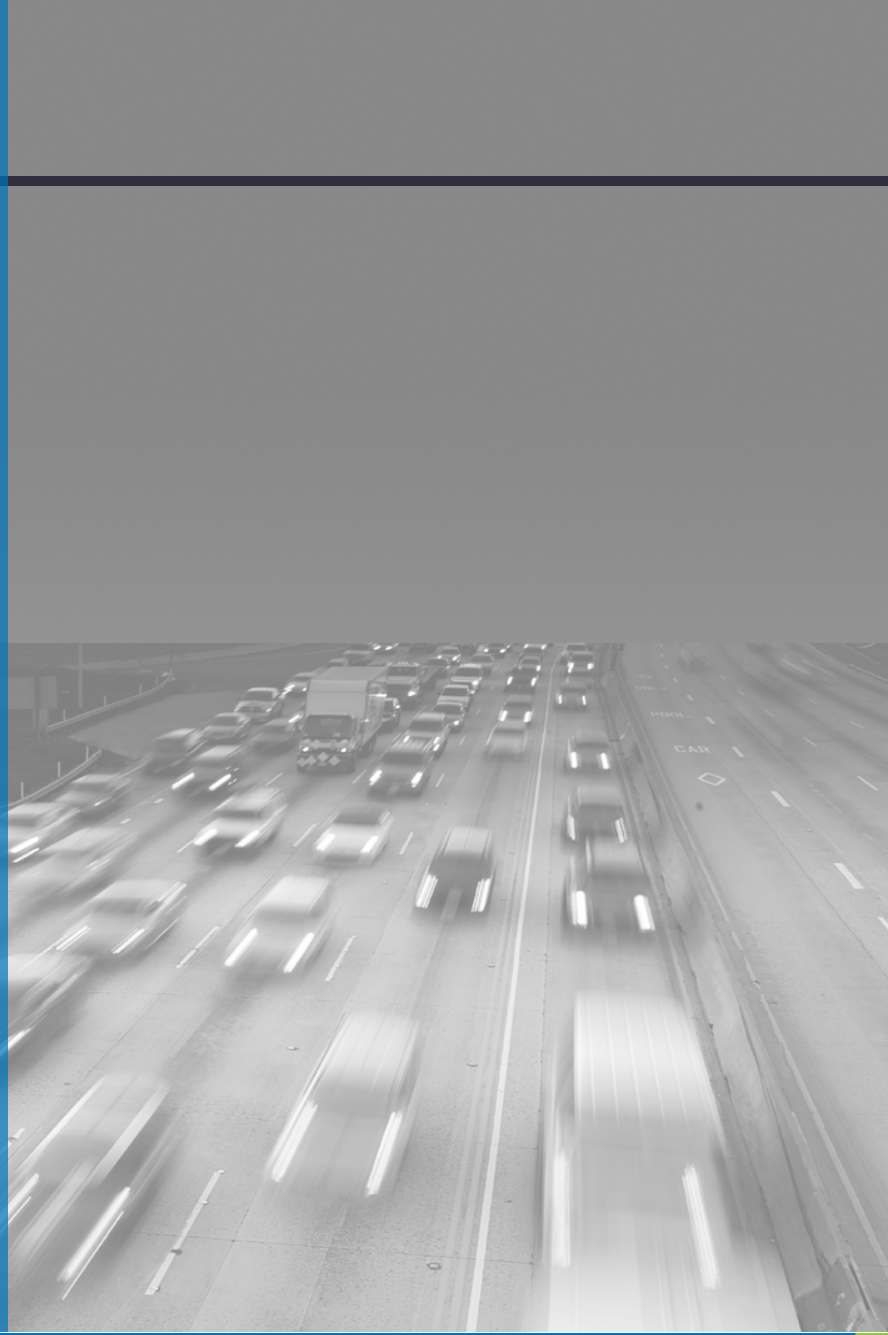
01 Introduction



Why this study matters?

1. What is the problem?

We don’t know what is the acceptable level of quality for pavement condition data.

Why this study matters?

2. Who cares?

Transportation agencies, and whoever uses pavement condition data for decision making

Why this study matters?

3. What are the benefits of solving the problem?

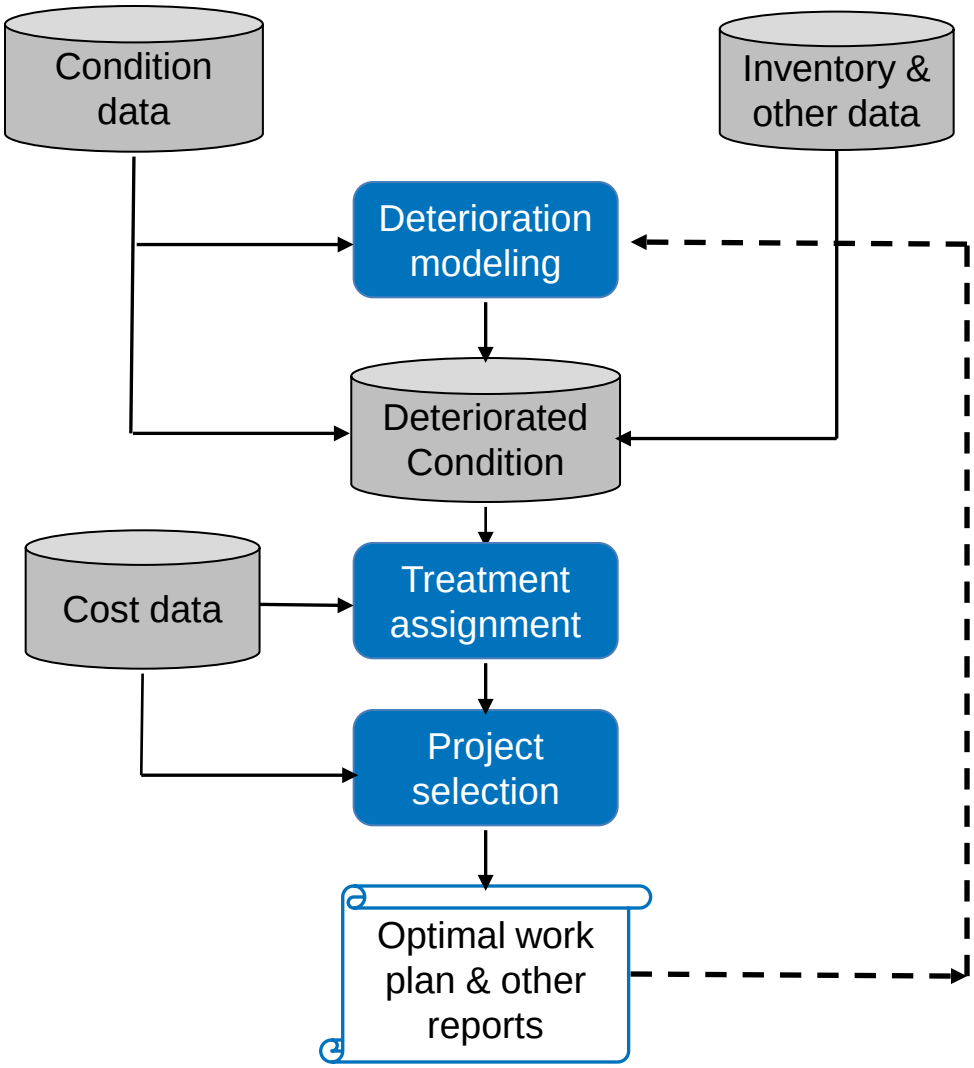
1. Agencies can plan better, and save money.
2. Citizens will enjoy a network with a higher quality.

Anything else?

02 Pavement Management System

Pavement Management System (PMS)

A set of tools or methods that assist decision-makers in finding optimum strategies for providing, evaluating, and maintaining pavements in a serviceable condition over a period of time (AASHTO)



03 Literature Review

Variability in Infrastructure Condition Data

Observations from Literature

- “The issue of variability inherent to visual asset condition assessments is a recognized limitation of these evaluations” (Migliaccio, 2011).
- “Distress data variability has been a critical issue in improving the effectiveness of PMS” (Bogus, 2010)”.
- “Pavement condition data quality can be bad enough to be completely useless” (Larson et al., 2009).
- “Variability of pavement surface distress data collection has always been an area of significant concern” (Daleiden, 1998).
- “Distress data variability exists and it can potentially be quite large” (Rada, 1997).
- “The visual inspection method, being subjective, is prone to personal bias and lack of consistency and repeatability” (Prakash, 1994).

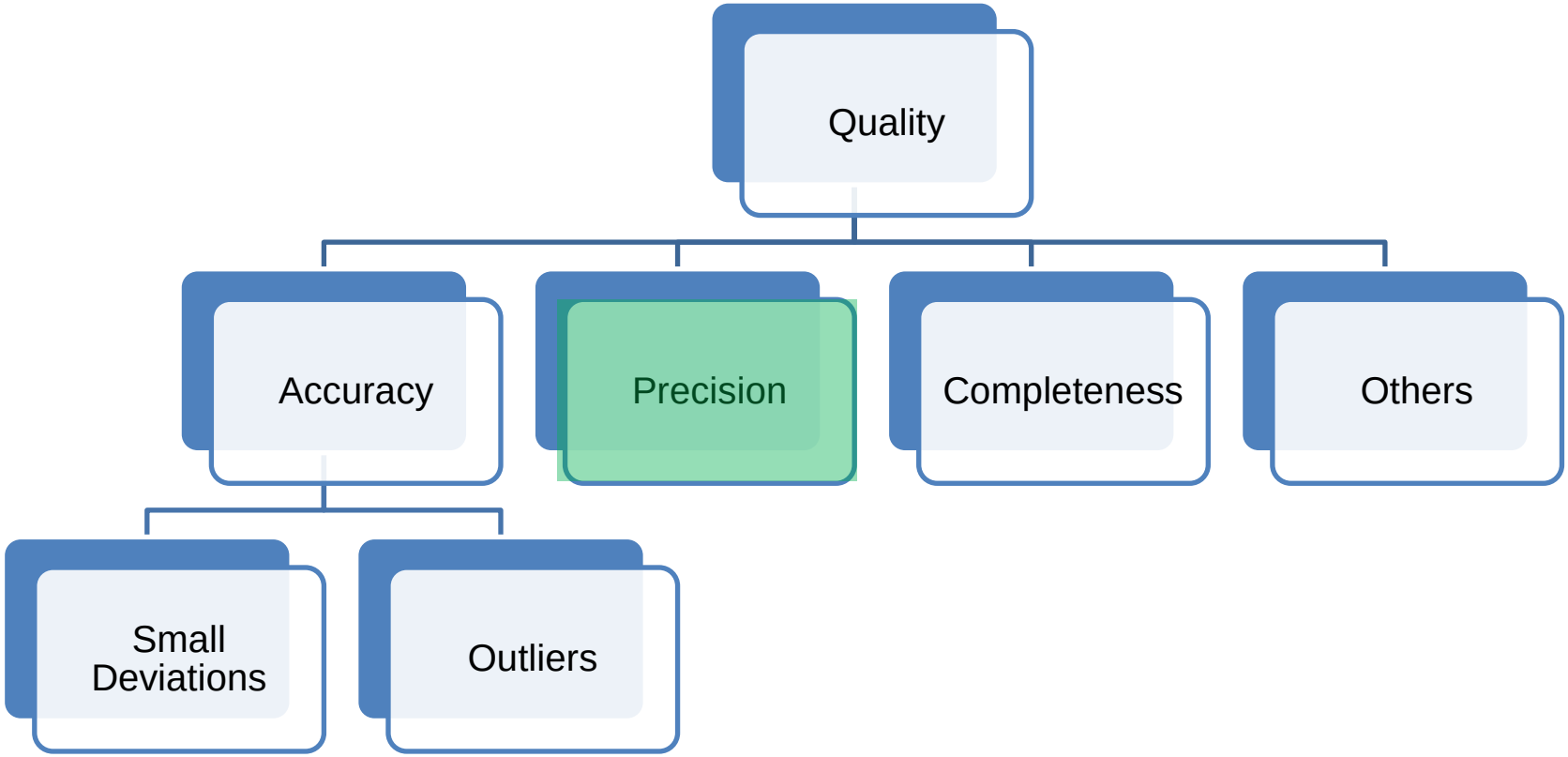
Why is Pavement Condition Data Variable?

In the case of pavement, several factors can affect the quality of condition data:

- Shape and condition of each pavement section *(Flintch and McGhee 2009)*.
- Bias toward detecting higher-severity distresses, while missing lower-severity distresses *(McQueen and Timm 2005)*.
- Data collection method *(McGhee, 2004)*
- Inability of images and videos to catch thin cracks *(Morian et al. 2002)*.
- Weather condition, direction and the angle of sunlight, temporary healing of cracks in summer *(Smith et al. 1998)*.

04 Data Quality

Aspects of Data Quality



Accuracy: The difference between a measurement reading and the true value of that measurement“ (NIST, 2003).

Precision: The ability of a process to repeat the same accurate measurement over time (NIST, 2003).

Data Quality Assurance

1. Collecting original data

2. Collecting audit data

3. Calculate difference between original and audit data

4. Compare the difference with the **target**
   - 95% of the collected data to have an absolute deviation of less than 10 points (out of 100) between audit and original data

05 The Study

- Objective
- Simulation
- Assumption
- Results

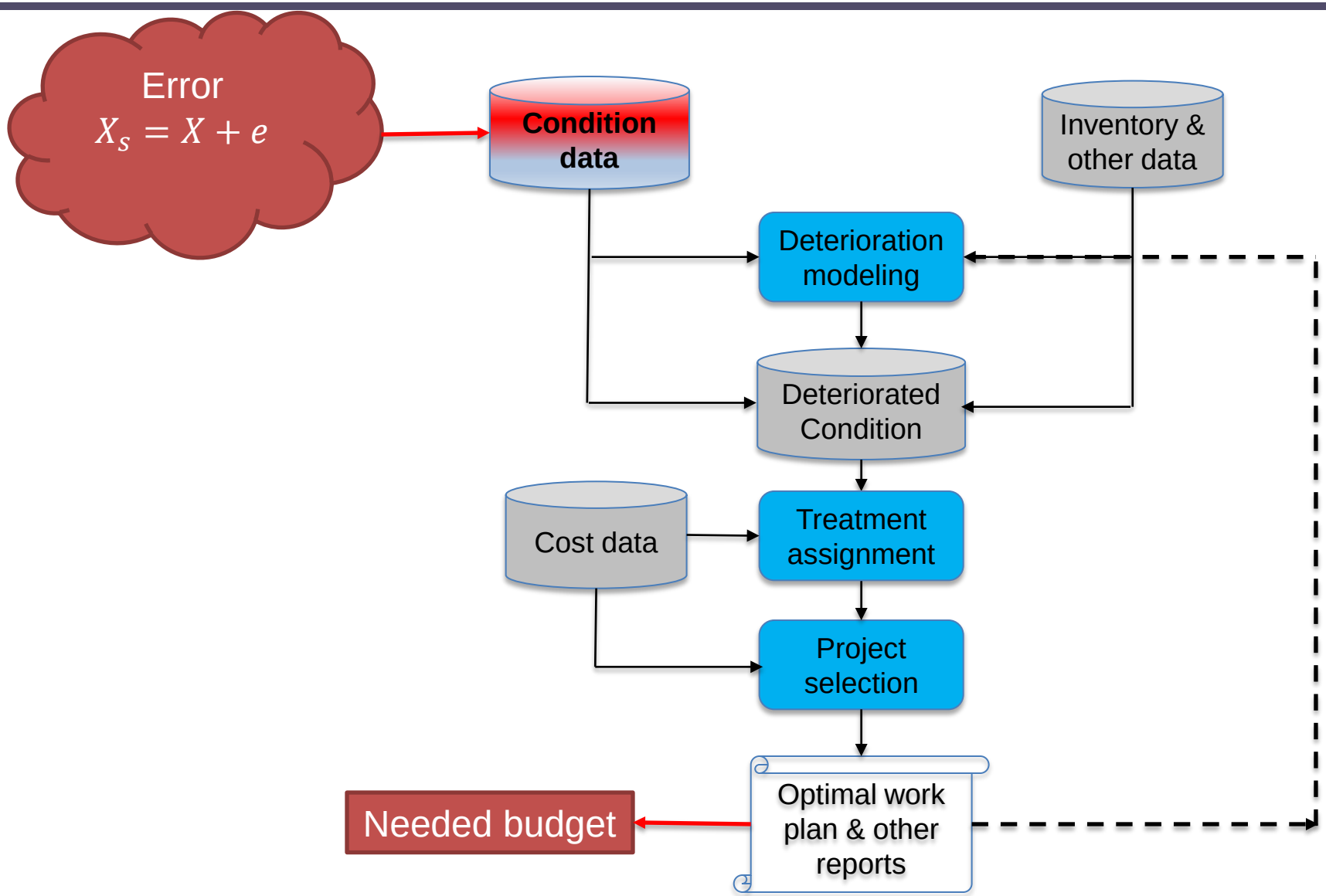
Study Objective

- Assess the Impact of Pavement Condition Data Quality target on the Accuracy of PMS output

- PMS and DB: Two states systems: PMS-1 and PMS-2

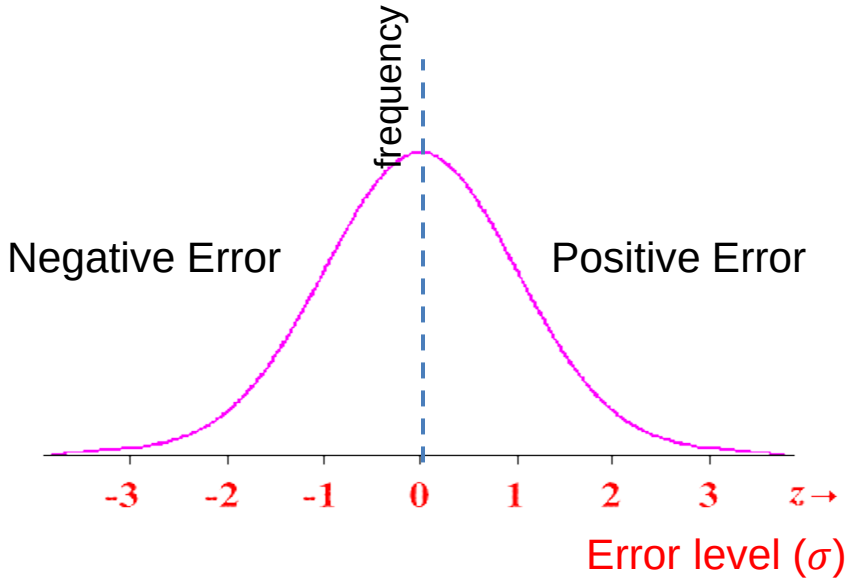
- PMS Output:
  - Needed Budget: Minimum budget needed to keep the weighted average condition index (CI) of the network above 85 and while not allowing more than 5% of the network length to be in poor performance level (CI<40).

Simulation



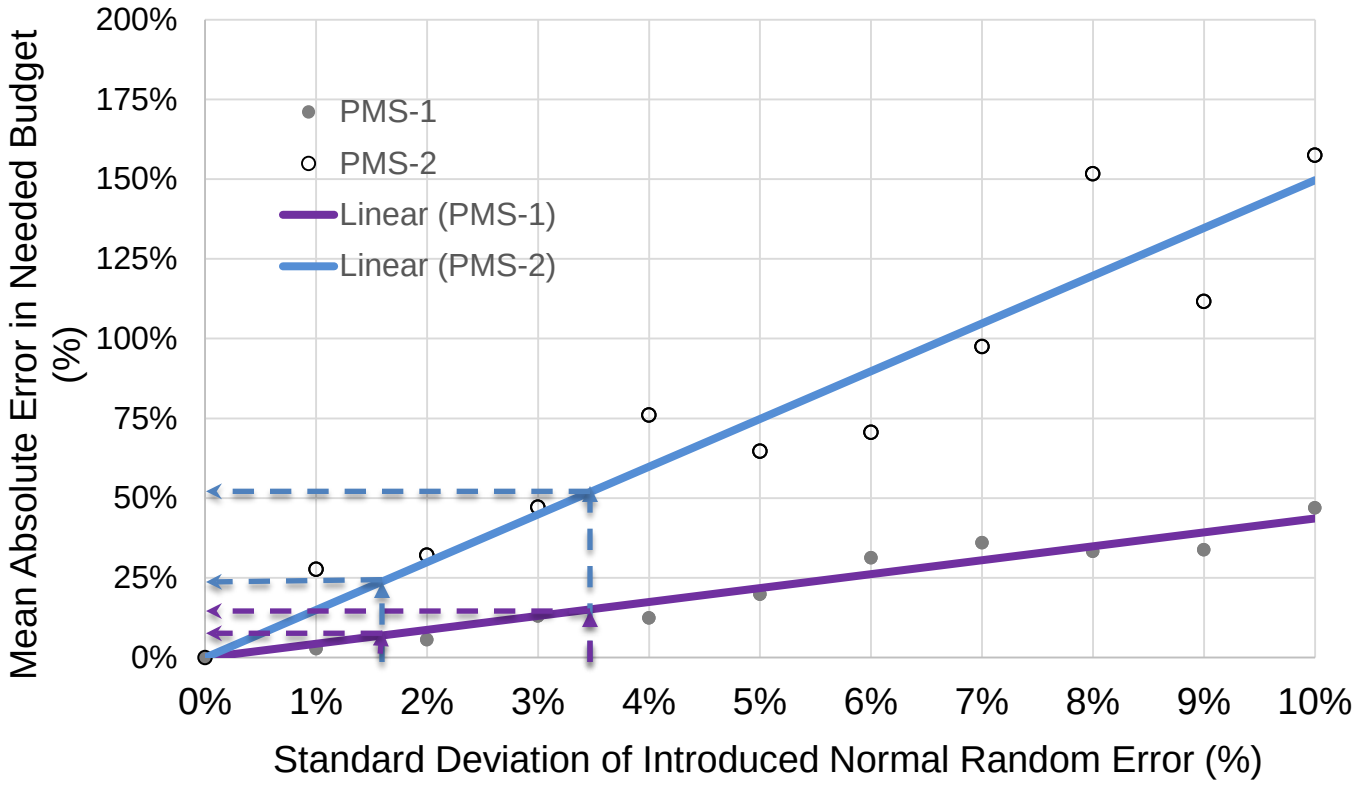
Assumption

Assumption: Error in original and audit data are normally distributed with the same error distribution



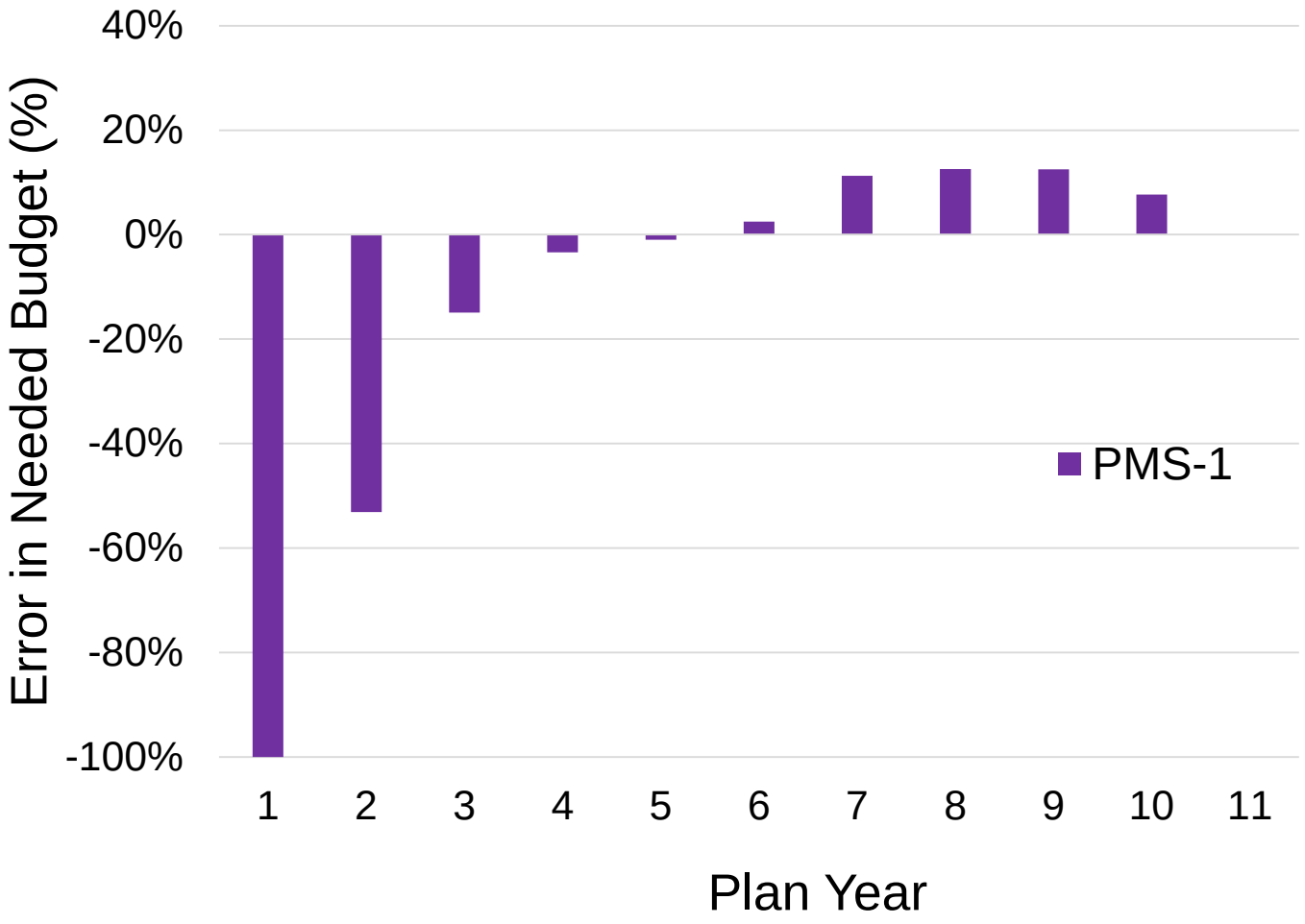
audit-original ~$\mathrm{N}(\mu, \sqrt{2}\sigma)$

Simulation Results

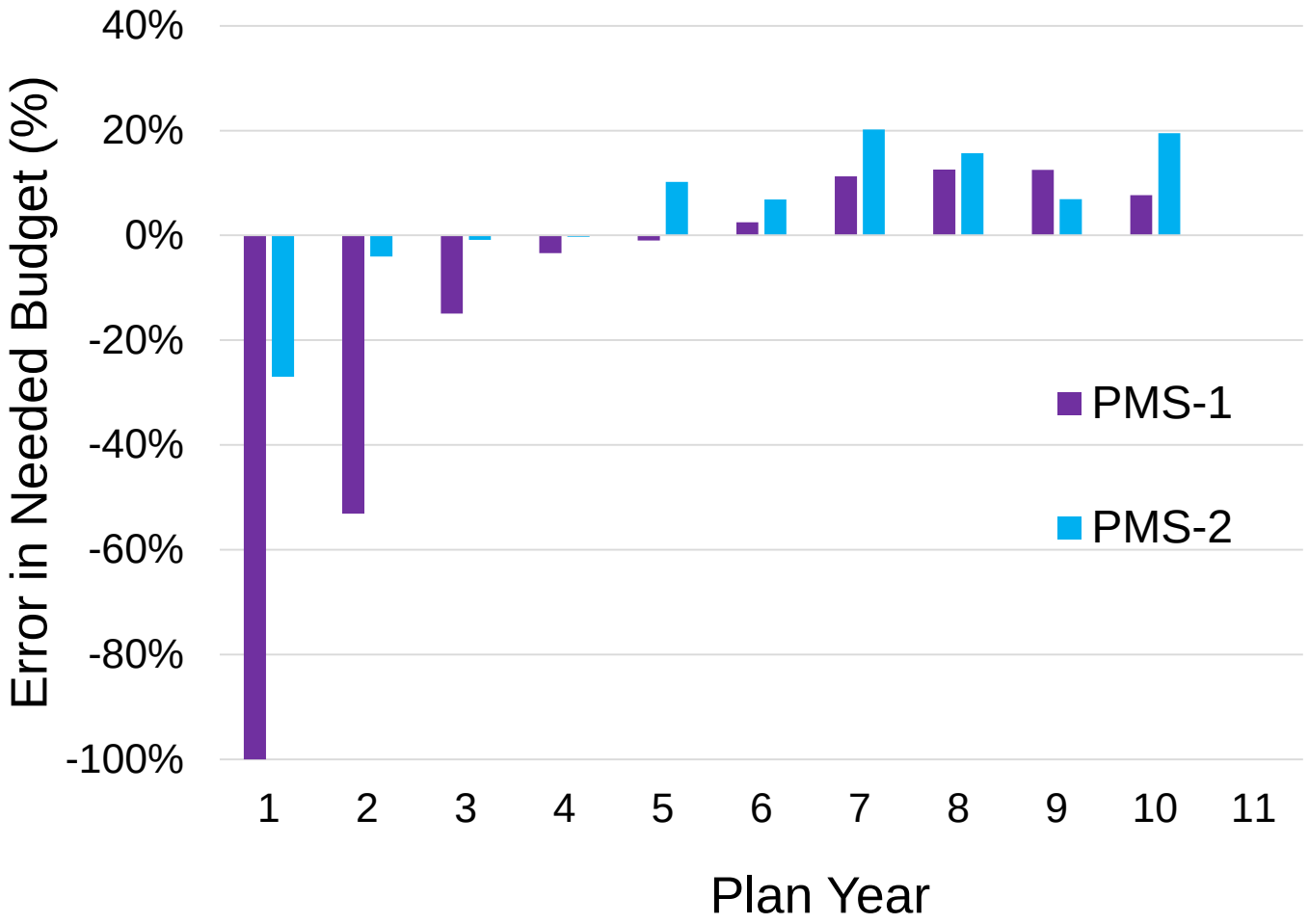


Example target: 95% of the collected data to have an absolute deviation of less than 50 points between additional and original data (σ = 1.75)

Simulation Results



Simulation Results



06 Summary and Conclusion

Summary and Conclusions

- Agencies need to know sensitivity of their decisions to different levels and types of errors.
- Error in condition data can highly distort PMS outputs especially when it occurs on larger sections.
- Investing on providing higher quality condition data is beneficial.
- Agencies should consider having a more conservative data quality acceptance criteria for larger pavement sections.
- Different systems have different sensitivity to errors.
- The consequences of PMS input data error for PMS outputs persist throughout the planning period and can fluctuate (i.e. change direction)

Future Works

- Study interaction between errors
- Study non-normal errors

Thank You.