

WHITE PAPER / **IMPROVED DECISION-MAKING WITH COMPREHENSIVE DATA ANALYSIS**

FINDING VALUE WITHIN A DEPARTMENT OF TRANSPORTATION'S EXISTING WEALTH OF DATA

BY Howard Lubliner, PhD, PE

Historically, departments of transportation (DOTs) have harnessed information in silos, using existing data that is focused on individual departments. Increasingly, DOTs are merging all data sets — departmentwide and agencywide — to revise and advise all facets of their operations.



DOTs maintain huge repositories of data. To manage this tremendous wealth of assets while meeting federal reporting requirements, they've invested significant time in properly storing and updating valuable data elements. For decades, however, this wealth of knowledge has been compartmentalized, used solely within the data's respective departments and analyzed for a singular purpose, such as pavement condition, bridge preservation or safety performance. Though useful to an extent, this traditional process has made it hard for DOTs to compare the effectiveness of their overall strategies and investments.

To get better use of existing data, DOTs are starting to adopt data merging and analytics techniques — meaning they're evaluating data from across their agencies collectively to discover valuable insights regarding infrastructure performance and agency practices.

WHAT ARE THE BENEFITS?

By culling mountains of previously independent data, DOTs can identify and select better safety projects and improve the frequency of materials testing. This process also allows agencies to re-evaluate the cost-effectiveness of decades-old contract incentives, which is an issue the Nebraska Department of Transportation (NDOT) is currently solving. Read how Nebraska is using data to unearth efficiencies on page 3.

WHY NOW?

The transportation industry has reached an inflection point. With electric and autonomous vehicles becoming more common on our roadways, the increasing focus of DOTs is on maintaining the existing transportation network. To achieve this while being mindful of the tax dollars used to fund the improvements, agencies are looking for new areas of efficiency and process improvement. Forward-thinking DOTs consider numerous factors when making investment decisions. But to get the most efficient, cost-effective results, they start with a comprehensive data analysis.

Recently, two national trends have brought this all-encompassing data collection analysis into the spotlight.

First, it is now much easier to join individual data sets with advanced data processing tools, open source statistical

SCENARIO PLANNING: USING DATA TO UNDERSTAND TRADE-OFFS

Harnessing data for a comprehensive analysis also helps DOTs provide narrative to key decision-makers, including state legislatures. In addition to analyzing all DOT data for more effective operations, analytic tools can dynamically provide feedback on the impacts that different funding scenarios will have on infrastructure. These performance predictions explain not only how organizational investments have performed in the past but also how they're projected to perform in the future and the consequences of certain scenarios if no action is taken.

In May 2018, the state of Kansas approved a legislative task force to, in part, consider the future of transportation funding. To meet the task force objective, Burns & McDonnell is helping the Kansas Department of Transportation develop materials that present a range of possible infrastructure preservation strategies, as well as the different funding tools that can be used to support this investment. Communicating effectively to government officials and the public at large is critical, as they have the final say in the amount of investment allotted for transportation.

languages and GIS databases that bring disaggregated data into a universal vocabulary reference structure.

Second, technology companies have promoted a broader understanding of data analytics, even through ads on primetime television. DOTs are beginning to expect the same performance and value from data analytics they see in top-performing private sector companies.

Compiling all information to better inform future decisions is more important than ever. With much of the original infrastructure that formed the backbone of our nation's prized transportation system reaching the end of its expected life, well-informed decisions are needed today to protect travelers tomorrow. And that can only happen after a thorough examination of all data sets.

HOW DOES IT WORK?

Step 1: Create data business cases. After a DOT merges all data and establishes a universal data vocabulary, a data analytics team, comprised of data analysts and subject matter experts, sits down with individual DOT business groups to create data business cases that pinpoint and address each group's specific challenges. Data analysts bring experience in data processing, visualization and analysis, while subject matter experts come with a working knowledge of the DOT processes and an understanding of how data analytics can improve the efficiency and reliability of those processes.

Step 2: Develop a work plan. After a business case is created, it's time to construct a work plan, which is wrapped in a hypothesis and contains a list of potential solutions that speak to each specific business case. This work plan also conveys the benefits anticipated for each business unit. Work plans can vary greatly, depending on the individual business groups and their business cases, and might need to be repeated until a solution or decision is reached.

Step 3: Conduct an informed analysis. Once there's clear direction on how a DOT wants to solve a challenge, the data analytics team takes a deep dive into the data. But it's not always a linear track. People who specialize in this arena know the data might uncover potential outcomes or trends not anticipated in the work plan. It takes someone with specific knowledge to identify an interesting data "find" or "path." When sifting through and merging the data, then comparing different elements against each other, specialists vet the data and determine what has value and what doesn't.

Trained professionals can identify findings that are likely to profoundly impact agency operations, as opposed to someone who is just looking for statistically significant trends. This part of the process builds a narrative that can inform future studies or support current work. Though those individual data elements might not have been part of the original search during the initial task, they can bring ancillary value to the client.

Step 4: Iterate the preliminary results. When interesting new information is brought to light, the focus often changes. Reviewing the initial results educates the data analytics team about the DOT's process and enlightens the agency about new information unexpectedly extracted from the data.

Bringing a third-party perspective to the DOT process, an experienced data analytics team, equipped with data analytic manipulation capabilities, can connect the dots and facilitate a conversation between technical staff and decision-makers. A data analyst with a clear understanding of both worlds can look at the data, find the value and communicate with decision-makers about specific topics. This is what differentiates this comprehensive data collection process from others and explains its effectiveness.

Step 5: Present the results to DOT executive staff and decision-makers. Once a decision is made, the DOT data unit can implement the necessary changes to its process, which also provides proof of investment.

DATA UNEARTHS EFFICIENCIES IN NEBRASKA

Because of a lack of proof cases, the public sector doesn't have a lot to show in terms of the benefits — or return on investment — of specialized data analytics. But that didn't stop NDOT from paving an analytical path forward.

With trailblazers on staff, the agency took the initiative to merge its data, then called in reinforcements to provide data analytics that could help improve process and system efficiencies across the board.

In January 2018, NDOT tasked Burns & McDonnell and High Street Consulting with delivering system (and budgetary) improvements. Building off existing Lean Six Sigma efforts — an approach that requires teamwork to remove process defects and waste, and reduce variation — the data analytics team took it one step further with a project known as **Linking Infrastructure Challenges With Data (LINC-D)**.

The ongoing data analytics process has informed many different business groups within the agency — reaching across entirely different elements of NDOT's operations — and the combined team is now working on the 12th individual work plan. Completed and current work plans cover topics ranging from pavement life and contract incentives to winter work and safety improvements.

DOES 'WINTER WORK' WORK FOR NEBRASKA?

It is common for DOTs to designate a time period for "winter work," which allows contractors to work during the identified winter months, with an open-ended time frame, without charging working days. But do the cost savings for building an off-system bridge during the off-season outweigh the cost and time commitment of having an inspector on-site? Through comprehensive data analysis at NDOT, a formal recommendation was made to maintain the program, but with some modifications.

To balance benefits with cost, the recommendation was to put a limit on how much winter work is allowed, with amended inspection frequency to bring cost efficiency to this practice. Now, NDOT is looking to use the revised winter work practice on state bridges and upcoming greenfield construction for a more cost-effective project.

CAN DATA MAKE NEBRASKA ROADS SAFER?

This proof of concept shows how a DOT can leverage data to make more effective safety decisions. Merging state-of-the-art practices for analyzing the performance of various road segments and intersections with historical NDOT crash and system data will allow the agency to identify locations most in need of safety improvements.

Once a project location is identified, an integrated safety framework will assist NDOT staff in identifying specific safety countermeasures that will cost-effectively reduce the targeted crash type. Ultimately, the agency will use this framework to add to its valuable database of historical project safety performance to better understand the impact that different project improvement techniques have on roadway safety performance. Collectively, these tools will help NDOT efficiently and cost-effectively utilize limited improvement dollars to maximize safety benefit.

CONCLUSION

A comprehensive data analytics process is the key to useful, efficient decision-making and smart investing. From creating a data business case to implementing chosen system improvements, data can point a DOT in the right direction, especially when it comes to scenario planning and impending infrastructure upgrades.

Keep in mind that this overall data analytics process isn't only about discovering revolutionary findings. It's about making incrementally better decisions for the entire DOT and its community of travelers.

BIOGRAPHY

HOWARD LUBLINER, PhD, PE, leads the Transportation Design and Production Department at Burns & McDonnell, which includes roadway design, traffic/ITS services and bridge/structural design. Responsible for implementing the technical quality program, he also brings extensive experience in planning, design, construction observation, asset management, and maintenance of a wide range of transportation projects, from high-volume urban freeways to low-volume rural roads. Howard also works with clients and industry organizations on roadside safety at the national level. Prior to joining the firm, he served the Kansas Department of Transportation (KDOT) for 16 years in a variety of roles, including roadway design, construction oversight, and Highway Safety Manual (HSM) implementation.