Big Data is the Answer. What was the Question?

Data is everywhere. From keying in your phone number for digital coupons at the grocery store to crowdsourcing, digital information is rapidly expanding every second. We call it “big data.” In this sea of information, finding data is not the problem. The difficulty lies in determining how best to transform the billions of records generated every second into usable and tangible information. In the transportation industry, big data can be used to reveal new insights and provide a deeper level of analysis.

With all of this data, where do we start?

According to the Pew Resource Center, the use of cell phones and computers has dramatically risen since 2002. We are already reaching a point where the amount of data is pushing the envelope of the storage capacity of today’s technology.

The increased amount of data being generated and methods of data consumption are good reasons why new strategies must be put in place for data management, and consumption of information can help to increase analysis capabilities.

In the transportation industry, our job has always been to move people and goods. As technology has evolved, we have leveraged the best available data to create models that attempt to replicate observed behavior and transportation patterns. The models have grown more complex, yielding results that more precisely anticipate future conditions and support a better informed decision-making process. Meanwhile, the future is growing more uncertain with connected and autonomous vehicles on the verge of disrupting the most basic notions of traditional network performance analysis.

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Moreover, performance measures are vital in the transportation industry as we begin exploring complex relationships through data, such as safety, overall performance or travel-time reliability. In addition to being mandated by the federal government to qualify for funding, these measures are essential for maintaining, monitoring and updating the performance of the transportation network.

Big data analytical capabilities emphasize the importance of performance measurements by making available a variety of data through the advent of sensors, connected vehicles and crowdsourcing applications, such as WAZE and Bluetooth technology. Transportation organizations have more data in their hands than ever. This massive influx of data can help in analyzing a network’s behavior, performance and patterns using real-time data analytics.

Staying on the cutting edge of this ever-evolving market is one of VHB’s specialties. VHB actively manages and works with big data, skillfully uncovering complex and hidden data relationships and resolving challenges, such as storing the data, performing historical and live analysis to react to real-world situations, and finding a way to get this information into the hands of decision makers, planners and users. VHB was recently selected to receive a Technology IQ Award by the Orlando Business Journal for innovative contributions to big data management.

How do we work with the different types and sources of data?

Traditionally, stakeholders, such as departments of transportation, metropolitan planning organizations and local governments, manage the efficiency of transportation networking systems by utilizing relational database methods, such as Microsoft SQL or Oracle, geographic information systems (GIS) mapping, and relational or spatial queries. VHB has revamped how these methods are applied by enabling a big data store that contains relational and non-relational data storage capabilities, specialized queries, elastic searches, clustering and dynamic GIS spatial representations.

Analysis of the health and performance of a transportation network system is done to identify patterns of recurring congestion and to monitor traffic during special events, crashes,
incidents or emergency evacuations. With the big data technologies developed by VHB, traffic data is able to be captured and stored in near real time, equaling nearly 432 million records per month. The data is handled dynamically—in seconds, a construction performance dashboard is populated, including charts, interactive maps and graphic representations of the status of roadways in that moment, as well as how its performance compares with previous dates, scenarios and timeframes.

Through historical comparative analysis, users can further analyze the measured or projected return on investment for specific changes in traffic patterns, signal timing and plan system improvements through a system that contains millions of live records. These real-world metrics are applied to current transportation workflows, delivering accurate, current and highly specialized information. This yields tangible results to both the agencies and the citizens who drive in the transportation network every day.

Understanding delay and its effect on travel-time reliability, including construction zones, is a key factor to managing congestion for the transportation network. Accessing historic and live data provides information to identify recurring congestion patterns, such as rush-hour traffic, and combat nonrecurring congestions in special events, such as traffic crashes or major entertainment events. Relationships to determine traffic flow and performance during these delayed conditions will assist engineers and planners to manage the system in a proactive manner and in a real-time situation. The additional far-reaching effects of the millions of historical records enables stakeholders to calculate the return on investment for future improvement projects, prioritize funding allocation, and identify operational changes to improve traffic volume and speed on roadways. These live and historic big data management technologies have never been utilized to this extent in the Florida transportation industry.

This big data management workflow brings together an innovative and tangible approach to handle various datasets and millions of records.
approach supports the management of construction zones, autonomous and connected vehicles, Bluetooth technologies, traffic signal timing, and many other transportation applications that rely on consistent, accurate and repeatable processes.

**What have we learned from working with big data?**

With increased technology capabilities and a better understanding of how to utilize data, planners and engineers can accurately answer questions, identify problems and manage the efficiency of the transportation network, without assumptions or perceived problems. While some companies can immediately begin taking steps to leverage much of this data, others will still need to invest in education, people and technology in order to move forward. Educating the next generation of professionals and our clients in data science, software programming and statistics will be equally as important as investing in significant infrastructure improvements.

Implementing big data technology requires creative thinking. Data isn’t one size fits all. With multiple ways to make use of data, the same information can be used in different scenarios to serve different solutions. Data not used or understood at the time may also become instrumental in future endeavors.

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Various professionals can approach challenges from different directions, putting the data to work in a way not previously considered. There is no such thing as bad data.

**What’s next?**

These data management techniques are just a few examples of what big data can deliver. Ultimately, the VHB dashboard will analyze near real-time traffic flow, roadway congestion, speed data and impacts of incidents on the network. As an example, the dashboard will allow professionals to visualize and analyze the impacts generated by a single incident on the entire network using both near real-time data and historical trends, providing a complete picture. Stakeholders will directly view the immediate impacts of travel time on both the affected roadway and the surrounding network, enabling pre-planning and efficiency analyses of a specific intersection’s signal timing, changes in traffic patterns, and how these incidents impact traffic flow, traffic volume and speeds on alternate routes.

Technology advancements may be seen in predictive analytics, drones enabled with remote data collection tools and autonomous vehicles. The
availability of additional data sources coupled with historical data may, in the future, allow transportation planners and engineers to not only respond to emerging events, but through the identification of known trends, use algorithmic models to accurately forecast impacts as they occur. This process will effectively position transportation professionals to proactively manage the impacts of incidents.

Traditional methods for data collection are also changing. For example, drones and other flight-capable aviation are already beginning to provide new access to data, including the ability to capture data for incident management and in-depth video streaming.

Another fast-approaching technology with the potential to redefine the way transportation networks are designed and managed is the autonomous vehicle. Emerging technology researchers forecast that a single autonomous vehicle may generate an average of 1 gigabyte of data per second. When these fully autonomous vehicles begin to regularly utilize the transportation network, a level of connectedness that has never been available before may allow planners, engineers, decision makers and the public to have even more access to continuous near real-time data streams.

At VHB, we are committed and are already exploring these future technologies to understand not only the impacts, but the capabilities and advantages that they can provide to the transportation industry.

About the Authors
Claudia Paskauskas, GIS/PP, PMP, MCSD, SSGB, and Keith Smith, GISP, are key members of VHB’s Technology Solutions Team, and Melissa Gross, PE, is a transportation planner at VHB. Together, they strive to integrate the use of cutting-edge technology into engineering and planning at VHB.

Claudia Paskauskas CPaskauskas@vhb.com
Keith Smith KSmith@vhb.com
Melissa Gross MGross@vhb.com

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