Optimizing Digital Asset Data in Transport & Infrastructure

Using digital technology for smarter management of asset data
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Executive summary

In this article, WSP shows how digital technologies optimize data collection, analysis and processing, creating value-added insights to better manage assets.

Owners, managers and operators of fleets, facilities and infrastructure worldwide face the challenge of expanding and sustaining safe, resilient and reliable services in an environment of aging assets and investment uncertainties, further complicated by assets and asset management systems that are increasing in complexity.

Digital asset data management (DADM) is revolutionizing a space that is vitally important to many organizations. While legacy database systems and solutions are still widely in use, emerging technologies have enhanced the way in which asset data is collected, stored, presented and leveraged.

Adding a further layer to the asset data lifecycle are the competitive advantages offered by augmented reality (AR) and virtual reality (VR), laser scanning, artificial intelligence (AI), deep learning, and unmanned aerial vehicles (UAVs), which are revolutionizing asset data creation and asset data management—providing real-time extraction of structured data and operational insights for immediate application.

For transportation and infrastructure, the real-life ramifications are powerful on both a macro and micro level, from overseeing entire transportation networks to assessing individual infrastructure health to proactively address operational issues and potential safety hazards.

However, not every business is equipped with the necessary technical expertise in-house to manage systems integration and data management or to help the organization understand how all its systems interact and how best to manage data going forward. Nor do all businesses have the exposure to all the different software available, or to a considered opinion of whether to carry on with their existing system or to move to a different solution better suited to their needs, budget and longer-term strategy.
Asset data management is a process of resource allocation, optimization and utilization.

Digital asset data management (DADM) takes a multidisciplinary approach to centralizing the management of large and complex datasets from multiple sources, including legacy systems and open data. Integration typically requires assessment of business processes, systems and technologies for optimal data integrity, with control and monitoring from a single point of view. The cumulative process is designed to deliver business intelligence, an actionable digital strategy, using digital technology for smarter asset management.
WSP plays a leading role in the development and growth of advanced asset management practices worldwide, helping clients solve real-world challenges and improve the services they deliver through more efficient and economic use of the assets they manage—doing the right amount of work at the right time, to achieve the right level of service for the right cost.

“We understand data and its structure, and are uniquely positioned to bring technology in at the start,” states Peter Cenek, WSP Research Manager - Environment. “We also possess the unique ability to bring the right mix of people to the table—engineers, planners, and experts in finance, economics, technology, change management, and more.”

Our global team consists of experienced digital advisors with outstanding technical capabilities in all asset classes, and decades of experience delivering organizational change, developing management practices and improving technology implementation. Our experts include authors of and key contributors to international guidelines and best practice development such as the International Standard for Asset Management Systems ISO 55001:2014, the core of 55001:2018.

WSP has a strong knowledge of all the asset classes that our clients work with, and a proven track record of delivering successful transformation programs to our clients.

Our deep understanding of asset class lifecycle needs—combined with technology and business transformation leadership—enables clients to improve performance, reduce lifecycle costs and minimize risk. We maintain a position at the forefront of the discipline, with ongoing investment in industry guidelines and international standards.

“We work with the client throughout the process, building on a foundation of trust in the reliability and value of the resulting master data,” says Elke Beca, WSP Principal - Transportation Analytics. “We realize our clients can experience managerial, operational and technical challenges—and we advise in all three areas.”
Asset management: Resource allocation, optimization and utilization

The singular purpose for managing assets is to deliver a service. An integrated lifecycle approach to asset management delivers the right level of service – efficiently and economically.
WSP can bring the right mix of people to the table—engineers, planners, and experts in finance, economics, technology, change management, and more.

Vendor and technology agnostic
Both vendor- and technology-agnostic, WSP bridges technology lines, positioning us to develop the most effective and suitable tools for each of our unique clients.

WSP experts work with global technology leaders to develop best-in-class solutions for clients, while providing insight into the efficiencies and deficiencies of existing software and hardware configurations. WSP DADM solutions provide clients with greater insight into existing operations and the potential for new developments.

“Our customized solutions leverage digital technologies into a smarter asset information management tool that is both more accurate and cost effective,” explains Mike Lusby, WSP Senior Instrumentation Engineer. “By providing the client with a more reliable source of data collection and analysis, we optimize how the client’s assets are managed and continue to be managed in the future.”

Developing benchmark data to guide strategic change
WSP’s industry-leading Asset Management Capability Assessment Model, am2c™, draws on over 20 years of experience in managing critical infrastructure. Our model is mapped to global standards, industry best practices and national industry legislative requirements.

WSP’s proprietary am2c™ model is used to assess an organization’s asset management maturity. Asset Management Maturity measures the degree of formality and optimization of processes and practices from ad hoc, to formally defined steps, to managed results, to active optimization. The output of the assessment is used to evaluate and benchmark an organization, and to support the development of an asset management improvement program.

The WSP model has a structure and approach that ensures consistent and repeatable assessment, and provides access to a significant global benchmark pool.
WSP’s Asset Management Capability Assessment Model Delivers an implementation strategy and improvement roadmap for asset management.

Asset management: Maturation staircase

- Maintenance of defective assets - run to failure
- Planned maintenance based on set intervals
- Maintenance based on sensor and diagnostic data
- Maintenance based on degradation models, projections and “lessons learned”
- Integrally connected infrastructure and organization

WSP is a leader in the DADM landscape.
Redefining data management

Transforming data capture

Ongoing advances in technology enable data collection to delve deeper into individual assets and their components to access critical information. Technologies such as Light Detection and Ranging (LiDAR), geographic information systems (GIS) and unmanned aerial vehicles (UAVs or drones) are being paired with legacy technologies to optimize and expedite the data collection process.

WSP teams around the world are redefining the data capture space with business processes and data rules sets that can be applied to enhance the validation of collected data and to eliminate human error at the point of capture. WSP assists clients in managing large infrastructure and land assets, as well as providing DADM services to portfolio owners holding large inventories of cultural heritage assets.

“Combining GIS and legacy database solutions positions us to provide clients with quicker and more efficient inventory access to help determine values, identify risks and optimize asset utilization,” says Doug Manarin, WSP Senior Consultant - Asset Management. “As a result, WSP also improves and facilitates the entire stakeholder consultation process for our clients.”

Self-adaptive systems have the ability to configure and reconfigure, continuously tune and optimize.

Self-adaptive systems have been studied and solutions have been developed in a number of fields such as robotics, autonomic computing, control systems, distributed systems and fault-tolerant computing.

Source: Medium
WSP prepares clients to address the management, operational and technical challenges associated with UAV implementation, as well as the evolving regulatory and policy issues. In addition to providing detailed mapping of infrastructure and topography across varied landscapes, UAV solutions are expected to play a critical role in future transport planning for mobility and the urban core. As an example, in less than an hour, a single drone can collect data across hundreds of acres, produce thousands of images and establish millions of survey points. As prices fall and supply rises, UAV technology is being implemented as an accurate and cost-efficient tool for reaching remote locations to monitor construction, inspect elements, inventory assets, monitor maintenance and conduct pre-construction surveys for both greenfield and brownfield projects.

WSP’s suite of geospatial technologies supporting engineering design, construction and asset management continues to evolve with the integration of UAVs, transforming possibility into reality.

As a trusted and future-ready digital advisor, WSP prepares clients to address the management, operational and technical challenges associated with UAV implementation, and also helps them navigate evolving regulatory and policy issues.

“Once regulatory, strategic and operational frameworks are in place, the deployment of solutions leveraging UAV technology can provide clients with highly effective and powerful DADM tools,” says Manarin.

Data analysis

Adaptive systems are revolutionizing traditional data processing and analysis. As machine learning applications continue to advance, WSP is developing in-house tools designed to provide clients with effective and affordable solutions.

“We are applying machine learning as an effective tool for introducing an automated solution to the time-consuming process of detecting data anomalies and defects,” explains Sara Hederos, WSP Department Manager - Geoinformatics and Asset Management. “Beyond the benefits of enhancing data integrity through the elimination of human error, a machine learning tool can free up resource hours and significantly cut costs for our clients.”

WSP’s DJI Matrice 210RTK, which we use for inspection work.
Working with a variety of tech companies, WSP is also engaged in the development of new workflow technologies for Building Information Modelling (BIM) that will facilitate more rapid visualization of construction documentation such as 5D BIM, a digital representation of the physical and functional characteristics of a project. 5D functionality can integrate design (3D), schedule (4D) and cost (5D) into a 3D output.

As an example, in Canada alone, WSP deploys more than 40 UAV platforms and pilots across a business line heavily concentrated on asset data collection, while geospatial solutions provide clients with additional asset management efficiencies on the systems side.

**Conversion of legacy data**

Digital dashboards and visualization tools have become vital in the conversion of raw data into useful digital formats.

With new technologies and capture sources feeding asset data in a variety of formats, WSP understands the difficulties clients can encounter in bringing stored legacy data up to speed in the digital age. WSP specializes in converting legacy data into efficient formats that best serve our clients’ needs.

For clients with disparate systems, data and information assets, who need these resources to come together, WSP can provide the necessary guidance and a roadmap. We understand that every organization will have systems and set ups individual to their business. WSP has the depth of knowledge and expertise to help.

**Systems integration**

The key to leveraging the power of emerging data management and analysis technologies lies in systems integration, ensuring communication across all data sources by merging disparate systems into a single, tailored solution.

Systems integration supports each stage of the data asset lifecycle, providing a clear plan for each stage, with defined plans, processes and deliverables ensuring confidence of delivery.

Extensive global experience in multiple systems integrations across all business lines positions WSP to extend our expertise to the DADM space, assisting clients with the optimization of their infrastructures, while exploring new ways to link multiple information systems via new technologies. From planning to initial design, through to development, management and maintenance, WSP possesses the skills and ability to support clients in their DADM journey.
**Future-ready, client-specific**

As digital factory and smart infrastructure capabilities advance, the capacity to move asset information modules into world of the Internet of Things (IoT) approaches.

WSP’s data collection and field condition assessment resources include GIS storage solutions and interactive, client-specific DADM platforms. We are continually researching new solutions that enhance all aspects of DADM, to give clients even greater confidence in the quality of the data assets used to inform their decision-making.

WSP’s ability to position clients to be future ready, includes the use of digital “twins” that combine data with technologies such as artificial intelligence, machine learning and software analytics to provide dynamic, real-time digital replicas of physical assets.

“As the DADM space evolves, we are committed to providing our clients with forward-thinking solutions that address tomorrow’s challenges today,” says Henry Okraglik, Global Director - WSP Digital. “Advancing the leading edge requires a collaborative effort, and WSP will continue to partner with technology providers whose solutions best integrate with the specific needs of our clients.”
WSP-designed solutions

Some of the solutions WSP has designed for clients include:

Interactive mapping and data portals

In response to the high costs associated with investing in enterprise-level solutions, WSP helps clients build and implement customized web mapping portals. These portals enable convenient and cost-effective interaction with proprietary data and facilitate integration with external data sources. Helping clients to select the right tools and technologies for their needs, WSP then deploys intuitive, powerful and customizable web tools to further information gathering, analysis and sharing.

In Canada, WSP geographic information systems (GIS) specialists have developed web portals that deliver dynamic, engaging interactive mapping experiences for clients including Metrolinx and Toronto Water.

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Data portal example for Metrolinx.
HS2
In the UK, WSP provided strategic advisory services to High Speed Rail (HS2) in defining and developing their Asset Information Model for use throughout the lifecycle of the HS2 multi-billion-pound programme, from design conception through to operations and maintenance. WSP’s asset management experts advised HS2 on current and future asset information requirements throughout the project lifecycle. This included developing an Asset Information Management Plan that outlined how the client would achieve their asset information objectives. The process involved formulating asset hierarchies by asset class; developing an asset register detailing major design elements; and defining what asset information would be required at each stage of the project lifecycle to enable creation of a “virtual” HS2 model.

Highways England
WSP has also delivered a portfolio of projects under the Smart Motorways Programme, which includes the addition of more than 240 miles of extra capacity through smart motorways.

To help Highways England make efficient use of data obtained through road sensors and CCTV cameras, we conducted a digital asset inventory of their entire system and tailored a solution to streamline digital management of all the assets in their network and improve network performance.

The creation of ISO 55000-compliant operational standards and guidelines followed, with WSP assisting the client in monitoring traffic flows and speeds, creating alerts and responding instantly to safety issues.
Stockholm Public Transport Administration

Every day the Stockholm railway system handles 1,350,000 passengers. The railway network includes seven metro lines and nine light rail lines forming a 228 km-long rail network. The network stretches through 47 underground stations and 169 other stations. An increase in daily maintenance and planned upgrades on the complex railway network highlighted the need for an asset management system to provide the necessary controls and monitoring.

WSP developed and delivered the Railview application and system, a robust tool to manage rail assets. Railview visually delivers all assets on the map dividing them into different technical and geographical placement or groups with intuitive and user-friendly map-based exploration tool and database for all existing railway objects.

The innovative asset management system has many advantages over traditional data systems. Firstly, the data collection is time-efficient, comprehensive and replaces on-site surveying that would require many weeks in a high-risk environment.

Moreover, the image capture component allows for visual inspection and verification of attributes, models or material. The LiDAR component allows for deriving height, length and much more thorough the precise position of the asset.

This project completely changed the client’s traditional way of collecting and inspecting data and opened up new possibilities in WSP’s other projects, for example crack detection in concrete tunnels in the Singapore Transit Authorities railway system, in dangerous or hardly accessible environments, like tunnels and highways.

04-05-06
LiDAR point cloud and image captured by WSP’s Railview application and system.
New Zealand Transport Agency

Since 1999, WSP has overseen the automated collection of condition data for the New Zealand (NZ) Transport Agency’s 22,000 km State Highway network using laser equipped survey vehicles.

WSP’s responsibilities have included specification, procurement and management of two contracts associated with the annual collection of roughness, rutting, texture, skid resistance, cracking and pavement deflection data, along with geometry data, GPS tracking and right-of-way video to allow any pavement and road surface defects to be accurately located and sighted by maintenance engineers and crews.

Multifunction road survey vehicle SCRIM® S10 undergoing validation trials.

WSP uses the data generated to produce informative annual reports on network road condition, enabling targeted implementation of safety policies and better management of the Agency’s road assets.

As part of the reporting exercise, WSP oversees an extensive equipment validation exercise. Contractors must demonstrate the data collected is accurate and repeatable. This precaution ensures the time series data remains uncompromised should NZ Transport Agency choose to change a survey contractor or measurement system.

Once surveys are underway, WSP provides day-to-day contract management and quality assurance, which includes extensive monitoring and validation of the 11 million data records collected annually to ensure the integrity of the load data in Agency’s inventory and condition database. This quality assurance process led to development and adoption of in-house advanced data integrity checking procedures and systems.

On behalf of the NZ Transport Agency, WSP also manages their Highway Structures Information Management System (HSIMS). This contains State Highway bridge asset data and legacy documentation. Consequently, WSP has designed a simple, yet effective, bridge DADM solution that generates high-value information online through provision of trend and location visualizations, as shown in the figure below.

07-08 Multifunction road survey vehicle SCRIM® S10 undergoing validation trials.

09 HSIMS interactive dashboard visualization of New Zealand State Highway bridges.
Austroads

Also in the road space, WSP developed Asset Componentisation Guidelines for Austroads, an organization of road transport and traffic agencies collectively responsible for the management of over 900,000 km of roads in Australia and New Zealand. The purpose of the initiative is to promote consistency in interpretations of data across multiple road agencies, to ensure integrity of financial statement comparisons.

WSP developed prescriptive guidance material to facilitate improved integration of Asset Management and Financial Management disciplines. The project will deliver prescriptive guidance regarding minimum levels of componentisation for complex assets, applicable to State / Territory Road Agencies and Local Government Authorities.

The project deliverables provided a benchmark to stakeholders and users (i.e. road management authorities and auditors) for driving a more consistent approach to preparation of financial statements. In turn, this will enable more efficient collation of national data sets used to enable equitable reform initiatives, such as national funding reform.

“By developing prescriptive guidance material, WSP is providing the client with a benchmark for driving a more consistent approach to the preparation of financial statements,” explains Okraglik. “Looking ahead, the tools that we are currently developing will also enable more efficient collation of national data sets.”

Land Information New Zealand

Also in New Zealand, WSP specialists have co-authored and undertaken the first pilot project of the NZ Asset Metadata Standards. These standards provide a specification for asset data that supports data creation, collection, storage and analytical capabilities to make evidenced-based investment decisions. This applies to both capital and operating environments.

Delivered in the latest mobile and cloud-based mobile technology, the pilot project allowed 3D models and asset information to be accessed by any team, anywhere directly from their mobile devices at every stage of the project (Design-Construction-Operations) while retaining a bidirectional connection with the native BIM environment throughout.

Optimizing Digital Asset Data
At the conclusion of the project’s CAPEX stage, site-verified BIM and associated data were provided in application-agnostic formats and uploaded to the client’s in-house AM/FM systems. This allowed the operational teams to digitally manage their assets from a trusted single source, providing detailed, accurate information whilst allowing barcode scanning of assets and connections with facility sensors.

“We actualized the promise of BIM,” says Dan Jurgens, WSP Technical Director - Digital Engineering. “For WSP, this project is another example of how we are using technology to transform possibility into reality.”

**Strengths and Opportunities**

WSP approaches DADM from a position of unmatched global strengths. We bring innovative ideas and techniques to the market in order to deliver realistic and cost-effective solutions to digital data assets and asset management systems. We are continually extending our reach into evolving technologies such as UAVs, 3D modelling and machine learning that are opening up new opportunities in DADM for our clients. By remaining vendor- and technology agnostic, we offer our clients an informed, considered opinion. With expertise in multiple disciplines, WSP guides clients through the complexities of the DADM lifecycle. A trusted digital advisor, we help clients worldwide transform their data into assets that contribute to their organization’s goals and success—wherever their business may be in the journey.

11 New Zealand Asset Metadata Standards in use in cloud-based mobile app.
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