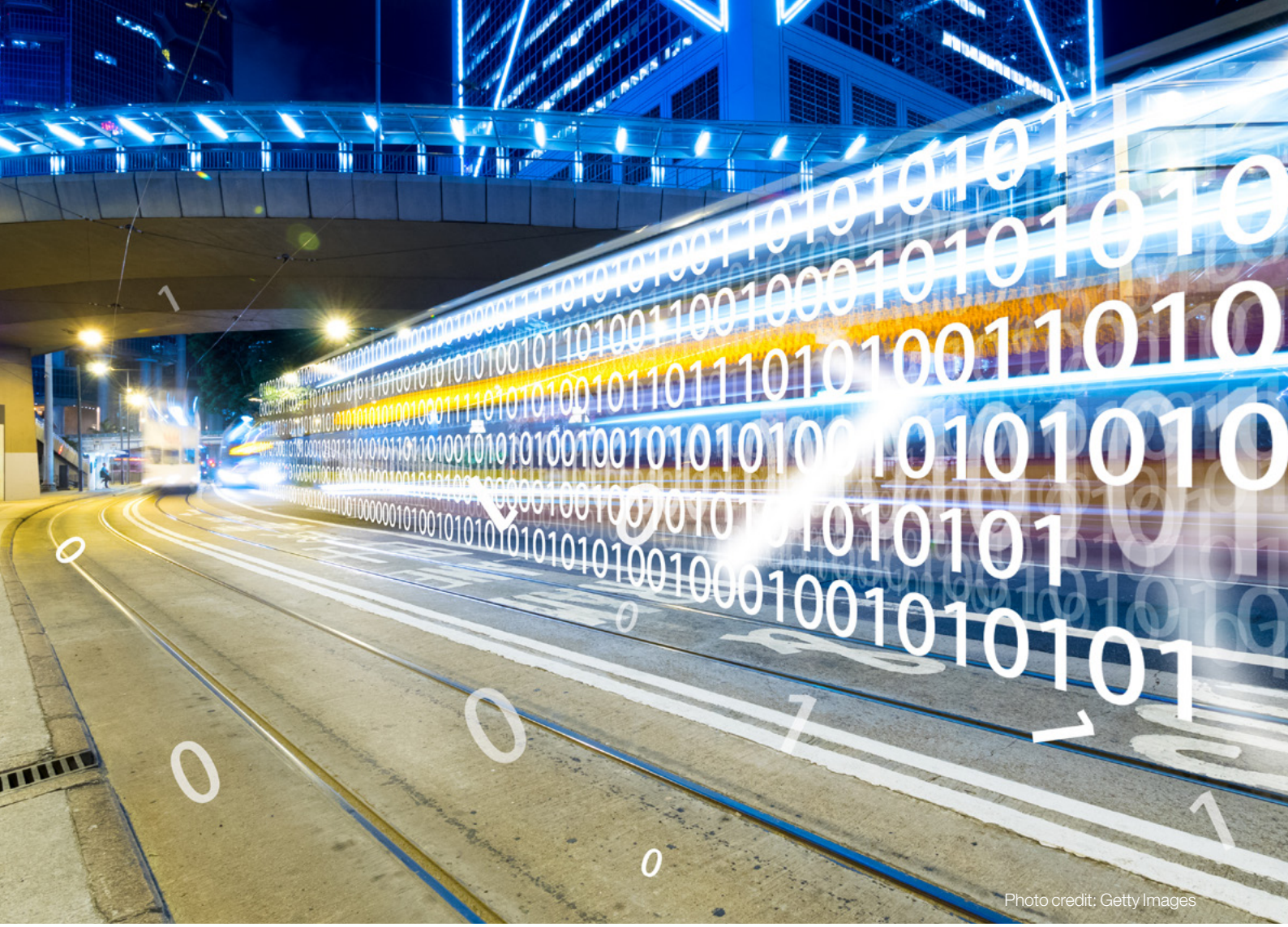

How advanced analytics can benefit infrastructure capital planning

Asset owners are lagging other industries in data analytics. Now's the time to get going.

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Advanced analytics—the ability to generate valuable insights from large amounts of data—has emerged as a powerful tool to understand and learn from past performance as a guide to more accurately predict trends. Analytics creates value when big data and advanced algorithms are applied to business problems to yield measurable improvements. By identifying, sizing, and prioritizing the biggest opportunities, businesses can create an analytics strategy that generates value.

Although advanced analytics are increasingly employed by infrastructure players in both the private and public sector, the industry still tends to lag others such as retail, financial services, and automotive in embracing its comprehensive use across the project life cycle. To the extent these methods are applied, it is predominantly in the project-delivery phase rather than integrated into capital planning. As a result, many asset owners experience weaker capital productivity than what we see in other sectors, as they are making major decisions based on primarily qualitative, rather than quantitative, factors.

Incorporating advanced analytics into the capital-planning phase can radically improve the ability of owners to make decisions based on the expected performance of their existing infrastructure. For example, it can enable them to form more refined asset lifecycle curves, which allows them to align investments with needs in design, construction, operations, and maintenance. It can also help owners and operators generate deeper insights and value on maintenance versus replacement decisions and asset-longevity trends.

Taking advantage of data-driven methods could help owners free up capital—we've seen portfolio savings of 5 to 15 percent—and permit them to reallocate money to more attractive projects. In this article, we outline how advanced analytics can benefit infrastructure owners when applied to capital planning and describe a methodology to pursue this rich opportunity. Those that seize the moment have a chance to become leaders in the field.

Taking advantage of the data-driven environment

Owners of complex assets are challenged to make use of the vast amount of data now being gathered by sensors and sources across their networks. Powerful analytics tools are readily available and can assist by creating a visualization platform and using machine learning to help spot patterns in the data.

The ability to predict the likelihood of a given event can then inform the organization's capital-portfolio-development process and help identify underlying life-cycle drivers, including which preventative mitigation measures it must invest in.

Another key benefit of advanced analytics is the level of precision it enables in an owner's decision making. While traditional decisions may have focused on whether to maintain or replace an asset entirely, advanced analytics can help owners prioritize replacement or repair of specific components rather than a complete asset.

For example, the use of sensors can allow a department of transportation to identify bridges that require a complete reconstruction and others that need only one or two new

girders to replace those presenting structural issues. In one case, the South Carolina Department of Transportation has a Federal Highway Administration grant to evaluate the value of structural-health-monitoring technology to complement visual inspection and other information regarding specific bridges.

Another emerging use is in the railroad industry, where sensors monitor track geometry, rail corrugation, and track-surface measurements, facilitating maintenance and long-term investment decisions. For one railway company, the use of existing-condition data as a predictor of required maintenance helped save more than 30,000 man-hours a year and allowed the company to redirect $20 million of annual engine-overhaul spending toward capital-replacement investments.

Integrating advanced analytics into capital-planning decisions

Infrastructure owners generate vast amounts of data. But the data are often isolated, unassimilated, and underused. In some cases, the data are employed for narrow analyses and not aggregated to enable a broader understanding of how an asset is performing. Three pillars support the integration of advanced analytics into the capital-planning process and development of useful insights for asset-portfolio owners:

- refinement of the current capital-planning process: integrating predictive insights and establishing structured, repeatable advanced-analytics processes using diverse data sets
- use and integration of leading-edge systems: identifying and aligning the data systems to inform the model and applying sophisticated advanced-analytics tools and systems
- commitment to build capabilities: ensuring that the appropriate people and skill sets are in place to promote model development and use across the portfolio

Below, we explore how infrastructure-asset owners can move ahead in these three areas.

Incorporating analytics into the capital-allocation process

Capital-allocation processes will vary among organizations. However, we believe a best-in-class approach uses evaluations of asset health in the development of the overall strategy.

Often, the decision to replace or refurbish an asset is influenced by broad, historically established industry benchmarks that are often conservative, advocating early replacement to rightfully avoid failure. However, using advanced analytics allows managers to better understand “instantaneous asset health” by predicting expected asset performance using multiple indicators compared against a wide and deep data set. For example, one asset owner employed predictive models and ground-movement sensors to identify anomalies during tunneling under a city. The approach enabled the asset owner to install a more

efficient sensor array and monitoring system that enhanced its ability to conduct predictive maintenance and thus reduce overall long-term capital investment.

Defining the advanced analytics process

When embracing the use of advanced analytics in capital-investment decisions, the goal is to capture and use all applicable data sources both internally and externally available to develop a robust predictive model.

Success employing these techniques is largely dependent on the ability of organizations to change the way they work and pilot innovation with an open mind. We have found that a three-phase approach is the most effective in developing the tailored predictive systems and integrating into an owner's ecosystem: design and data ingestion, proof of concept, and integrate and scale.

Design and data ingestion

During the initial phase of incorporating advanced analytics into the organization, a structured database of all likely internal and external data sources is developed. The early evaluation of the data set provides a first assessment of likely drivers affecting overall asset performance. Sources of data would include the following:

- design and construction records
- operational records
- maintenance and recurring capital-expenditure records
- inspection reports
- incident reports
- historical failure data
- expected remaining life
- seismic data
- historical weather data
- interviews
- previous criticality assessments

Owners need to understand that data are an asset (in fact, tech companies typically build business models around it). As data ingestion becomes more sophisticated, owners should

strive to collect macro and micro data about their projects throughout the life of the project development and execution cycle, as well as link it to external market trends.

Proof of concept

The second phase is supported by the outputs from the initial model design and data-ingestion process. A range of tools can be used to model past events and identify a set of quantified performance drivers to predict future performance. Some of the analytical approaches include proportional-hazard modeling, incipient-failure detection, and probability-distribution functions.

The output from this phase enables a dynamic predictive model for critical assets to identify failure mode, performance drivers, and life-cycle timing.

Integrate and scale

The advanced-analytics model is constantly updated to provide real-time predictions of asset performance. Having established the initial model, other predictive models can then be created to estimate likely performance of other asset types and subsystems within the capital portfolio. Typically, the systems, processes, and capabilities developed up to this point are used to efficiently scale the use of advanced analytics across the remainder of the infrastructure portfolio.

Deploying and integrating leading analytics systems

Significant thought goes into which systems and tools to deploy when developing a predictive system. The systems and tools should be integrated with existing information-technology systems.

Commitment to build capabilities

The third pillar supporting the integration of advanced analytics into the capital-planning process is ensuring that the right people and skill sets are in place. Owners should invest in professionals who can develop enterprise-level analytics.

This will likely require investment in all aspects of talent development, including recruiting, hiring, and training. In addition, and perhaps most important, organizations will likely need to retool their systems, processes, and culture to reflect the value of advanced analytics. Leaders must make clear that analytics is not a marginal capability; on the contrary, they must ensure that its practitioners have the authority and organizational reach necessary for impact.

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Infrastructure-asset owners have been slow to introduce advanced analytics into their capital-planning process. But they can take heart from the experiences of adjacent

manufacturing industries, where the introduction of advanced analytics has led to improved returns on invested capital. Incorporating advanced analytics into the capital-portfolio-planning process could lead to more efficient deployment of capital in both the private and public sector, enabling owners to fund additional projects across their networks.