Capgemini

Reinventing Infrastructure and Capital Projects

The Application of Advanced Analytics

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The Role of Advanced Analytics in disrupting the Construction and Infrastructure Sector

It is often stated that data is the new oil. However, sometimes the engine to move organisations forward in exploiting data is not ready.

This seems to be the case for the Construction and Infrastructure sector, which is actually at the back of the pack[1] when it comes to managing data. According to FMI, 96% of all data captured goes unused in this industry. Moreover, 13% of the working hours are spent looking for project data and information. This implies a massive waste of time and budget[2].

Let's start by stating what you will not find in this *Point of View*. You won't find an obvious list of all the benefits of using Advanced Analytics, nor about defining overused technical concepts such as Big Data or Machine Learning. At Capgemini Invent, we are not simply providing another one-dimensional, simplistic summary of new paradigms, but rather guiding organisations in taking successful and impactful steps in leveraging the use of data.

A Systemic Issue

Many organisations have the use of analytics in their roadmap as the vast amount of data generated in the Construction and Infrastructure sector can be remarkably valuable - even more if accurately processed by data analytics tools. However, organisations still fail to start off on the right foot.

This happens because of a few main reasons:

Firstly, construction and infrastructure sector operations generate a lot of data often stored in multiple, sometimes antiquated, and decentralised systems, making progress hard to track and plan, less transparent, and more prone to failure.

Secondly, because of the lack of a well-designed and robustly implemented strategy that empowers companies to make data-driven decisions, improve efficiency, generate an internal digital culture, and accelerate growth prioritising opportunities able to generate the most valuable impact.

Finally, the absence of high-quality, pertinent, and promptly available data necessary to empower algorithms results in data stagnation, undermining the accuracy of analysis, restricting decision-making capabilities, and impeding the capacity of advanced analytics and AI models for iterative learning.

1 *Which Industries Are the Most Digital (and Why)?*, Harvard Business Review
2 *Big Data = Big Questions for the Engineering and Construction Industry, FMI, 2018*

Data at every step of the project

A large amount of data is created across every project lifecycle phase. This data can take many forms and characteristics; produced, transformed, transferred, stored, used, discarded and deleted by a myriad of stakeholders. The table below provides an illustrative look at some examples data generated in the various phase of the Construction and Asset Management lifecycle.

Led by Owners	1 Definition & Tender ***Typical stakeholders:*** Investors / Developers, Architectural Engineers, Project Consultants, Financial Institutions, Client, PMs, Local Authorities	Sub-phase	**Demand Analysis, Programming and Feasibility Studies**	**Objective, Scope & Impact**	**Bidding**
		Data Generated	•Social-economic •Demand trends •Historical data •Site information •Financial Availability •Regulation	•Business case •Objectives	•Contract documents •Bidding data
Led by Contractors & Designers	2 Design & Preconstruction ***Typical stakeholders:*** Planners, Designers, Architectural Engineers, Contractors	Sub-phase	**Preliminary/ Concept Design**	**Detailed Design**	**Preparation**
		Data Generated	•Site information •Physical, economic, and social requirements •High-level drawings and design concepts	•Characteristics and quantity of materials • Detailed drawings •Specifications •H&S-related risk inputs	•Timelines •Budget •Key metrics on environmental impact •Initial risk management data •Compliance data •Permits information
	3 Construction ***Typical stakeholders:*** Manufacturer, Suppliers, Project Manager, Architectural Engineers, Contractors, Client	Sub-phase	**Construction and Procurement**		**Commissioning, as-built, handover**
		Data Generated	•Environmental impact •Payment records •Contract administration •Inventory and stock •Quantities •Workforce Management •Health and Safety •Quality •Waste mgmt. •Schedule, risk and cost •Weather data		•As-built drawings •Defects •Closeout documents •Equipment rentals •Final quality report •Lessons learned report •Certificates
Led by Operators	4 Operation & Maintenance (Asset Mgmt) ***Typical stakeholders:*** End user, Client, Asset Operator	Sub-phase	**Maintenance**		**Operations**
		Data Generated	•Asset condition and history •Equipment performance •Routine inspection •Inventory •Maintenance costs		•Energy use data •Occupancy and asset use •Health and Safety •Compliance

However, data is just a means to an end in our view: For organisations to really maximise the opportunities inherent in the data, such data should be translated into information, and the information into knowledge.

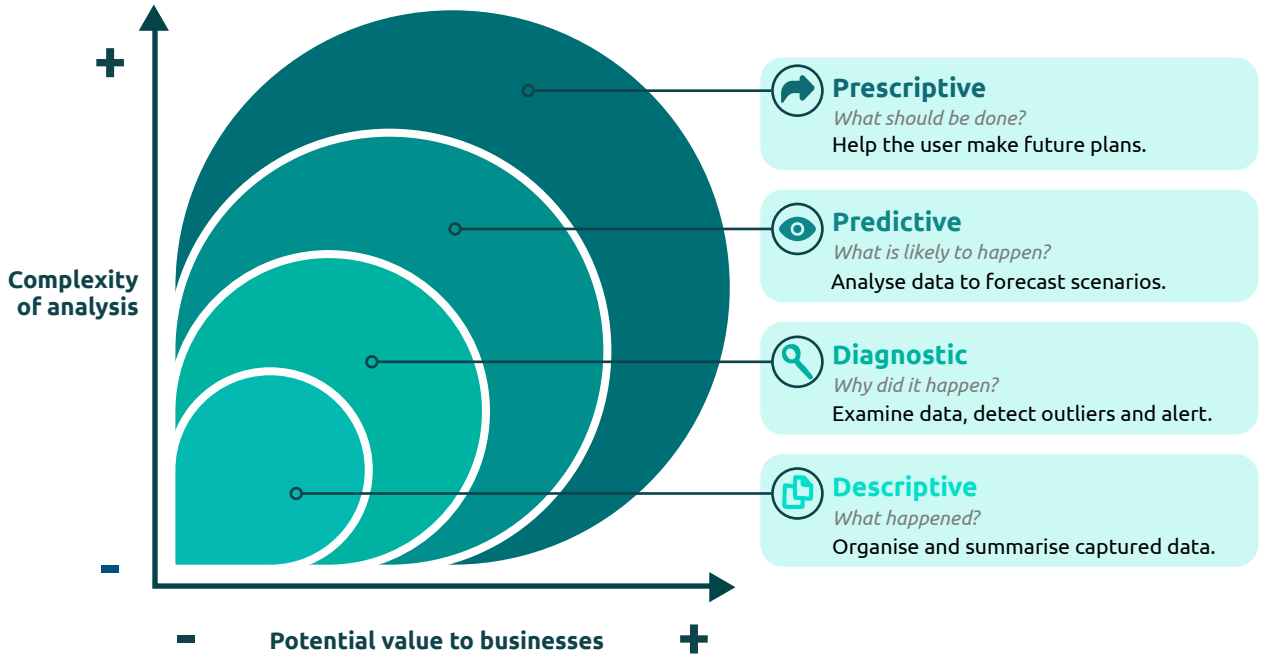
Only this knowledge will truly provide support in making better decisions at operational, management and executive levels and, in the end, become a key competitive advantage.

Let's now explore in more detail how advanced analytics can help.

Advanced Analytics in less advanced terms

To have a clear view of the potential value to emerge from the data generated in the Construction and Infrastructure sector, we need to understand the different existing types of Advanced Analytics from a simple point of view.

In general terms, Advanced Analytics is the practice of analysing data to obtain valuable information using sophisticated techniques and tools. But there are many paths that enable to categorise Advanced Analytics into different branches. For instance, they can be clustered by method (Data Mining, Data Visualisation, Statistical analysis, and Artificial Analysis); by the size of the data (Big Data vs. Small Data), by temporality (Real-Time vs. Non-Real-Time) or by function (descriptive analytics, diagnostic analytics, predictive analytics, and prescriptive analytics). Here below we will analyse the latter.



Advanced Analytics in action

Contractors and Operators can use the benefits of Advanced Analytics to radically improve the way they define, plan and execute construction projects, as well as operate and maintain infrastructure assets in a more efficient and effective way. The ever-growing number of technology solutions and the more advanced capabilities expose a vast array of use cases.

We have outlined a few use cases for each of the lifecycle phases to illustrate the current possibilities.

1 Definition & Tender Phase	• **Use Case:** Software suite that processes detailed aerial and ground imagery to create maps of construction sites as well as anticipate patterns during project development. • **Analytics:** descriptive, predictive • **Value provided:** Enhanced decision-making and reduced surveying costs.	• **Use Case:** Advanced bidding strategy based on multi-parameter models using past projects data (cost, time, resource availability, suppliers performance…) • **Analytics:** diagnostics, descriptive, predictive, prescriptive • **Value provided:** Increased project winning rates; reduced initial risk exposure
2 Design Phase	• **Use Case:** Real-time design visualisation, construction sequencing and simulation used to create virtual models to identify possible issues and best approach before building starts • **Analytics:** descriptive, predictive, prescriptive • **Value provided:** More efficient execution schedule and optimised resources; reduced operational risks	• **Use Case:** Forecasts project outcomes using historical data, and easily determine which milestones are at greater risk to develop proactive mitigation strategies • **Analytics:** descriptive, predictive, prescriptive • **Value provided:** Accurate project risk management, reduced cost overruns and schedule slippages.
3 Construction Phase	• **Use Case:** Compare project's schedules, anticipate delays, resource conflicts and recommend schedule changes. • **Analytics:** predictive, prescriptive • **Value provided:** More robust progress monitoring , more control over change management process, reduced project delay likelihood	• **Use Case:** Measure cost performance and schedule performance index by tracking labour's productivity and efficiency on construction site. • **Analytics:** predictive, prescriptive • **Value provided:** Improved workers' productivity, expanded insights on progress patterns, accurate production historical data for future bids development.
4 Operation & Maintenance	• **Use Case:** Prioritisation of buildings' renovation plans, and climate resilience diagnosis. • **Analytics:** diagnostic, predictive, prescriptive • **Value provided:** Extended asset life reducing corrective costs, minimised availability penalties, more efficient funds drawdown	• **Use Case:** All-in-one maintenance management to schedule, track and asses preventive maintenance and control assets inventory. • **Analytics:** descriptive, predictive • **Value provided:** Optimised maintenance resources, augmented asset management capabilities

Update your operating model

The use of advanced analytics should not be considered as a fancy add-on for an already-busy workforce – it should be used as a booster of their capabilities and the model they operate in.

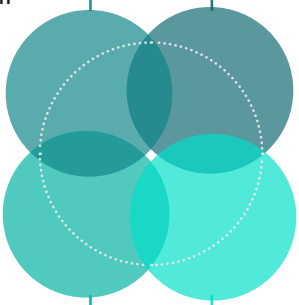
Organisation & Culture Lens

It is critical to identify how each role will be impacted in their responsibilities by using Advanced Analytics, as numerous questions will arise: *"Do all roles need to be involved in all-things-analytics? Do I need to reconsider my project structure?"*

At the same time, organisations will be asking their employees to change some of their behaviours so that the potential of Advanced Analytics is fully realised and embedded in their daily routine.

Processes Lens

Certain processes on site and during the daily operations and maintenance of assets are ingrained in the workforce. However, these may need to be reconsidered as Advanced Analytics changes the paradigm. Some processes will move from being reactive to predictive, whilst other processes may disappear as the new tools cover all the steps end-to-end.



Governance Lens

Advanced Analytics introduces more powerful capabilities in project and O&M teams. By leveraging this technology, the way items are discussed and decisions made will radically change. This means that certain governance procedures will need to be adapted as more quantitative, insightful and agile predictions and diagnostics are used.

Technology Lens

As we have discussed, organisations already face an increasing technology complexity as legacy systems are evaluated, new digital solutions introduced and data management refined. The introduction of Advanced Analytics tools will need to be evaluated and integrated in the enterprise architecture, whilst the data necessary to power these solutions will need to be managed in a way that can be effectively utilised.

Added Value to each level of the organisation's hierarchy

Advanced Analytics provide value to roles located across the whole construction and infrastructure organisation hierarchy including Executive, Management and Operations teams. Here is how each role can benefit from leveraging these tools.

Executive Level	Based on better data quality and timelines, executives can improve visibility and confidence on the performance of the portfolio of projects. Through leveraging historic data analysis and inferred trends, they can better design their strategies based on informed predictions.
Management Level	Based on uncovered patterns, management teams can increase the ability to take proactive actions to modify the project trajectory using diagnostic analytics and optimise focus on value-add activities and other critical tasks. At the same time, operators can influence their asset management plan and funds allocation decisions based on Advanced Analytics recommendations.
Operations Level	By leveraging predictive and automation capabilities, operations teams can improve daily productivity using recommendations based on AI and improve the quality of their outputs by saving time.

A solid approach to advance your analytics

Very commonly, we witness organisations being held back by undertaking isolated initiatives driven by many different reasons: a team in a particular contract may be trying a promising AI-tool, another project team may be developing their own python-based model to run some statistical calculations on a set of data… However, our experience show that this is not a sustainable approach to embed advanced analytics in their operations.

Although collecting the data may sound like the logical first step, our view is that a more holistic and strategic view is critical. A high-level illustrative roadmap is provided below:

1

Vision and organisational design

It is critical to define what the organisation, at the various levels, mean by becoming data-driven and identify those most likely to be impacted. This, in turn, will provide a view of the ideal journeys and use cases to be analysed and considered in the next phases.

2

Adapt the operating model

Based on the vision and design work, the pillars of the operating model (roles, policies, processes, governance and technology) will need to be adapted to account for the expanded capabilities advanced analytics will introduce.

3

Develop and test

Based on a logically structured and prioritised set of requirements resulting from the previous phases, the necessary technology enhancements in the existing enterprise landscape as well as any new developments will need to be carried out.

A selected set of key users will be summoned to test the new capabilities to suggest tweaks before the roll-out.

4

Prepare and implement

Using a previously defined change management strategy, it is essential to support your teams in adapting to a new way of working.

In an incremental and robust fashion, the new capabilities are implemented across the various projects based on risk.

5

Refresh and continue

Continue with the strategic plan based on your vision and organisational design, recognising adjustments may be needed and new use cases or capabilities may need to be introduced in a controlled way.

How Capgemini can help

Having worked with leading organisations in designing their strategy around data analytics, transforming their operating models to digital ones and implementing effectively new ways of working, we are very well positioned to support you in your advanced analytics journey.

Innovation, Strategy & Design

Our colleagues at frog excel in discovering the impact of emerging technologies, as Advanced Analytics, on the transformation of leading organisations, defining your vision on how to address this technology or in setting-up your long-term adoption strategy.

frog
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Capgemini Invent

Digital Operating Model and Change

Our management consulting division, can craft your technology strategy, defining your advanced analytics framework, adapting your operating model and guiding transformative changes within your company.

Capgemini invent

Build and Deploy

Our technology experts are strongly positioned to develop and test the technology assets and solutions required for your operations, as well as support you during the implementation phase.

Capgemini engineering

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