

Project data analytics: the state of the art and science



KEYWORDS

- Project data analytics
- Artificial intelligence (AI)
- Machine learning
- Big data
- Autonomous agents

The context

The project delivery profession is in the midst of unprecedented technological innovation. Ever-increasing complex projects and programmes combined with the arrival of new digital technologies offer a wealth of opportunities to improve project performance. Responding to those opportunities is made difficult by the unfamiliarity of many project professionals with the technologies involved and the benefits that can accrue through their use.

This 'pathfinder' report assists project professionals by bringing together work in project data analytics to give a succinct statement of current progress. It gives a picture of what is happening now in this field gained from interviews with key stakeholders. It highlights the research APM is undertaking in this area to identify future developments of project data analytics. The lack of a common understanding of terms used in this arena is acting as a barrier to their adoption so the report begins by giving clear definitions of available digital technologies and the relationships between them. This document will be complemented with a full report on conclusion of its associated investigations.

What is project data analytics?

Project data analytics, at its simplest, is the use of past and current project data to enable effective decisions on project delivery. This includes:

- **Descriptive analytics** presenting data in the most effective format.
- **Predictive analytics** using past data to predict future performance.

Project data analytics interfaces with:

Big data This refers to extremely large bodies of data (or datasets). In project terms, this often refers to the historic 'data plumes' of legacy that are created from the use of project control or enterprise management systems. Project data analytics (both predictive and descriptive) uses big data in its activities.

Machine learning This is the name given to computer algorithms that 'learn from doing'. In project terms, machine learning has, at its centre, algorithms that are used to spot patterns between some characteristic of projects or programmes and some aspect of project performance. This process gets more accurate the more it is used. Machine learning is a fundamental part of predictive project data analytics.

Artificial intelligence This refers to the study of 'intelligent agents,' autonomous non-human entities that can take in information from their environment and act upon their environment in a way that enables them to succeed in their goals. Intelligent agents need to have mastered machine learning and aspects of predictive data analytics in order to be able to do this. In a project context, some people have speculated that an intelligent agent could enhance or change the roles and status of many project professionals.

The current use of project data analytics

When considering the current adoption of project data analytics, it is useful to distinguish between:

- Predictive and descriptive analytics.
- Analytics that happen within an organisation and across organisations.

In order to understand the current state of the art and science of Project Data Analytics, an investigation was undertaken that pooled the existing knowledge of researchers at Manchester, Southampton, Sheffield and Warwick and supplemented this by interviewing key stakeholder groups (e.g. relevant APM special interest groups; Data Analytic SMEs; Conventional Project Control consultancies; PMC user organisations)

Interviewees were asked two key questions:

- What are you doing with Project Data Analytics now?
- What will you be doing next?

Descriptive data analytics within an organisations: This is now accepted practice. Many organisations are now using off-the-shelf analytic tools that extract data from existing project platforms and present it in a dashboard format. In some cases, organisations will have created bespoke systems to do this. Evidence indicates that using descriptive analytics can result in superior project performance.

Predictive data analytics within an organisations: This is happening using a bespoke approach in a limited way in very few organisations. Where it has been undertaken in a limited fashion, predictive performance of the analytic system has out-performed that of project professionals.

Descriptive data analytics across organisations: This has long been undertaken in the guise of 'benchmarking' which has been at its most useful when the organisations and projects have been very similar to each other. Data trusts are now being created in specific related sectors that have the potential to share data across organisations.

Predictive data analytics across organisations: This has only been carried out by project management researchers.

	Across projects in one organisation	Across projects in many organisations	
Descriptive analytics	<ul style="list-style-type: none"> Always done this but the difference is now the availability of volumes of data and off-the-shelf tools (c.f. Quickview, PowerBI) Evidence to show that adoption leads to superior programme performance (c.f. Logikal surveys) <p>BARRIERS: 'Geeks' meet business; what data is needed for decisions?; poor quality, outmoded data presentation</p>	<ul style="list-style-type: none"> Traditional 'Benchmarking' (c.f. as undertaken by CII, Turner and Townsend, IPA) Very few trans-organisational data trusts (c.f. the Construction Data Trust, the Oxford Project Portfolio) <p>BARRIERS: Inconsistent definitions; attitudes to data sharing; the reference class forecasting issue (apples & pears comparisons)</p>	<ul style="list-style-type: none"> Accepted practice Next steps Not yet used in practice
Predictive analytics	<ul style="list-style-type: none"> Some very specific consultancy involvement (c.f. Deloitte predictive project analytics) Limited specific feature performance predictive analysis using machine learning (c.f. Oakland Group and Network Rail on project underspend) <p>BARRIERS: Big number of data points but small number of projects unbalanced data; unfamiliarity in algorithm identification</p>	<ul style="list-style-type: none"> Extremely few instances limited to research projects (c.f. 'Megaproject' and 'Understanding Nuclear Decommissioning') <p>BARRIERS: All of the above!</p>	

Research in project data analytics

Research into project data analytics is in its infancy though reviews of current practice such as that undertaken by PwC and sponsored by the International Project Management Association (IPMA) are beginning to appear. Established annual project controls surveys undertaken by Logikal are also now reflecting project data analytics in the questions that they ask. APM has sponsored three on-going research fund projects around project data analytics with all due to be published by spring 2021:

Leveraging the value of lessons learnt through the power of intelligent agents

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This investigation examines the application of intelligent agents to the critical area of learning lessons across projects. It will investigate the use of 'chatbots' to identify and disseminate lessons learnt. (A chatbot is a software application that emulates a human by 'chatting' either by text or speech to guide the user through a task.) It will use this experience to reflect more widely on the use of AI in projects. Intelligent agents won't be badged as AI but as a tool in the project manager's arsenal.

To what extent we can blackbox project management as a profession? - can AI learn to be a professional project manager?

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This investigation takes as its starting point the professional status of project managers and the tapestry of knowledge, skills and attitude that it takes to achieve professional status as a project practitioner. The investigation attempts to 'unbox' this knowledge to see if and how artificial intelligence could be used to replicate the functionality of this knowledge. This will allow the researchers to identify how networks of humans and intelligent agent could co-exist in a way that would improve project delivery performance. Project professionals enjoy their profession and career status' shelter in front of AI due to that they need to deal with human emotions and conduct project management practice in different sectors that are hard to be recorded and digitalised. They welcome AI as a support role in the team to do repetitive tasks and initial data-generating.

Artificial intelligence in project management: How to leverage big data mitigation in complex projects

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This investigation provides an overview of the potential for AI in projects particularly through a big data perspective. As projects grow in complexity, project professionals increasingly are exposed to large swathes of big data across the three main attributes of volume, velocity, and variety. Professionals are tasked with managing the success-to-failure pendulum by applying an array of project data analytics throughout the project life cycle. This investigation will identify the priorities of organisations who are faced with applying and implementing these new technologies in practice. The adoption of data driven AI in complex projects has the potential to dramatically increase success and yield innovative outcomes.

The work of these individual projects is being extended through the creation of the Project Data Analytics Research Network. The Network plans to undertake a variety of research investigations in project data analytics and is interested in hearing from potential collaborators. More information can be obtained from Prof. Naomi Brookes and Luis Lattuf Flores, WMG University of Warwick Naomi.Brookes@warwick.ac.uk

Key report take-aways

- There is a real need for common understanding of project data analytics and related terms. This report provides a starting point for this.
- Descriptive project data analytics is already happening in organisations and is associated with demonstrably superior project delivery performance. Predictive Data Analytics encompassing Big Data and Machine Learning is in its infancy.
- The current use of full Artificial Intelligence in managing overall project delivery is virtually non-existent and is likely to remain so until better understandings of the knowledge involved in projects has been created and the challenges of using predictive project data analytics have been overcome. The use of Artificial Intelligence in specific aspects of project practice, such as in lessons learnt, is looking far more possible.
- Research in the area of project data analytics, although in its infancy, is already beginning to yield interesting results. Project practitioners do see the potential for data analytics and even artificial intelligence in their projects but don't see it as a panacea. The adoption of these technologies is stymied by a 'geeks vs business' culture where many practitioners fail to adopt these technologies because they haven't been made aware of what they really involve.

APM have convened a Data Advisory Group which brings together professional bodies including the APM and the Major Projects Association (MPA), the Infrastructure and Projects Authority (IPA), academics, funding providers such as UKRI and leading organisations in the field of project data and analytics for example Projecting Success and Sir Robert McAlpine amongst others. The group aims to improve 'data literacy' enabling individuals and organisations to understand how they might be able to make better use of data, signposting developments and sharing learning. For more information on the Data Advisory Group or APM's research activity in this area please contact research@apm.org.uk