

(R)evolution: Barriers and Enablers of Project Data Analytics in Infrastructure Projects

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EXECUTIVE SUMMARY

Project data analytics (PDA) involves using data better to support decision-making in project delivery. Projects have always used data in this way but the vast legacy of data from project control systems combined with the advent of widely available tools and systems to manipulate this data mean that PDA now has the potential to dramatically change project delivery. Infrastructure project delivery is perceived as notoriously poor. Feasibility studies indicate that using PDA better could produce savings of over £23bn per annum in the infrastructure sector. Yet PDA is still not understood or adopted. This report explains why this might be the case and what can be done about it.

This report used a Delphi approach to identify the barriers and enablers of PDA adoption in infrastructure project delivery. It consulted an extended panel of senior project practitioner experts from across the stakeholder groupings and role type in the infrastructure sector. It used a structured process of elicitation of views in a series of rounds of consultation that used the output from one session as the input to the next. Annex A contains a full list of Delphi participants. One of the most important features of this report are the direct quotations taken from these participants on their experience of project data analytics.

Using the outputs from this consultation, researchers were able to identify the major thematic issues that were acting as barriers and enablers to PDA adoption. Researchers then asked participants to rank the barriers and enablers. Participants did rank the importance of these factors differently, but researchers were able to identify a core of issues which were unanimously considered as important in adopting PDA:

Implementation Issue Themes	Core High Ranked Barrier/Enabler
Benign Data Environments	Good Data Quality
Motivations to Adopt the PDA Unknown	Available Exemplar Cases
Unprecedented Change Management	Recognising the Scale of the Change Task
PDA Friendly Culture	Eliminating the Fear of Data
Universal Data Literacy	Need for Awareness Not Analysts
PDA Standards and Systems	

It is noteworthy that participants did not rank issues surrounding the standards and systems of PDA adoption as of the highest importance. Instead they prioritised aspects of the fundamental environment for PDA. Their responses exemplified that adopting PDA successfully goes way beyond the simple acquisition of a new piece of analytics software or a new dashboard.

The Delphi participant response has a number of implications for adopting PDA. Firstly, the thematic issues are linked together in a network of complex inter-relationships. These need to be managed carefully in implementation to ensure the establishment of virtuous (and not vicious) cycles. There is no 'silver bullet': all aspects of implementing need to be considered holistically and simultaneously. Secondly, organisations need to recognise that their journey to adopting PDA needs to reflect how mature they are across the thematic areas. Only by addressing all aspects of organisational implementation and by tailoring their journey will organisations be able to benefit from the huge potential that project data analytics offers.



Nick Smallwood - Chief Executive Officer
Infrastructure and Projects Authority
Head of the UK Government's Project Delivery Function

Foreword

It has never been more important to deliver our major projects consistently and successfully. A record £650 billion of infrastructure investment is projected over the next decade. It is crucial this is delivered successfully, and following the impact of the Covid-19 pandemic, now is the time to implement a 'once-in-a-generation' transformation in project delivery that will benefit just about every corner of the UK.

To do this we need to address the core issues that have held back project performance. We must leverage new tech, skilled jobs and robust data to modernise our approach and drive greater benefits. Central to the adoption of digital technologies is the utilisation of project data analytics. As set out in Transforming Infrastructure Performance: Roadmap to 2030, data enables the links between outcomes, decisions, and interventions, and so is central to our infrastructure system. By ensuring that we have the right data in the right format at key decision points we can improve project delivery. That data must then be supported with digital technologies to enable the delivery of the complex projects and programmes that the current environment demands of us.

I commend the work of the Project Praxis Group at the University of Warwick in identifying the barriers and enablers for project data analytics. The Group have garnered the experience of our foremost infrastructure project delivery organisations in implementing this highly impactful digital technology. This will enable organisations to be more effective in their implementation of project data analytics, facilitating more effective delivery. It is only by working collaboratively on these kinds of initiatives that we will achieve a crucial and fundamental shift in the delivery of our major projects.

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Why should we adopt Project Data Analytics?

Large infrastructure projects are notorious for their perceived poor delivery. At the root of this poor delivery lies poor decision-making. Decisions around original plans or reactions to events that may disrupt those plans are not taken in a timely fashion or with sufficient insight. This has often occurred because there is no data seemingly available to make these decisions in any other way. But it is ironic that we now have more data than ever on our projects and the ready availability of tools that can combine and process data from disparate sources.

Project Data Analytics (PDA) has the potential to transform infrastructure project delivery. Infrastructure projects contributed 1.2% of GVA to the UK in 2019. Feasibility studies indicate that use of PDA could identify 13% of savings on a large infrastructure client's delivery portfolio meaning that £23bn per annum could be created by using data-driven decision making in UK infrastructure projects.

So what is Project Data Analytics?

PDA, 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 (Dashboards are a good example of this)

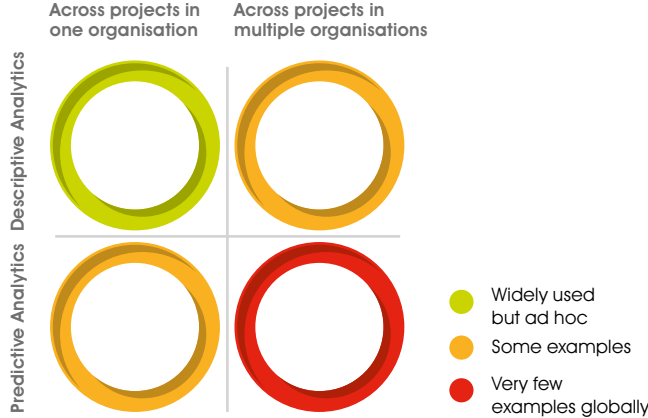
Predictive analytics

Using data to predict future performance

Predictive data analytics uses machine learning in order to make predictions. Machine learning involves computer programmes that 'learn from doing' and spot patterns between characteristics of projects or programmes and performance. Machine learning uses the legacy of data produced by project control systems such as Primavera. This process gets more accurate the more it is used. Machine learning is one of the technologies required to implement artificial intelligence (AI) but AI in projects is not the same as project data analytics.

What's the state of the art of Project Data Analytics?

Given the huge potential for PDA, it's certainly true that this potential is far from being achieved. Initial studies demonstrate that whilst descriptive PDA, especially in terms of dashboards, are widely used, these are not resulting in the improvements in decision making that would be expected. Predictive PDA is only being pursued by an exceedingly small number of infrastructure providers.



Given the huge potential for PDA to improve infrastructure project delivery and its failure so far to live up to its promise, there is a pressing need to understand the barriers and enablers to the adoption of PDA. This report responds to this need and uses the experience of a sample of infrastructure project practitioners to understand what needs to happen for PDA to live up to its potential. This investigation was undertaken by the Project Praxis group, WMG, University of Warwick and sponsored by the Oakland Group.

02 The Approach

Why a Delphi Investigation

The aim of this investigation was to answer the following question:

“What are the barriers and enablers of introducing Project Data Analytics to the delivery of complex infrastructure projects?”

A Delphi Study was selected as the best way to respond to this question. A Delphi Study is a systematic and interactive research technique for obtaining an expert judgment on a specific topic. It involves consulting an extended panel of experts who are asked to participate in two or more rounds of a structured elicitation of views. After each round, the researchers facilitating the process summarise the responses from the previous round and use it as an input to catalyse responses in the subsequent round, hence reaching a form of group consensus on the issues in hand. Delphi techniques have a long provenance in helping tease out issues when facing novel challenges.

In order to satisfy both of these criteria, the following individuals were involved in the Delphi exercise. Individual experts represented the views of their organisations. Further details are contained in Annex A.

The Delphi Participants

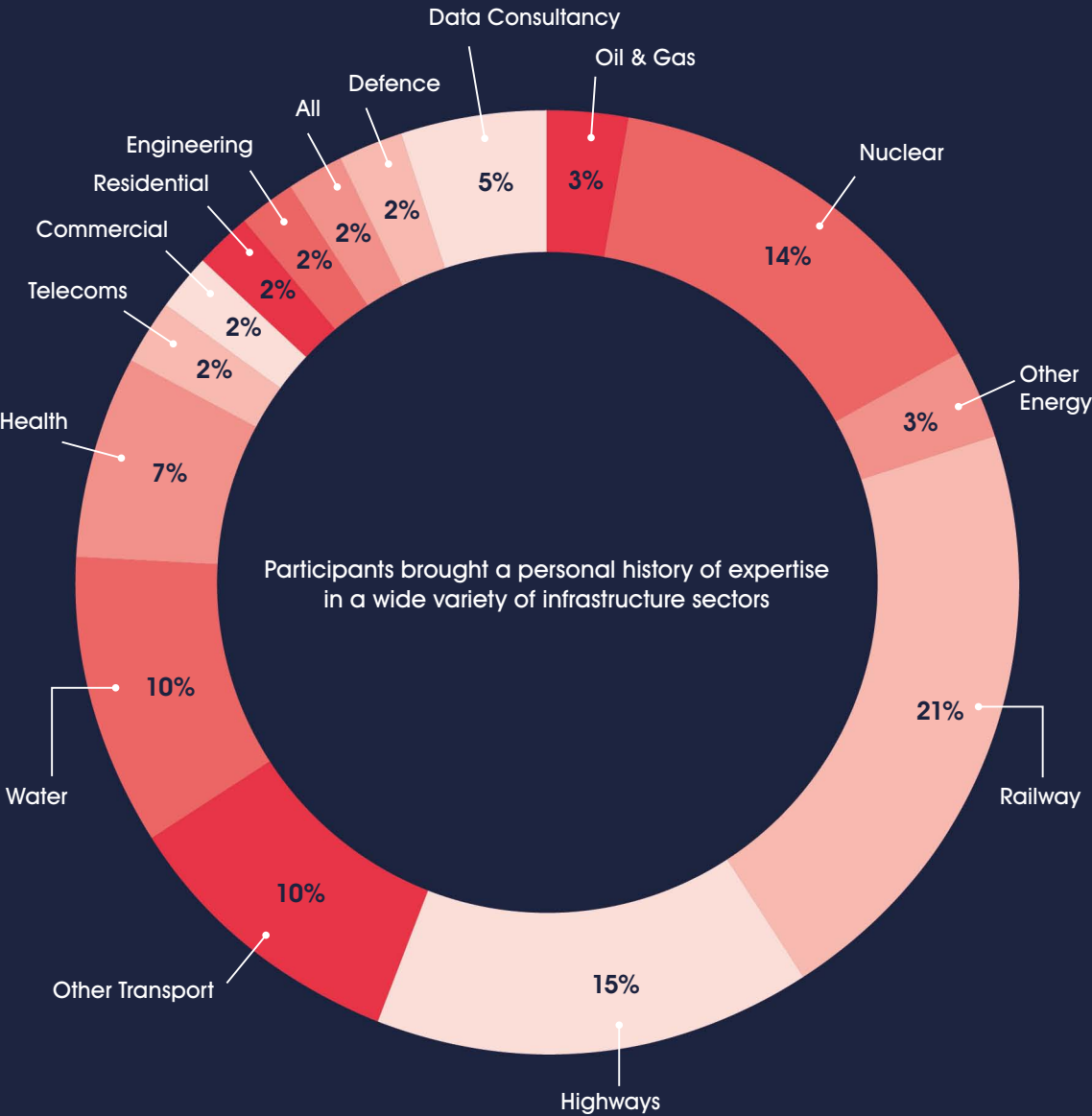
To understand the issues surrounding the adoption of PDA, it was vital to gain a perspective across a wide range of stakeholder groups:

- Infrastructure clients
- Global construction and professional services organisation
- Data and/or Delivery consultants
- Professional membership organisations

Furthermore, the viewpoints of roles across project delivery were also needed:

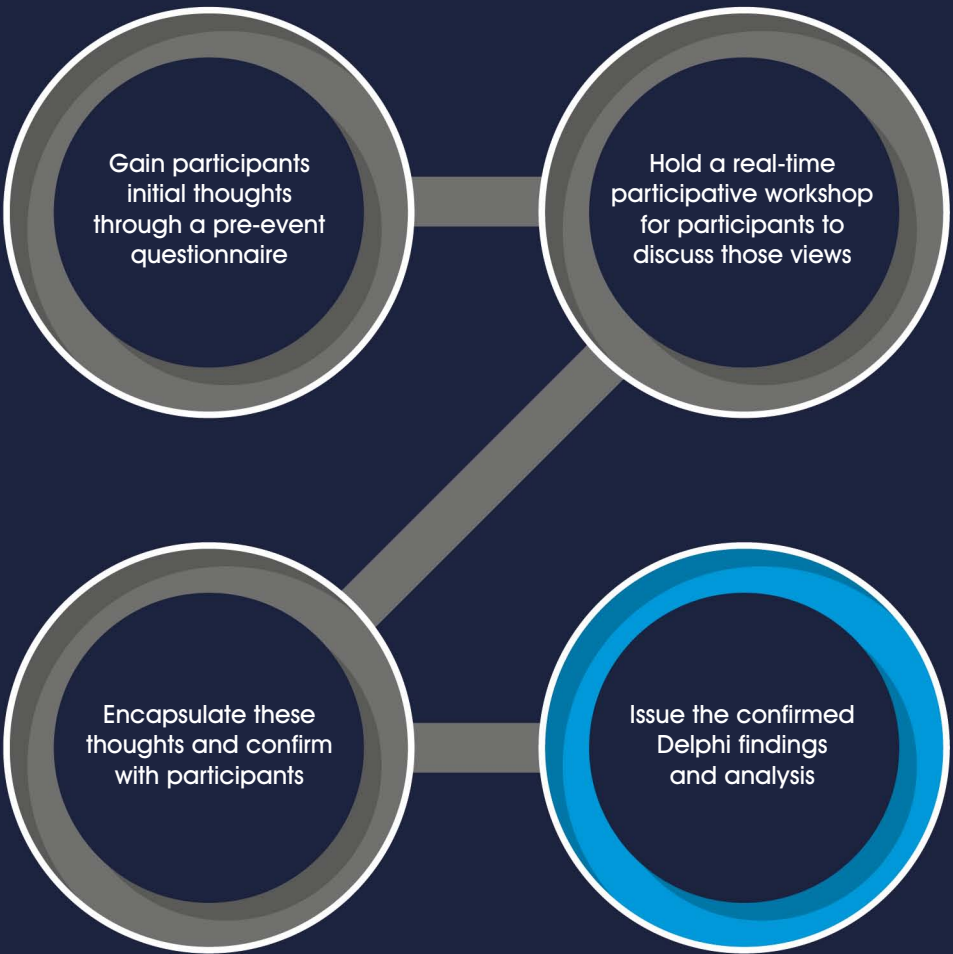
- Project Delivery
- Project Controls
- Projects Assurance
- Project Management Offices
- ‘Data’ Professionals

	Senior Leader	Assurance	Cross-Organisational	Data & Analytics	Delivery	PMO	Project Controls
Delivery and/or data consultancy	●			●			
Professional Membership Organisation	●						
Infrastructure Client - Transport		●				●	●
Infrastructure Client - Energy			●				●
Infrastructure Client - Water						●	●
Global Construction and Professional Services				●	●		●
UK Construction and Engineering Organisation				●			
HMG			●				



The Delphi Process

The overall process for the Delphi investigation is given below:



The first stage in the Delphi investigation was the issuing of the pre-event questionnaire to participants to gain their initial viewpoint of the barriers and enablers of PDA. This produced the first-pass of barriers and enablers identification as shown below:

Initially Identified Barriers

- Ownership of data along the supply chain
- Proliferations of systems
- Anti-sharing mentality
- Skill shortages
- No standards
- Poor data quality

Initially Identified Enablers

- Valuing data in decision making
- Articulated business benefits
- Creating senior 'data roles'
- Transferring lessons learnt
- Visionary leadership

The researchers then used these responses to catalyse participant discussions at a live on-line workshop where attendees were asked to evaluate initial barriers and enablers, develop them as they saw fit and add to them where necessary. This process provided an in-depth understanding of the issues surrounding the implementation of PDA. Delegates were also then asked to rank the impact of these barriers and enablers on a Likert scale of 1-5 for their impact on PDA.

The researchers used this data as an input to an analysis process outlined below, which enabled them to create comprehensive enumeration of the barriers and enablers to PDA adoption, and the relative importance of these barriers and enablers.

- 1 Derive revised list of barriers and enablers from Miro Boards 'post-its'.
- 2 Develop a homogeneous and heterogeneous thematic analysis of barriers and enablers identifying major themes and their constituent sub-themes display as a fishbone diagram.
- 3 Identify exemplar quotations for each sub-theme from recordings.
- 4 Apply: i) Delphi explicit rankings. ii) qualitative quantifications of importance to arrive at an evaluation of overall importance for each sub-theme barrier/enabler.

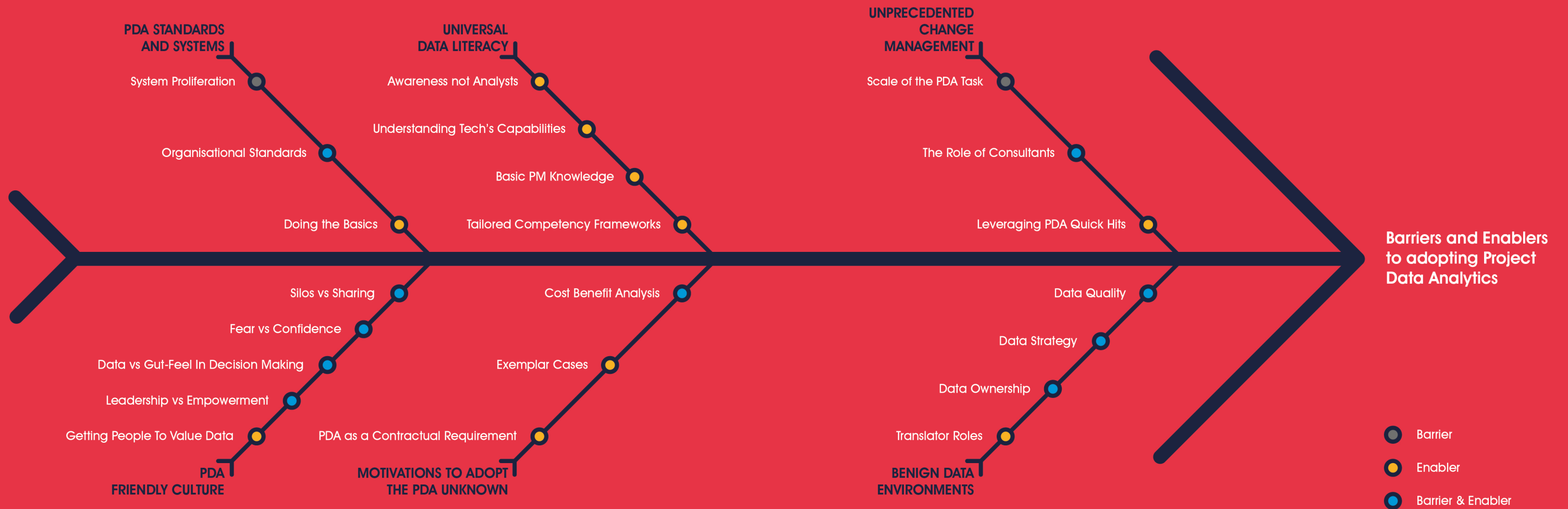
Key Themes for Barriers and Enablers

Analysing the results of the Delphi exercise revealed six key thematic areas into which the barriers and enablers of PDA can be grouped.

Thematic Issue	Explanation
PDA Systems and Standards	Issues relating to the software, architecture and systems that are used to capture, collate, process and analyse the data used in PDA
Universal Data Literacy	Issues relating to fundamental levels of data literacy needed by individual project practitioners to implement PDA
Unprecedented Change Management	Issues relating to the project delivery organisation's ability to implement the transformative change needed for PDA
PDA Friendly Culture	Issues relating to the cultural environment required for PDA to thrive
Motivations to Adopt the PDA Unknown	Issues relating to the levels of motivation of the project delivery organisation and individuals within it to adopt PDA

Benign Data Environment	Issues relating to the data environment that acts as a foundation for being able to adopt PDA
These six areas further broke-down into 22 different related sub-themes as shown in the fishbone diagram. Some of these sub-themes clearly inhibited the adoption of PDA ('barriers'), whilst other sub-themes facilitated PDA ('enablers'). Some sub-themes could act as both a barrier and enabler depending on the context in which they were operating (barriers/enablers)	





PDA Standards and Systems

System Proliferation

Delphi participants viewed the proliferation of systems from which data needed to be drawn as inhibiting the implementation of PDA. Proliferation of separate systems arose because of the historic development of independent (often) proprietary systems in different parts of an organisation. This problem was exacerbated when mergers and acquisitions (M&A) activity demanded the integration of very different organisational approaches.



"When you have **disparate business units** within your state with different methodologies and different terms and different units, then it makes it really difficult to compare data even within the organisation."

Senior Cross-Organisation Learning Executive, Infrastructure Client - Energy.

"We had so many people developing so many **proprietary systems** for what should have been an Open Access type of approach from the beginning."

Senior Project Controls Executive, Infrastructure Client - Transport.

"Our company just gobbles up other engineering companies and **inherits the tools that those other organisations have**, so we went on a bit of a mission sometime back to start to standardise the engineering digital tools that we use."

Senior Data and Analytics Executive, International Construction and Professional Services Organisation.



Organisational Standards

Organisational standards were seen as a way to overcome the problem of proliferation of systems. (Though, of course, this would still mean that there was a substantive body of data that required considerable effort in bringing together.)



"As long as you've got a standard for what it is that you need from a data perspective within each of your systems, it doesn't matter whether or not you've got 2 or 10; obviously, it's more efficient if you've got fewer, but as long as you're able to extract the data from all of those, **proliferation of systems** is not necessarily a problem for PDA."

Senior Data and Analytics Executive, UK Construction and Engineering Organisation.

"**Proliferation of systems** is not necessarily a problem other than the data is in a database that you have to basically find a way to extract that data from multiple databases. It would be more efficient if it wasn't a proliferating database; however, the underlying issue with that isn't that there are many systems, it is that they all may be coded differently."

Senior Project Controls Executive, International Construction and Professional Services Organisation.



Doing the Basics

Participants identified that they were often encountering difficulties in PDA through very basic failures to use common definitions throughout their organisations for items as fundamental as project identifiers.



"It is related to **standardisation of field names** for example. We may have the same piece of data, such as a project number, and within multiple systems or even within the same system it has a different name. This makes it really difficult to link things up so that you have one version of the truth and therefore it takes a lot of manual intervention."

Senior PMO Executive,
Infrastructure Client - Water.

"You need to have some **systems or processes** in the first place to capture that data to enable quality. It is a self-enabling thing. Once you've got a system in place where you can bring the data together and analyse it better, you can improve the quality of data and therefore your analytics become better. So, it is a self-improving system once you put it in place."

Senior PMO Executive,
Infrastructure Client - Water.

"The problem we have is that data formats are not compatible a lot of the time; it would really be a step forward just agreeing what data format we will all use, for example coming up with a **standardised data format or data manual**."

Senior PMO Executive,
Infrastructure Client - Transport.



Awareness not Analysts

Participants were very clear that they did not feel the need to have cohorts of data analysts join the ranks of infrastructure project practitioners. What they required instead was an idea of ‘universal literacy’ around what data is and how it can be used.



“This isn’t about **training** all the people in projects and trying to make them data scientists, this is about people with a good appreciation on how it (PDA) fits together with their day job.”

CEO, Delivery and/or Data Consultancy.

“There are a lot of a **variable skills** across our organisations in analysis, understanding, interpreting of information, and displaying of information and that’s even before we get into really complicated statistical analysis; therefore, we have some **real basics that are missing** so is worth discussing and understanding the value of establishing really centralised methods of control of data versus widespread organisational competence and understanding of these principles.”

Senior Project Controls Executive, Infrastructure Client – Transport.

“It’s a qualifier for me. It’s not that we need to set up scores and go and have another 10,000 people with a particular function joining the project profession; every project professional needs to improve their **data literacy**.”

CEO, Projects Professional Membership Organisation.

“It’s not the fault of the industry because they’ve been trained to be a QS or project manager, not a tech person; but the **gap of data literacy** in some examples is enormous and I think that’s a barrier. So, helping people understand what’s possible and what’s not possible is really important.”

Business Development Director, Delivery and/or Data Consultancy.



Understanding Tech’s Capabilities

Related to the above sub-theme is the need to cut-through the jargon around topics like PDA, and give people a basic understanding of what PDA can and can’t do. An understanding of the tech’s capabilities is sometimes also necessary to explain why existing solutions are not as good as users think they are. Participants identified that, through ignorance of capabilities, organisations were implementing descriptive PDA when they really wanted the functionality of predictive PDA.



“The lack of understanding of the **difference between data and digital** is important; to me that is a digital transformation challenge (adoption of PDA and new systems), rather than a data challenge. The data challenge is the fact that you’ve not necessarily **got any standards within all of your systems**; the number of systems that you’ve got is, as long as you’re managing those in other ways, less of an issue.”

Senior Data and Analytics Executive, UK Construction and Engineering Organisation.

“The first thing that I’ve learned painfully over the years to do, when you’re dealing with customers as a consultant, is how to have that conversation to understand what their level of understanding of data is. **There are so many buzz words out there**. I have a lot of customers that will talk about wanting to do machine learning and AI, but when you start to drill into it you realise that they just picked up the buzz words without actually understanding what they mean.”

Senior Data and Analytics Executive, Delivery and/or Data Consultancy.

“I will put one example: we were demonstrating a dashboard to a group of project managers, and it seemed that they were interested, but suddenly someone made a comment: ‘I’ve seen this before and this person was doing that many years ago.’ We actually knew that all they were doing was linking a Power BI to an Excel spreadsheet. What we are doing is creating a strategic data lake and structure, but it’s really hard to describe that. So **it may look the same, but what we are doing is so much more powerful**. It needs a different language to communicate that to people.”

Senior Data and Analytics Executive, Delivery and/or Data Consultancy.



Basic PM Knowledge

Problems of data literacy are exacerbated by, in some cases, practitioners not understanding the basic PM tools that they are using and need data for.



“There is a sense that we as the community have a role to educate the decision makers, not to just ask them what they want. Communicating probabilistic data on project outcomes to executives is actually hard. **Even getting some of them to understand the basic concept of a P50 estimate is hard.** They don't actually know how to process and use the data we do give them even if we do succeed in assembling it for them.”

Senior Cross-Organisation Learning Executive,
Infrastructure Client – Energy.

“I've seen it in project boards where we are talking about **SPI and CPI**, and when I ask the people around the table “what does that mean?” They can't answer; and yet they are making decisions based upon that data. So, I think there is a fundamental issue about data literacy.”

CEO, Projects Professional Membership Organisation.



Tailored Competency Frameworks

Participants identified that competence frameworks were a great mechanism for ensuring data literacy was promulgated through the practitioner community.



“Make a review of the government's functional standards for project management, and even though they include some information management requirements, they could be more explicit and say that organisations need a data strategy early on in the project. Moreover, you could do same to **the competency frameworks**; there are some professional level enablers that can make data more prevalent in the set-up and operation of projects.”

CEO, Projects Professional Membership Organisation.



Unprecedented Change Management

Scale of the PDA Task

One of the major barriers in terms of implementing PDA was the sheer magnitude of the implementation task, which is reflected in the multiplicity of barriers and enablers identified by the Delphi participants. These barrier and enablers are not confined simply to the integration of disparate tools, but require the simultaneous considerations of culture, data and skills as well as analytical hardware and software.



“Knowing where to start is critical otherwise you never get started.”

Business Development Director,
Delivery and/or Data Consultancy.

“Understanding and identifying the starting point is the biggest challenge for customers. They’ve heard about AI, they want to get AI, but actually they need to be aware of the road map of what they have to do to get AI.”

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.

“It’s a long journey isn’t it; how do you get going on it? You are competing against other transformation initiatives. **Trying to eat the elephant all at once is too hard, too big, and too culturally challenging** to make a shift.”

Commercial Director, Delivery and/or Data Consultancy.





The Role of Consultants

Given the difficulties in implementation, it is unsurprising that participants identified consultants as a potential enabler for the smoother introduction of data analytics. However, they warned against any engagement, which suggested that implementing PDA was easy or resulted in the delivery of one-off solutions that were not integrated into the organisation. Furthermore, participants also identified that the use of consultants prevented the organisation developing its own competencies. Thus using consultants can act as both a barrier and enabler to the adoption of PDA.



“It is interesting the client perspective; what we’re trying to recognise, and it’s taken us a while, is that we don’t know everything and what ultimately is our business; we’re not an IT data business but it’s something that we need to embrace and use, so the **partnership and collaboration with the appropriate experts is key.**”

Senior Project Controls Executive, Infrastructure Client - Energy.

“If we continue to **rely only on external organisations**, we continue to sort of rob our own internal organisations of the chance of potentially developing some of those skill sets. So, it’s really worth trying to **balance** that and really build some internal competence and data literacy.”

Senior Project Controls Executive, Infrastructure Client - Transport.

“One of the big things that **these organisations (consultancies) will tell you is that you can’t buy the solution**, what you need to do is to understand your problems and then define your solution through your own process; define your solution through what is right for you and then learn that and know that yourself, and then implement tools and governance that support those processes that you wanted to deploy.”

Senior PMO Executive, Infrastructure Client - Transport.

“**Consultancies should be more about giving something that is not only used for 6 months** (like a sexy spreadsheet or dashboard) and never be used again. Consultancies make big money doing these quick dashboards and walk away. Consultancies will clean the data, do the processes in isolation, present the dashboard and at the end the client uses the dashboard for 6 months to show off and then it disappears.”

Senior Cross-Organisation Learning Executive, HMG.

“It is a **big task** (PDA) to ask an organisation to solve this problem on its own, but there are some **third parties** out there who would be happy to do this for you; these are organisations that are quite adept at doing this, have decades of experience, and therefore you can lean on them.”

Senior Cross-Organisation Learning Executive, Infrastructure Client - Energy.





Leveraging PDA Quick Hits

Engendering 'quick hits' has been identified by a large number of participants as facilitating change. The use of quick hits was seen as particularly important in providing an antidote to the unknown nature of PDA to many project practitioners.



"By having **small quick wins**, we have demonstrated all of a sudden what is possible, and that is opening up hearts and minds more than anything else; therefore, the next time you ask for some more investment it's less difficult because they've seen what's possible."

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.

"It's really hard to get people excited about PDA; that's why you need to carry on with this dual strategy of doing the **quick and easy wins**, which may not be all that exciting to you, but to other people it's really exciting because it is stuff that they haven't used before, and at the same time you continue doing the long run strategy."

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.



PDA Friendly Culture

Silos vs Sharing

Crucial to the adoption of PDA is the need to change attitudes to sharing data. Participants identified that it is necessary to change the attitudes and mentality that the data belongs only within a silo in a particular part of the organisation to a mentality that enables data to be shared intra- and inter- organisationally.



“People view their **project data** as if it is only relevant for their project rather than being relevant to the wider organisation; we need a **culture** of people understanding that the data is not just for them individually, it's for everybody; for example, somebody in two years' time may want to do something similar to your project and will look back to your data.”

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.

“There's a **silo mentality** and a competitive environment within one organisation; one department wants to beat the other department in coming up with a solution, and there is no golden thread joining it altogether.”

Senior Delivery Executive,
International Construction and
Professional Services Organisation.

“Where I am at the moment **project management is quite siloed**, and if you're delivering a project in construction you don't talk to people who are delivering projects in marketing.”

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.

“You need to overcome that **barrier of being really honest** with each other in terms of **data sharing** and bringing that data in.”

Senior PMO Executive,
Infrastructure Client – Water.



Fear vs Confidence

In order to share data, participants identified the importance of reducing fear around PDA implementation and improving people's confidence in data driven decision-making. Fear manifested itself not only in terms of fear of the unknown but with particular reference to the impact that PDA would have on their roles and by the way in which PDA could provide additional ways for individuals to be 'punished' for their poor project delivery. Much hyperbole has been written about the impact of AI on the project profession. Much publicity has been given to the idea that AI, and by association PDA, will result in an elimination of certain roles in project delivery and substantively change the remaining roles. The fear engendered by such elaboration leads to a stymied opinion of PDA. People's lack of data literacy contributes to this process. One of the crucial ways to overcome this aspect of fear is to increase project professionals' data literacy.

Fear is also engendered because project professionals are aware of the widespread responses within organisations to bad news on project delivery, which can involve a knee-jerk reaction and public humiliation for the individual who is seen as causing the project to fail. PDA takes the control of disseminating performance data out of the hands of project deliverers. The removal of the capability of 'softening the blow' of bad news is genuinely feared where a culture condemns project failure. Without a fundamental change of culture in such organisations, it is difficult to see the adoption of PDA being smooth.

On the other hand, participants also reported in how confidence could be improved through data sharing and the improved decision-making capabilities that using PDA on shared data might bring.



"It's the **fear of the unknown**. People see things emerging and they ask themselves, 'what does it mean for me?' There is a general reluctance to adopt predictive analytics only because it is out of their comfort zone, and we have to do something about it."

Senior Assurance Executive,
Infrastructure Client - Transport.

"The **fear of what will be uncovered** by PDA differs by role. If you are a programme director or PMO, you love the data, you need the data, you want the data, but is project managers who fill it in; they need to roll the data up and they really do not want to do it. The senior director can start seeing and saying to the project manager, 'why is this part more efficient or less efficient than others'; **so, 'why am I going to give you the stick to beat me with?'** And this effect is multiplied by 10 in government."

Senior Cross-Organisation Learning Executive, HMG.

"Analytics is actually giving **confidence to make data driven decisions**; if you've got corroborative data across different data sets you know you can make that decision."

Senior PMO Executive,
Infrastructure Client - Transport.

"**Making sure people don't feel scared to try things out** is important, because if they try something in the tech space and it fails, they might think that is going to reflect badly on them. **In the tech space failure is fine and can be positive** as long as we do a review of what happened; and that's a huge shift for project management as they hate failure."

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.

"I don't think we have enough **reward mechanisms in place for reporting of bad news** and people don't generally get rewarded for saying those things up front; we usually end up in positions where people wait for somebody else to blink first and take the fall for errors or problems in the project life cycle, and that continues to remain an issue."

Senior Project Controls Executive,
Infrastructure Client - Transport.



Data vs Gut-Feel in Decision Making

Another substantive barrier in adopting PDA are cultures that celebrate 'gut-feel' in decision-making and consider that the ability to make decisions in the face of inaccurate data on the basis of experience alone is a defining aspect of project delivery competence. This aligns with a culture in which project delivery is seen as a heroic battle against the vagaries and unpredictability of the project environment. If this type of culture pervades an organisation, it is very difficult to convince practitioners of the worth of PDA given that using data in decision-making is not seen as being in any way rewarded. It also relates to the 'fear' sub-theme: project deliverers are afraid that PDA will rob them of one of their defining capabilities. Overcoming this barrier is very difficult as this type of culture has been forged over decades.



"Despite significant access to data and information, we continue to see emotion playing a significant role in the decision-making process. **Data-minded people tend to be more inclined to trust the data**, even when receiving information which indicates a project isn't going according to plan; **however, there are many execs and decision-makers who aren't data-minded people**. There'll be an emotional journey for them to go through, when presented with information: 'I'm here to make decisions, because of my experience, my knowledge and understanding, no computer is going to know this better than I do. If a data analyst can give all this information and make that decision for me, what is my role as an executive?'. We have to take this into account and encourage data-informed decision making."

Senior Project Controls Executive, Infrastructure Client – Transport.

"Sometimes you're dealing with decision makers that, because of the selective way execs get promoted, **actually don't care about the data.**"

Senior Cross-Organisation Learning Executive, Infrastructure Client - Energy.

"We have to recognise that there is a **cultural barrier to wanting these analytical tools**, and then to accept and listen to what they are telling you when you got them in place. I've seen instances in our case where data analytics has been used successfully to predict adverse outcomes; nevertheless, is **fingers in the ears**. We've tried to report it, but the organisation's reporting infrastructures have filtered out the bad news and only the good news goes through."

Senior Cross-Organisation Learning Executive, Infrastructure Client – Energy.

"People (senior project deliverers) are in these roles because they have had to **make decisions without reliable data**. They have had to fly by the seat of their pants. They stand up there and **take accountability with very little information**. If what we're thinking is correct and actually data can enable you to make better decisions, the format of the boardroom will be radically changed."

Senior PMO Executive, Infrastructure Client - Transport.

"Our project managers are **wearing their underpants on the outside of their trousers** and they're all superheroes and will get every project fixed and finished in time."

Senior Delivery Executive, International Construction and Professional Services Organisation.

"Every project manager will tell me time and time again that their project is going to finish on time despite the fact that all **the evidence says otherwise.**"

Senior Delivery Executive, International Construction and Professional Services Organisation.



Leadership vs Empowerment

Participants highlighted the importance of empowerment rather than visionary leadership in implementing PDA especially when competing leadership visions are particularly contradictory or problematic.



"To have an **empowered workforce** who feel like they can contribute is almost as important as having a visionary leadership. If you have a great leadership but then you're not enabling people to actually show what they can do you're not going to get anywhere."

Senior Data and Analytics Executive, Delivery and/or Data Consultancy.

"When the senior leadership of an organisation have **different and competing visions** (based on different interpretations of artificial intelligence or machine learning for example), this cause barriers to progress in implementing PDA"

Senior Data and Analytics Executive, International Construction and Professional Services Organisation.



Getting People to Value Data

Overcoming the barrier of valuing data in one's own organisation is not the only issue: overcoming the barrier of clients' inability to value data may be even more difficult. Participants noted that clients were often unwilling to fund data analytic activities when they put bids in.



"It is not the job of the client to be educated in PDA; however, putting a really basic example, a lot of times in our organisation we are still ultimately selling people's hours, so the client sees those people's names and see the roles they are doing in the project, but at the moment you start putting IT resources or data people into the resources it brings **a lot of questions and difficulty from part of the client.**"

Senior Data and Analytics Executive, International Construction and Professional Services Organisation.

"I have this feeling that within the project management community, **people see the data that they are producing as transitory**; for example, they produce the data for their monthly report, and they really don't think of how it might be used for the greater good of PDA."

Development Lead, Delivery and/or Data Consultancy.

"At the end, **clients are always intelligent but there is a joint education piece.** Actually, I have to say that some of our big clients are coming on that journey (PDA), but only in pockets. These clients allow us to sell these data people into the projects, but in general a lot still won't because they don't get the importance yet."

Senior Data and Analytics Executive, International Construction and Professional Services Organisation.



Motivations to Adopt the PDA Unknown

Given the nascent nature of the use of PDA, motivating organisations to use PDA when they can't fully articulate what it is or its benefits is challenging. Individual barriers and enablers that fall into this main theme include:



"There is a **struggle making the case** for change and I think it's because data analytics is an enabler. And when I go to talk to heads of professions or heads of PMO or SROs or project directors, they all appear to be seeking solutions. So, it is the jump into solutions, rather than tackling the enablers. And unfortunately, PDA is an enabler not the solution."

CEO, Projects Professional Membership Organisation.

"(The **business case** for PDA) is your starting point; if it is difficult to sell to people, is difficult to get them on board, and then to kind of see the benefits of it."

Senior Assurance Executive
Infrastructure Client - Transport.

"You see it more (**case for data analytics investment**) in Google, in FinTech, in banking, and retail, but in infrastructure organisations they think 'why should we spend so many pounds in these tools when we could do a highway or something that is more tangible?' and I think that is a quite difficult piece for project teams"

Senior Cross-Organisation Learning Executive, HMG.

"There is an investment requirement to put PDA into place, especially in a large programme; if we do not have that **business case articulated**, it is not going to happen."

Senior PMO Executive,
Infrastructure Client – Water.

Cost Benefit Analysis (CBA)

CBA form an important part of investment decisions and the nature of PDA makes difficult for organisations to make convincing investment cases. Providing 'template' CBAs was seen by participants as a crucial step in enabling the adoption of PDA.

"I've experienced that people struggle to properly identify the benefits for individual projects, and therefore struggle to allocate benefits caused by specific projects, rather than something else happening over there, which I think means that the **traditional cost benefit analysis** doesn't really fit."

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.



Exemplar Cases

One mechanism which participants could see real worth in improving motivation for PDA was the generation of 'exemplar' cases. These would be documented case-studies of where PDA had been used successfully (either predictively or descriptively) by organisations to improve project delivery performance. These exemplar cases would provide a tangible and demonstrable way to understand PDA capabilities. Professional organisations, such as the APM, were seen as potential prime providers of these cases.



"There is a **lack of really practical, tangible, use cases** that people can see are fairly available. It's all sorts of let us talk about the jam tomorrow, the robots and AI, but what can you do for me in 6 months that can save me money or improve performance, and there is a struggle with that."

CEO, Delivery and/or Data Consultancy.

"I always was told that **seeing is believing** and by doing those little pockets of PDA projects within a company, it starts opening up those opportunities to put it together."

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.

"Without being able to put facts and figures on its (PDA's) implementation, it is hard to convince other people of its usefulness. Therefore, **having cases that prove the value of predictive analytics would be very powerful**, especially when it is directly relevant to people's project experiences. And to do this it needs to relate to their own organisation."

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.



PDA as a Contractual Requirement

If a client makes something a contractual requirement it will be provided by the supply chain. This approach has been used with some success to encourage other forms of digitalisation into major project delivery such as BIM. Participants suggested that such a move would be a real enabler for PDA.



“We can encourage many things bottom-up, but if one massive client organisation would just **demand their supply chain** to do this (PDA), we would start doing this faster.”

CEO, Delivery and/or Data Consultancy.

“If the **client** wants (project data analytics), you make it happen; moreover, if it is **embedded within that contract** then it is going to happen.”

Senior Data and Analytics Executive, UK Construction and Engineering Organisation.



Image courtesy of National Highways

Benign Data Environment

Crucial to the introduction of PDA is the data environment that supports analytical activities. These include issues of data quality, strategy, infrastructure and governance. It's a statement of the obvious to say that PDA needs data and unsurprisingly, therefore, that participants strongly articulate the data environment's importance.

Data Quality

Good data quality in terms of its veracity and timeliness was identified as a fundamental enabler of PDA. The old adage of 'Garbage In – Garbage Out' was never more true than for PDA. Participants recognised that perfect quality data was an unachievable target and that PDA implementations needed to be able to cope with that. They also recognise that data quality needed to improve dramatically to enable predictive rather than purely descriptive data analytics. Participants recognised that virtuous circles can be engendered between data quality and PDA. The more analytics are carried out the more data quality improves, and the more data quality improves the more analytics will yield more meaningful results, and in turn yield more PDA utilisation.



"Data quality is critical for the move from BI (business intelligence) to AI (artificial intelligence). AI shows that even if you think your data is okay, data gaps and null fields kill machine learning models. So, you have to go back and fill in the blanks. You must go on a massive cleaning mission. Data quality is significantly important."

Senior Data and Analytics Executive, International Construction and Professional Services Organisation.

"One of the things I've learned is **if you try and get all data to 100% of quality, you'll never succeed**; start recognising where there are areas where you can deal with 80% quality, for example, and the impact is minimal. I think there is a relativity to it; however, particularly with this industry, data quality is not really understood properly."

Business Development Director,
Delivery and/or Data Consultancy.

"You want perfect data quality, but we are starting in this industry from a relatively low base in terms of what we've got and sometimes you can get paralysed and just not do anything because you never got 100% quality; so, understanding where you're not going to get that 100% and then manufacturing it around those barriers is a way of doing it."

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.

"You can crack on with **descriptive analytics** quite quickly with **average data quality**, and by doing that I think it actually helps you shine a light on your **data quality issues**; but then without that strategy in place it is a barrier to entry to **predictive analytics**."

Senior Data and Analytics Executive, International Construction and Professional Services Organisation.

"Data quality is self-enabling and self-improving. Once you've got a system in place where you can bring the data together and analyse it better, you can improve the quality of data and therefore your analytics become better."

Senior PMO Executive,
Infrastructure Client – Water.

"If you are **accountable for the quality of the data** and what is reported publicly, then that is when you get the traction to improve quality. That way people are driven to make sure that what they are doing is robust."

Senior Assurance Executive
Infrastructure Client – Transport.





Data Strategy

Participants emphasised the need for a clear data strategy (in terms of a clear structured understanding of what data is required where to improve decision-making). The importance of this overall strategy tying in with the project data strategy was emphasised. The lack of a data strategy was not seen as a complete barrier by some participants, however. The need for a 'bottom-up' development of PDA was seen as important if PDA is ever to be adopted.



"In our organisation we've got some brilliant things going on in the business, but it's not quite tight together with the **wider strategy**."

Senior Data and Analytics Executive,
International Construction and
Professional Services Organisation.

"**In a perfect world you want your data strategy** in place and everything, but you can't wait until after it is in place; so, it's important but it doesn't overshadow some of the other issues."

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.

"**Data strategy** is the case of thinking what data do we actually need, and what can we use to get from A to B."

Senior Data and Analytics Executive,
International Construction and
Professional Services Organisation.



Data Ownership

Participants particularly noted the challenges of ownership of performance data that resides across the supply chain. This leads to real problems in sharing the data for analytics purposes.



"Lots of data is held in the **supply chain**."

Senior Assurance Executive
Infrastructure Client – Transport.

"The **data ownership challenge comes when the supply chain** does not want to share data around profit and loss performance. That sort of (project) performance data is perceived as providing competitive advantage and its ownership is a big barrier to the use of PDA."

Senior Data and Analytics Executive,
International Construction and
Professional Services Organisation.

"When I have tried sharing benchmarking and project delivery data, as soon as you go to the **supply chain** you start encountering **confidentiality and commercial issues**."

Senior Project Controls Executive,
Infrastructure Client - Energy.



Translator Roles

Relating to the previous sub-theme, and in a world where project controls and data may still have different organisational manifestations, participants identified the need for a 'bridging role' between the two in order to facilitate the adoption of PDA.



"There needs to be an **interlock between the data team and the project management team**; so, whether there should be a dedicated role, even if it is not someone's full time role, but kind of a nominated person as part of the project management team to interface with the data team and make sure the project management data is as it should be, could be a good thing."

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.

"You can have **technical roles** that understand the data in terms of what's being presented, which is very different from technical roles that understand how you get data out of systems and put into a data structure, a database, serve it up, etc., and the **people that understand that fully end to end are quite rare**."

Business Development Director,
Delivery and/or Data Consultancy.

"We have professions for engineering and project management and project controls, but certainly within my side I don't see anything for the data profession, and maybe in **creating a specific role responsible and accountable for data**, that would raise the profile and you would have more chance of integrating across the company more."

Senior Project Controls Executive,
Infrastructure Client - Energy.

"You don't have to be a data person, but **you do need to have the awareness**; nevertheless, you also need the data people as well who have the skills to actually be the solutions."

Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.

"Communication is also about making sure that you've got the translators because there's a lot of really good technical people over there with the technical skills required to create the data solutions, but **they are not very good at articulating into business-driven messages**; thus, that message can get lost along the way. Having really good business analyst helps, but it's not about having that sitting in just one role; you need to make sure that you've got key people who are able to pass that message along the line of the different roles that are involved in the process."

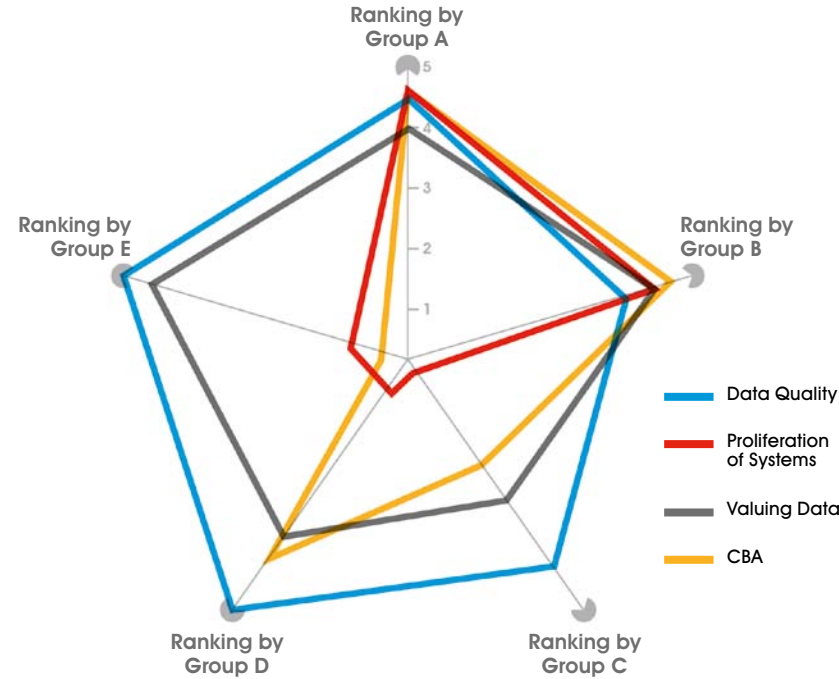
Senior Data and Analytics Executive,
Delivery and/or Data Consultancy.



Ranking the Themes and Sub-Themes

The Delphi participants identified a large range of themes and sub-themes and the obvious next question would be to ascertain which of these were more important in the adoption of PDA to delegates. Interestingly, for some themes, groups of delegates ranked them as universally highly whereas, for other themes and sub-themes, rankings were substantively different. As the spider diagram shows, whilst participants ranked data quality universally important, there was less agreement on the importance of valuing data and a very diverse opinion on the impact of cost-benefit analyses and proliferation of systems.

It is interesting to speculate on why rankings were different. Firstly some groups were focussed around particular roles (e.g. data experts, project controls), others were mixed groups. Data experts ranked proliferation of systems as not very impactful – arguably because they understood what was needed to overcome this situation. Whereas mixed groups ranked this sub-theme far more highly perhaps because their lack of domain knowledge made them perceive it as more difficult. Secondly, different organisations at different levels of maturity would consider themes as more or less impactful. If a participant’s organisation had a good level of data quality, for example, they would not rank improving it as important as an organisation which had very poor data quality.



In light of this situation ranking was achieved by a combination of quantitative methods, and only those themes/ sub-themes that scored highly across these mechanisms were considered as the most impactful issues. By using this method, the following five sub-themes were considered by delegates as the most impactful.



The identification of these issues as the most impactful on the adoption of PDA demonstrates the holistic and radical change that implementing PDA involves. It cannot be seen as a simple introduction of a new set of software tools. Indeed issues surrounding standards and systems were not viewed by delegates as those which would cause them the most problems in implementing PDA.



Outlier Issues

Delegates identified a further set of 'outlier issues.' These issues did not relate to aspects of participant organisations, the individuals within those organisations and the organisations supply chain. Instead these issues focussed on wider environmental issues or on issues pertaining to the nature of projects themselves.

The UK Government's emphasis on BIM and not on PDA

The UK Government, through such bodies as UK Research and Innovation (UKRI), have widely promoted digitisation in infrastructure construction largely in terms of Building Information Modelling (BIM). This does not explicitly refer to project data analytics and there are no funding opportunities for PDA in UKRI in the same way that BIM is supported. This is noteworthy given the billions of pounds of savings estimates that would occur per annum if project data analytics was widely implemented in the UK Infrastructure sector.

Support from professional project organisations

Participants recognised that there was a substantive role for professional project organisations, such as the Association of Project Management (APM) to play in implementing PDA, especially in terms of the provision of exemplar cases and competency frameworks.

The impact of technological change in PDA

Implementation of PDA is made more difficult by the rapidly changing panoply of products that are available in the data analytics space. Identifying how to cope with this situation adds layers to the complexity of PDA adoption.

The nature of projects

The definition of a project involves uniqueness i.e. something is defined as a project because it is a 'one-off'. Theoretically, it is therefore very difficult to use predictive analytics as each project is different from the last so historic data cannot be built up to support this. Projects, however, do have similarities which enable predictive analytics to be used on their performance. However, no current robust method exists to measure how different a project has to be to move beyond a 'comparing apples to apples' situation and into a 'comparing apples with pears.'

Making Virtuous Circles of PDA Implementation

This investigation identified a panoply of themes and sub-themes that need to be considered in adopting PDA if its implementation is to be successful. It used ranking to identify the most important issues across organisations in implementing PDA which were:

- Good data quality
- Availability of exemplar cases
- Recognising the scale of the change task
- Eliminating the fear surrounding PDA
- Having universal data awareness

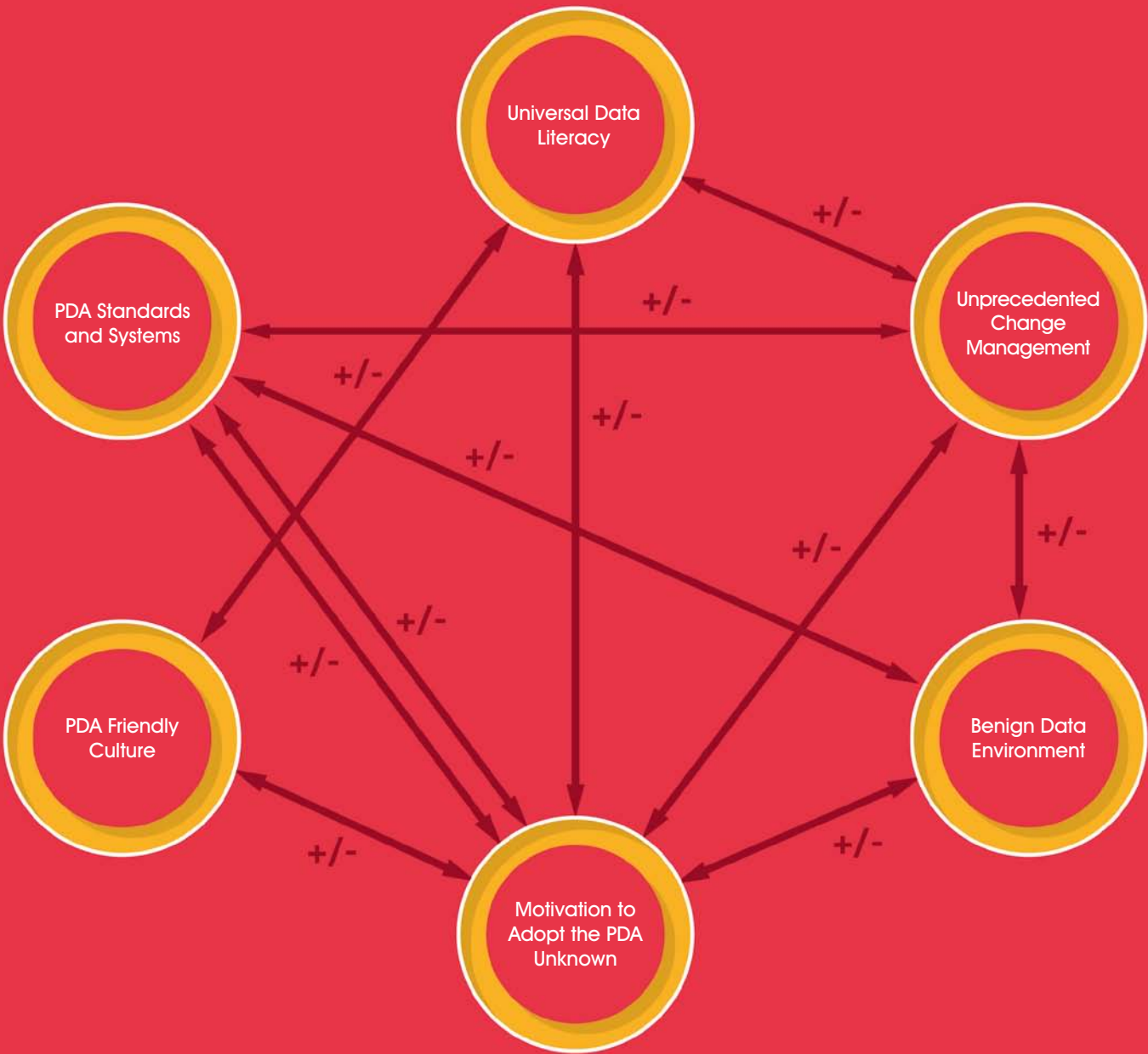
Unfortunately, however, these high ranking issues cannot be dealt with in isolation. A complex set of relationships between the identified implementation themes exists. For example, if the PDA friendliness of the culture is increased (e.g. through removing a 'silo' mentality), the motivation to adopt increases. If the level of PDA standards and systems are improved (e.g. by introducing some basic organisations standards around naming conventions) then

the data environment becomes more benign and this, in turn, not only improves the implementation of PDA systems and standards, but also then increases the motivation to adopt PDA. Thus a whole host of interlinked virtuous circles need to be established for effective PDA implementation. And care also needs to be taken that virtuous circles do not degrade into viscous circles' as the level of complexity of interrelationships means that this is a definite possibility.



"Project Data Analytics can be implemented. But **there is not a 'silver bullet'** lots needs to happen."

Senior Cross-Organisation Learning Executive, HMG.



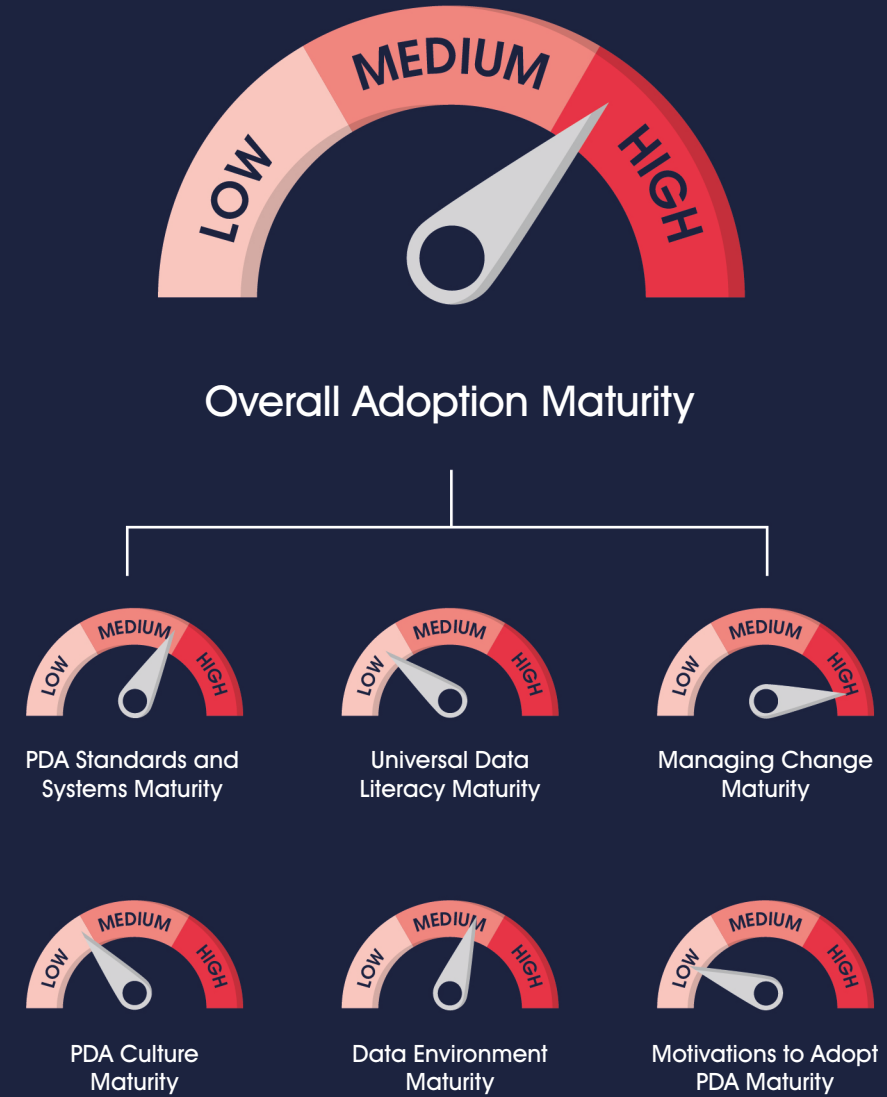
The propensity for virtuous (and vicious) circles in PDA implementation reinforces the fact that there is no 'silver bullet' for quick implementation and that getting PDA embedded in an organisation will take a holistic approach across all aspects of organisational life.

Assessing PDA Organisational Readiness Through Maturity Models

In implementing PDA, and despite the holistic approach required, organisations do need to decide what to tackle first. This investigation revealed that what is most important to an individual organisation does depend on how mature they are in the key themes of PDA implementation, namely:

- PDA Systems and Standards
- Universal Data Literacy
- Unprecedented Change Management
- PDA Friendly Culture
- Motivation to Adopt the PDA Unknown
- Benign Data Environment

What is therefore required is a suite of tools by which organisations can readily identify their level of maturity and achievement in these areas and hence identify where they need to focus their efforts. Individual thematic area maturity could be combined into an overall maturity assessment.



Actions going forward

PDA has huge potential to assist in the delivery of infrastructure projects bringing £billions of annual savings to the UK. However, this investigation has identified a host of barriers and enablers to PDA's effective deployment. Organisations adopting PDA need to take this into account by realising that there is no 'silver bullet' for implementation. Organisations will have to tackle implementation holistically and build-up virtuous (and avoid viscous) circles of thematic success.

Pay particular attention to the 'top five' implementations issues

The top five issues identified in this report are important to all organisations regardless of their level of maturity. These issues need particular focus:

Improving Data Quality

This is a prerequisite for the successful implementation of project data analytics. Most organisations do not understand the maturity of their project data (and probably are afraid to investigate it too closely!). Organisations need to understand their data quality maturity immediately. They also need to implement very basic organisation standards (e.g. on naming conventions) now to prevent anymore poor quality data being generated.

Making Exemplar Cases Available

Participants all valued exemplar cases of where PDA had been successful in other organisations as an inspiration to implementing it themselves. Successful implementations of descriptive PDA (especially 'dashboarding') are available but have not been shared or collated. There is a prime role for professional project organisations in supporting this activity. Exemplars of effective predictive PDA are harder to find, which places an even greater onus on professional organisations to support this. 'Quick wins' are an organisation's own exemplar cases and carry even more weight given their extremely relatable context. Organisations should think about how to create their own exemplar cases, though this may involve taking data 'slices' through the organisation in order to put this into effect.

Creating Awareness not Analysts

There was a widespread response from the Delphi participants that large-scale entrants of data analysts into the project delivery professions was not required. Instead they saw a universal need for all project practitioners to be 'data literate' (i.e. to have an understanding of the role of data and how it might contribute to decision making) and to be tech savvy (i.e. what tech can and cannot do). Organisations need to identify where they are going to get this sort of competence training from, especially given the current dearth of such offerings.

Managing the Size of the Change Task

Delphi participants saw the size and complexity of the change task as a very large barrier to effective PDA adoption. It is beholden on organisations to reflect honestly on their ability to introduce this scale transformative change in the field of project delivery. If they feel that they have the internal capability to do this, they need to plan the logistics of this change carefully. If they consider that they do not have the expertise, they need to work out what support they need and from whom. Participants indicated that there was definitely a role for consultants in this process but they needed to be aware of the scale of the task involved and to embed skills within the existing organisation population.

Eliminating Fear from Project Delivery

Delphi participants clearly identified that, in many organisations, fear was preventing flows of accurate project performance data and honest discussions on that data. Poor performance was punished and practitioners were worried that PDA had the potential to create more opportunities for such punishment. This situation was magnified where a culture of 'gut-feel' over using data predominated in project decision-making. Organisations need to be truthful in understanding their own culture in this respect. They need to consider if a 'fear' culture is standing in the way of better performance regardless of the adoption of PDA. If it is, changing that culture is not a trivial task.

But remember that contextual maturity dictates an organisation's own PDA journey.

The 'top five' issues were viewed as very important by Delphi participants in any PDA adoption journey. Other implementation issues were not judged as equally important to all organisations. To understand what was important, organisations needed to understand where they stood on the PDA adoption journey. Without this honest reflection, organisations would not be able to judge which of the 22 issues in the 6 implementation themes they needed to concentrate on first.

Annex A:

Details of the Delphi Participants

				
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Contact

The Project Praxis Group at WMG - University of Warwick specialises in cutting-edge research that can improve practice outcomes today. We work with a wide variety of project organisations and professional membership organisations.

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Naomi brings a wealth of expertise in project and programme management to WMG. She began her career in the aerospace industry with Rolls-Royce plc. Since then, she has worked in academia in both business and engineering faculties (where she has held a prestigious Royal Academy of Engineering professorship) and has founded her own consultancy practice. She has authored over 130 peer-reviewed journal papers, book chapters and articles in project and innovation management and has conducted research projects funded by a wide variety of organisations including the UK Research Councils and the European Science foundation.

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Luis has a background in civil engineering and construction project management. He is now doing a sponsored PhD looking into the area of project data analytics, its opportunities to improve project delivery performance, and the barriers and enablers for its adoption. He is also a PhD research grant award winner from the Major Projects Association.

