ice
Institution of Civil Engineers

From Transactions to Enterprises

A new approach to delivering high performing infrastructure

Infrastructure Client Group
March 2017

Project 13

Why do we need to change?

Britain needs high performing infrastructure. Without it we have little hope of improving the productivity of our economy. Without an improvement in productivity we will not be able to secure the quality of life demanded by our growing population.

Yet the model we use to deliver and operate much of our infrastructure is broken. Too often it produces assets and networks that are expensive, perform poorly and fail to exploit the advances in technology that are transforming other industries. Too often the supply chain that delivers our infrastructure seems locked into a cycle of low margins, low investment and dysfunctional relationships.

What are we going to do about it?

We are creating a community of infrastructure owners and suppliers committed to change.

We are committed to a moving away from transactional, cost driven procurement of individual assets. We are embracing the creation of value driven, collaborative teams that can deliver investment programmes that secure the outcomes demanded by clients and the public.

How can I get involved?

ICE is working with a group of leading infrastructure owners under the ba nner Project 13 to:

- Pilot new approaches to delivery on live projects
- Offer peer review and support to other colleagues seeking to implement the ideas in this report
- Disseminate findings through a programme of publications and events

If you want to join the Project 13 community and help transform our sector please contact **policy@ice.org.uk** or visit **ice.org.uk/project13**

Foreword

Andy Mitchell
Chair of the Infrastructure Client Group and CEO Tideway

As infrastructure owners, ICG members are committed to a modern infrastructure that enables the UK economy to grow and its productivity to improve.

We are delighted that government shares this view and has placed high performing infrastructure at the heart of its plans.

The status quo cannot be relied on to deliver this outcome. Our traditional approach to procuring infrastructure is already struggling to provide the innovative technical solutions and efficient project delivery we need.

This situation is likely to get worse as we move into a new era of infrastructure development. Most investment is now in existing networks, whose owners are rightly focusing their resources on delivery of services – and value - to their customers. These networks are becoming more integrated and are increasingly reliant on digital technologies for their operation. There is ample evidence that in this environment a procurement model that is based on a series of isolated, highly transactional relationships between owners and their suppliers will not offer best value and often deliver a poor service.

This is why we need a new approach. If we are to give the public the services they need at a price they can afford we need to secure the best possible outcomes with the limited resources we have.

Fortunately we can draw on experience from here in the UK. For example, in the water sector Ofwat has used its quinquennial negotiations with the water companies to improve services to customers, reduce costs and limit carbon emissions. They have moved towards regulation based on outcomes and the combined efficiency of their operating and capital expenditure. The companies have responded to this challenge by developing new delivery models for their investment programmes. They have moved away from lowest price as their measure of value for money and are working with their suppliers to access the skills and technologies they need to build the right infrastructure and achieve the best possible outcomes for their customers. Similar approaches are emerging in other sectors and we believe could be deployed even more widely.

In this report we describe the key features of this new approach to delivering infrastructure. It gives practical advice on its implementation and on systems of governance to ensure it delivers value for money.

It is however just a starting point. In the final section we set out a programme of work that will be driven by leaders from all parts of the infrastructure sector to develop and extend this new way of doing things.

"On time and within budget" is no longer enough. Government and owners will need to be more demanding and focus on clearly defined outcomes and improvements in efficiency. The supply chain will need to respond and commit to collaboration and continuous improvement.

I hope that you will join us in this vital initiative.

"Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker."

Paul Krugman
The Age of Diminishing Expectations, 1994

Contents

Organisation, Governance and Integration are essential to securing better outcomes. Digital transformation and Capable owners are enablers that over time set the pace of change.

1. The report and why we commissioned it

This report has been commissioned by the Infrastructure Client Group (ICG) with support from the Institution of Civil Engineers (ICE). The ICG recognised the need for a new approach to delivering the UK's infrastructure that will encourage innovation, produce better outcomes and reduce waste in the delivery process. In particular we wanted to identify more intelligent ways to organise competition, generate more value for end users and provide the right structure for our suppliers to invest in improving their capabilities.

The work has been led by Miles Ashley and Martin Buck and directed by a task force drawn from ICG members, the construction industry and leading academics (Appendix A). The proposals are derived from consultations with infrastructure companies and their suppliers and from studies of projects in three different infrastructure programmes. The Bartlett School of Construction and Project Management at University College London (UCL) has led these project studies.

Through the consultations we have described what success looks like for all the parties involved in delivering new infrastructure and the factors that would encourage them to invest in innovation and in their capabilities.

The analysis of leading edge practice has **allowed us to identify five features that taken together form the basis of the new approach to delivering infrastructure.** The report describes these key features and through case studies demonstrates how their deployment has delivered substantial benefits for infrastructure owners and their customers.

The report also provides a critical analysis of more traditional approaches to delivering new infrastructure. It provides evidence that these approaches often lead to costly and sub optimal solutions for infrastructure owners while at the same time damaging the capabilities of the supply chain.

In the appendices to the report we summarise our consultations with the infrastructure and construction sectors and the studies of six projects within the infrastructure programmes of Anglian Water Services (AW), the Environment Agency (EA) and London Underground (LU). These projects represent the spectrum of the new approach from effective working with traditional contractors to an alliance in its twelfth year of improving performance. The insights from these studies have informed the proposals we have set out in the rest of the report.

Finally and most importantly this paper is a call to arms. Our five features will be developed further and will be applied to more projects as more owners commit to improve their performance. We set out a work programme, led by industry leaders from across infrastructure and construction and explain how you can get involved.

Terminology

One of the challenges we have faced in preparing this report is to describe the roles and functions within the infrastructure programmes we have studied and within the proposed new approach. We have made a conscious decision to move away from some terms such as *client* where we believe they imply a transactional relationship.

Throughout this report we therefore use the following generic terms to describe the parties involved in the new approach:

Owner – the organisation that owns and operates the infrastructure, promotes the investment in the infrastructure programme and receives the completed facilities and puts them into operation.

Integrator – the organisation that plans and delivers the infrastructure programme. It manages the supply chain, coordinates design and construction, commissions the completed facilities and hands them over to the Owner.

Advisor – an organisation that provides advice and professional services to the Owner or the Integrator.

Supplier – an organisation that supplies materials, components, specialist services, construction or labour to enable the delivery of the programme.

Case study

Anglian water's @one alliance

Transforming the delivery of investment in the UK water industry

In 2005 Anglian Water (AW) recognised that their traditional approach to procuring projects in the market was unlikely to achieve the improvements in performance required by their shareholders and their regulator Ofwat. They decided to form an alliance with their consultants and contractors through which they could collaborate with their key suppliers to develop better solutions to their infrastructure needs and improve performance in delivering their projects.

The @one Alliance has evolved from a simple collaboration into an integrated, high performing enterprise staffed with people from AW and their six partner companies and with long term relationships with key suppliers. Over the current regulatory period the @one Alliance will design and build some 800 projects at a cost of £1.2bn. AW's Alliance Director leads the organisation and it works closely with AW's operational and asset management teams. Since 2005, through this integrated and collaborative approach, the Alliance has consistently out-performed the targets set in the AW business plan.

Figure 1.
Safety – the Alliance has reduced its accident frequency rate from 0.4 to zero.

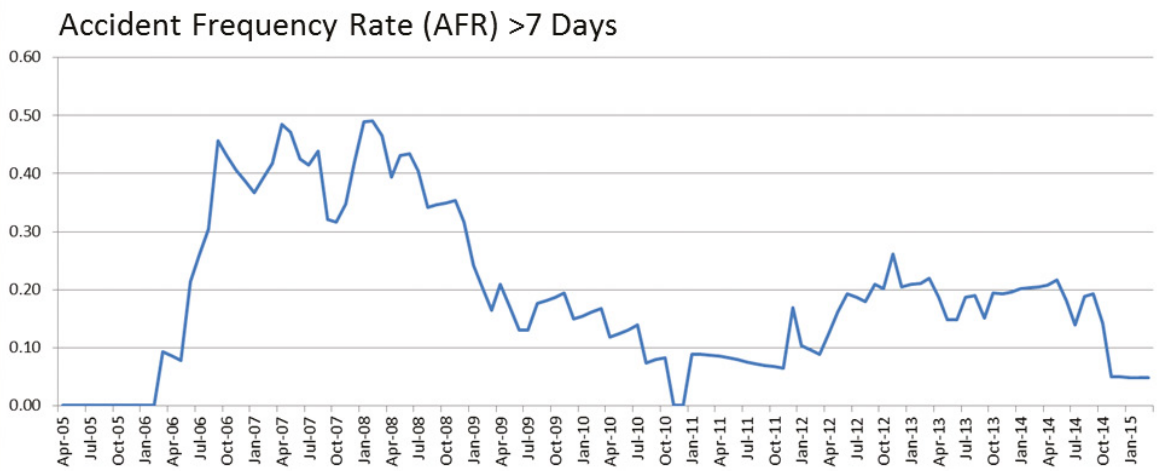


Figure 2.
Efficiency– the Alliance has reduced the cost of investment projects by almost 30%.

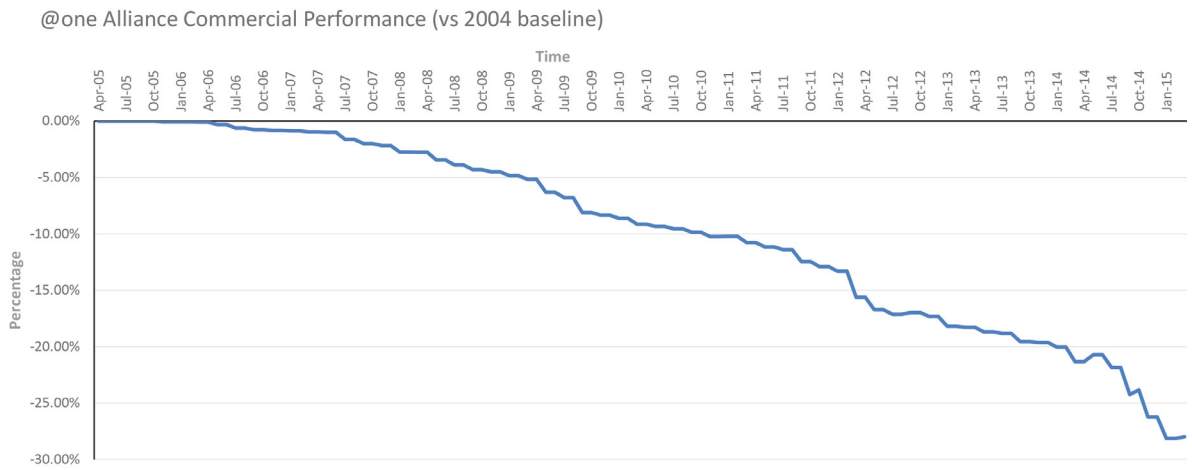
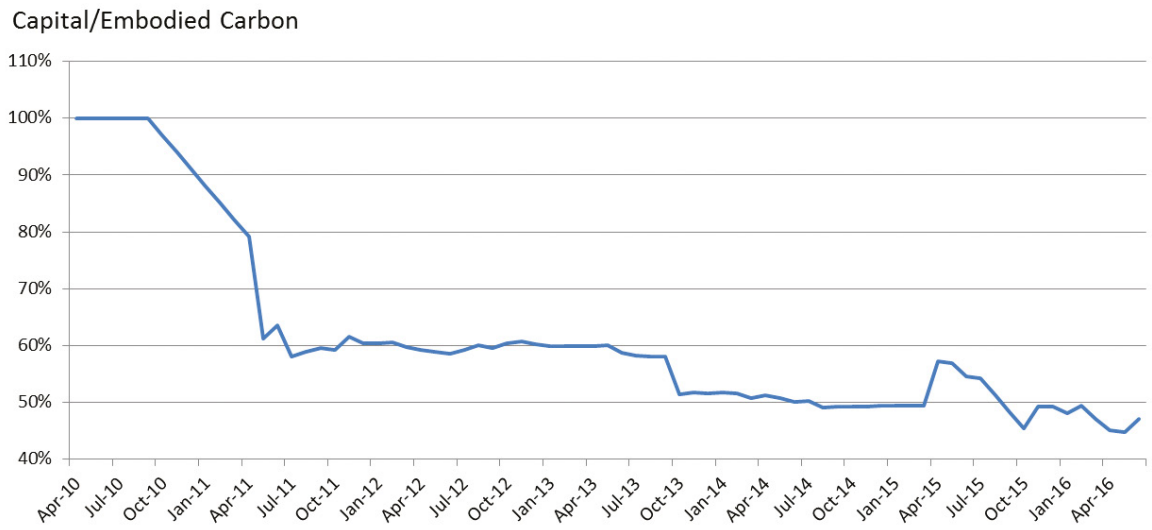


Figure 3.
Carbon Reduction – the Alliance has halved the carbon embodied in new infrastructure.



2. What is wrong with the traditional approach?

How did we get here?

In the 1980's much of the UK's economic infrastructure was transferred to the private sector. In the years that followed privatisation, the new infrastructure companies that owned and operated these networks transformed their organisations. There was no single model but as a general rule they outsourced their technical skills and relied on the market to deliver any new facilities. Consultants were used to design projects that were then delivered by contractors chosen by competitive tender.

The relationships created by this model are often highly transactional and the parties use contracts as the principal means of securing their objectives. In many cases owners use lowest initial price and maximum transfer of risk as their measure of value for money. Contractors typically break the projects down into packages and invite tenders from suppliers for the work they cannot deliver themselves. It is not unusual for 80% of the total value of a project to be sub-contracted in this way.

What is wrong with this approach?

At first sight this approach seems to offer owners a simple way of obtaining the infrastructure they need at the lowest cost whilst satisfying regulatory requirements for open competition. However it often fails because the parties to the project encounter a recurring problem:

- Consultants struggle to acquire the knowledge needed to design the right project to solve the owner's infrastructure problem.
- Clients discover that the lowest price does not represent best value.
- Contractors are unable manage the delivery process efficiently and cannot bear the risks in delivering the project.

Why do consultants struggle to design the right project?

Identifying the right project is the single most important step in maximising the value we obtain from investments in infrastructure.

It is difficult for consultants to acquire the knowledge and expertise needed to design the right project without owning and operating infrastructure. They also struggle to identify the emerging technologies that shape new infrastructure solutions as these are usually being developed by infrastructure owners or in the supply chain. The traditional model often prevents owners and their consultants from engaging key suppliers in the design process on the basis that this will limit competition.

The consultants' business model is based on selling their services by the hour. This provides few incentives to develop alternative solutions that deliver the required outcomes with less investment in design and construction. Furthermore, the margins they earn are not sufficient for consultants to maintain the large networks of relationships within the infrastructure sector and the supply chain that are critical in keeping abreast of the latest ideas and innovations. Put simply, the tendency for consultants to consolidate into ever larger firms reliant on selling ever more man-hours is not providing infrastructure owners in the UK with the services they need.

Why lowest cost does not always represent best value

The processes of designing infrastructure, obtaining tenders, administering contracts and dealing with claims all incur transaction costs, management costs and overheads down the supply chain. These costs are embedded in every price submitted by tenderers and in the final price paid by the owner. The construction industry shows little interest in measuring these costs in a consistent manner and this lack of transparency

means there is no pressure to reduce them. In practice the myth that lowest cost equals best value only survives because of the lack of best value options to compare it with.

Unpublished studies of two large building projects in London suggest that the overall cost of project management, design, commercial management, overheads and profit within the supply chain are as much as 50% of the price paid by the owner. We are not suggesting that all of these costs could be eliminated, but we could reduce them significantly by streamlining design and project management and through long-term relationships with suppliers that enable them to reduce their overheads. More efficient management of programmes could reduce overall costs by as much as 20%.

Why contractors struggle to manage the delivery process effectively

The growth in sub-contracting over the last thirty years has changed the principal function of contractors from planning and managing work to procuring and administering sub-contracts. The contractor provides the overall planning for the project and coordinates the many interfaces between the sub-contractors. Sub-contractors in turn manage their own detailed engineering, logistics and production on site. Most projects lack an overall production system that coordinates design, manufacturing of components and assembly on site. As a result, inefficiencies and waste have become embedded in the delivery process and in the unit rates and other assumptions that suppliers use when preparing their tenders.

This situation has evolved over the last thirty years. A study by BSRIA in 1997 of the installation of M&E services on projects (Ref. 1) showed that more than 50% of the labour used on projects in the UK could be saved by eliminating avoidable delays and achieving best practice task productivity.

Ten years later a study by waste management experts WRAP (Ref. 2) suggested that up to 15% of all materials delivered to construction sites ends up in skips. And a recent study by the Get It Right initiative **www.getitright.uk.com** showed that defects and errors in delivering projects can add 20% to their costs.

Against this backdrop, construction is the only major industry in the UK that has failed to improve its productivity over the last twenty years.

"Construction productivity has been flat for decades, according to McKinsey research. In manufacturing by contrast productivity has nearly doubled over the same period and continuous improvement has been the norm."

McKinsey & Company
The construction productivity imperative, July 2015

… and why they struggle to bear risk

Modern infrastructure projects are complex. The relationships between the owners, their customers and their contractors has made it all but impossible to transfer significant risks in the delivery process to contractors. Attempts to transfer these risks through the contract usually lead to them being priced into tenders and passed on to sub-contractors. And when the adverse events arise in the course of delivering the project, it is rare for the circumstances to be exactly as foreseen in the contract leading to lengthy disputes between the parties.

> **"The client may therefore pay for risk twice – once to pay the supply chain for holding or managing the risk, and then to bear the actual costs of the risk when its transfer ultimately proves impossible."**
>
> **Infrastructure and Projects Authority**
> Major capital programmes: a discussion document based on insights from recent experience, 2016.

It is often suggested that the construction industry benefits from all this inefficiency and uncertainty, but that is not the case. A report by KPMG in 2014 (Ref. 3) of the financial performance of a group of UK contractors showed that since 2007 their margins from construction work ranged from 0% to 4% and since 2010 the cash generated by construction operations had reduced almost to zero. For many years contractors have dealt with low margins from construction by generating large positive cash flows and investing them in other activities. With pressure from Government to pay suppliers promptly, this business model is clearly unsustainable.

The case for a new delivery model

The root causes of this poor performance lie in disintegration and disaggregation. By separating design from construction and breaking projects down into hundreds of sub-contracts we impede the flow of knowledge from the supply chain to the front end of the project where value is created, adding cost and uncertainty at every step along the way. The Government's 2010 Infrastructure Cost Review was right when it proposed new business models and integrated supply chains.

So how can infrastructure companies deliver their investment programmes to provide the best possible infrastructure efficiently and predictably? The answer doesn't lie in more complex transactions and more layers of project management – the PPP contracts imposed on London Underground demonstrated the folly of that approach.

Infrastructure companies must take ownership of the complexity of their projects and their relationships with their supply chains. Owners need to use competition more creatively. Rather than chasing lowest initial costs, they should create arrangements that enable the parties to work together to deliver the best possible outcomes for all. Fortunately we are not starting from scratch. A number of companies are moving in this direction and the principles underpinning a new delivery model are taking shape.

> **"When we are confronted with evidence that challenges our deeply held beliefs we are more likely to reframe the evidence than we are to alter our beliefs. We simply invent new reasons, new justifications, and new explanations. Sometimes we ignore the evidence altogether".**
>
> **Matthew Syed**
> Black Box Thinking; Marginal Gains and the Secrets of High Performance.

Case study

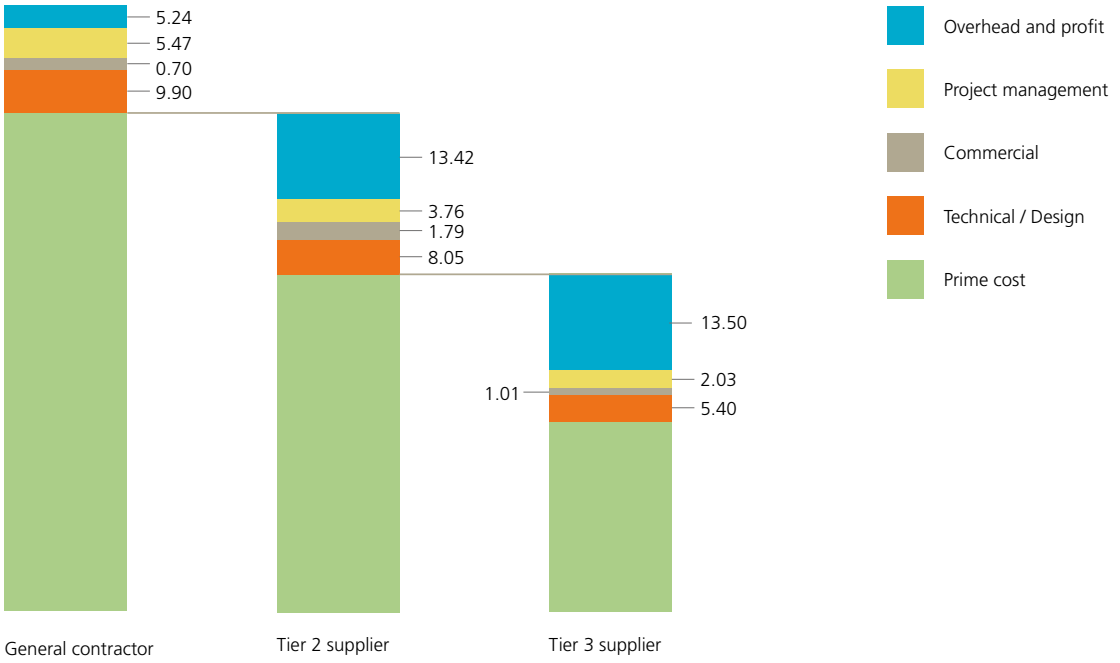
The costs of doing business the traditional way

Management costs, overheads and transaction costs

At every level in the construction supply chain the prices tendered by companies include allowances for their management costs, overheads and the costs of transacting business with each other. Some of these costs are essential to deliver the project but a significant proportion are transaction costs incurred through tendering and administration of contracts at all levels in the supply chain. It is difficult to estimate transaction costs or compare them between different projects as they are usually hidden within the prices tendered.

An unpublished analysis of the costs of two large building projects in London suggests that in total the management costs, overheads and transaction costs could be as much as 50% of the final price paid by the owner to the contractor. The design and management costs are consistent at all levels in the supply chain. Overheads and profit are a significantly higher proportion of costs at Tier 2 and Tier 3 probably because these companies own plant and equipment and employ large numbers of skilled people. Their overheads reflect the assumptions they make about the average utilization of these fixed costs.

Figure 4.



Case study

High Speed 1

The importance of achieving planned outcomes

In 1996 the UK Government awarded a concession to London & Continental Railways (LCR) to build and operate a high-speed railway between London and the Channel Tunnel. The railway would provide international and domestic train services and stimulate development around the new international stations at St Pancras, Stratford and Ebbsfleet. The route through North Kent and into St Pancras Station was chosen to facilitate the extension of the high-speed railway to the large conurbations in the Midlands and the north of England.

The PFI contract provided LCR with three sources of revenue. To finance construction, the Government transferred to LCR the revenues from Eurostar UK, the company that operated international services between London and the Continent. Once the railway was operating, LCR would benefit from the sale of the twenty high-speed train paths in each direction and from development of the lands around the international stations.

By 1998 it was evident that the financing plan was not viable and the Government stepped in to restructure the project. Government guaranteed the debt needed to fund the project and Railtrack agreed to acquire and operate the infrastructure once it had been completed. In 2007 the railway was opened for international services and in 2009 the high-speed domestic services began to serve stations in Kent. The Government nationalised LCR and in 2010 the concession to operate the railway was sold to a consortium of Borealis Infrastructure and the Ontario Teachers' Pension Plan.

The infrastructure for HS1 was delivered within 20% of the original budget and only eleven months late, comparing well with other similar railways. (1) Since it opened, the railway has performed reliably with only 0.43% of services being delayed by infrastructure incidents in 2010/11. The problem has been the failure of the project to deliver the forecast revenues. Between 2007 and 2011 the number of international passenger journeys on Eurostar services averaged one third of the level forecast by LCR in 1995. Whilst the land around St Pancras Station is now being developed, Ebbsfleet is still a large carpark.

(1) The completion and sale of High Speed 1
National Audit Office, March 2012.

3. Features of the new approach to delivering infrastructure

From transactions to a shared enterprise

At the core of the new approach is a shift away from the procurement of new infrastructure as a series of individual projects each procured independently in the market. In its place it creates organisations that integrate the core functions of infrastructure owners with the capabilities of their advisors and suppliers. These organisations seek to deliver the owners' outcomes through the management of a shared enterprise that can evolve over time from a simple collaboration into a high performing enterprise.

There is no single recipe that will create high performing enterprises for all owners, in all circumstances. And there might be good reasons why owners with programmes of straightforward infrastructure projects might want to stop at a simple collaboration with their suppliers. The proposed new approach should therefore be viewed as a family of delivery models based on the same five key features but at different stages in their evolution.

Five key features of the new approach

Though our consultations with infrastructure owners and their suppliers and the studies of six current projects we have identified a number of factors that enable teams to work together effectively. These factors can be grouped into five features that are critical in enabling infrastructure owners and their suppliers to deliver the right infrastructure solutions efficiently and reliably. There are clearly overlaps between the five features but they are a practical basis on which owners can plan and implement the new approach to delivering their infrastructure.

1. Governance
Owner's definition of value
Long-term relationships with suppliers
Performance measurement

2. Organisation
Coalition of suppliers
Aligned commercial interests
Effective organisation

3. Integration
Effective teamwork
Production management
Health, safety and wellbeing

4. Capable Owner

5. Digital Transformation

Whilst the new approach is about moving from a reliance on transactions to the development of effective delivery organisations, it is not an abandonment of competition between suppliers to provide services to infrastructure owners. These features are designed to enable different, more effective competitions based on the contributions companies make to these shared enterprises and on their performance demonstrated over time.

Three stages of maturity

It takes time for organisations to move away from the traditional approach and evolve into high performing shared enterprises. Our studies of projects show that as collaborations mature, the partners become less reliant on the contracts between them and more skilled at managing their combined resources to produce the required outcomes. Case studies show that in the early stages of this evolution the improvements in performance are quite modest but as the evolution progresses the improvements accelerate.

Unlike the traditional approach, these improvements in performance are carried over from project to project.

Figure 5 highlights three stages in this evolution from a simple collaboration to a high performing shared enterprise. The data in the table is based on evidence from the project studies and shows in outline how the development of the five key features is related to the evolution of the organisation. Whilst different owners will progress at different paces and in different ways, they can use this table to assess their progress in making the transition to a high performing enterprise.

Figure 5.
Evolution of the new approach to delivering infrastructure

	Simple Collaboration	Integrated functions and relationships	High performing enterprise
Governance	Definition of value agreed by the owner. Long-term relationships with suppliers accepted. Performance targets and reporting agreed.	Value shapes investment programme. Regular reports on supplier performance. Performance reporting integrated with production.	Value at the centre of asset management. Suppliers influencing investment decisions. Performance reporting integrated with asset management.
Organisation	Supply chain strategy in place. Traditional contracts with financial incentives. Core team co-located with common systems.	Key suppliers procured through frameworks. Cost reimbursable contracts with incentives. Single integrated project organisation.	Suppliers working together in clusters. Suppliers' rewards depend on performance. Best candidates for key roles in the integrated organisation..
Integration	Integration defined and integrator in place. Integrated planning and management. Good practice in health, safety and wellbeing (HSW).	Integrated business processes and systems. Production system in place. HSW defines good practice for the construction industry.	Fully integrated programme team with key suppliers contributing. Real-time digitally enabled production systems. HSW defines good practice for UK industry.
Capable owner	Owner's champion appointed. Owner's functions aligned with delivery team. Plan in place to develop Owner capabilities	Owner functions integrated with delivery team. Key capabilities in place. Development and succession plans in place.	Owner and suppliers working together to develop investment strategy and next generation improvement plans.
Digital transformation	Digital Strategy in place Level 2 BIM in use across the programme. Plan for digital delivery in place. Plan for smart infrastructure in place. Value of information recognised	Suppliers of digital services/ technologies appointed. Consultants' and contractors' business models adapted to the digital environment. Plan for adoption of Level 3 BIM. Information being managed as a resource across the whole 'data estate'	Suppliers of digital services/ technologies at the core of the programme team. Digital production platform in place. Asset management integrated with delivery. Integrated through-life approach to information in place

4. Understanding the five key features

Governance

Infrastructure owners establish rules, processes and practices to guide their interactions with their suppliers and their decision-making. Companies usually have a system to govern their commitments to investments and a parallel system to govern the procurement and delivery of their projects. Companies tend to get the results their governance systems demand. The new delivery model needs owners to put in place a system that will support the new model and focus everybody, from the Board and senior management down on maximising the value obtained from every investment in their infrastructure.

Owner's definition of value

The cornerstones of the new governance system are a definition of value in terms of the outcomes to be achieved from investments in infrastructure. This is set against the long-run costs and an effective process for prioritising, assessing, approving, procuring, monitoring and measuring investments against that definition.

Most public and private sector infrastructure owners use a form of cost-benefit analysis to make such decisions, expressing the result as a benefit to cost ratio (BCR) or internal rate of return (IRR). When this number exceeds a pre-determined hurdle rate the investment is regarded as sound and, subject to affordability, is able to proceed to design and construction.

In practice the analysis is often undertaken with insufficient rigour on the basis of limited and sometimes questionable data. Furthermore, initial commitments to buying best whole-life value rarely carry through into the actual procurement processes that in most cases focus on the costs of construction. Long-term value is unwittingly sacrificed in the pursuit of short-term costs savings. The result is repeated instances of projects failing to deliver their intended outcomes.

An effective system of governance would provide a consistent approach to delivering value throughout the life of an infrastructure asset, ensuring that intended outcomes are delivered for minimum whole life cost. But this requires owners to have the capabilities to define value in the initial planning of an investment and then track its delivery through the life of the asset.

Long-term relationships

Governance of procurement and delivery is often based on obtaining the lowest price through a competitive tender and then delivering the construction on time, within budget and to quality. The flaw in this approach is that it assumes that lowest price represents best value and that completion on time, within budget and to quality defines the desired outcome.

As an example, the high-speed rail link between the Channel Tunnel and London's St Pancras Station was delivered within the original budget and schedule but has failed to achieve the revenues forecast from international passengers and property development.

The new approach tackles this problem by establishing long-term relationships between the owner, the integrator and their key advisors and suppliers. The relationships are based on a shared commitment to deliver continuous improvements in performance over periods of several years. For this to work effectively, systems of governance must be established to ensure that these relationships deliver the required outcomes and improvements in performance at every step along the way.

This requires much greater transparency between the parties and commercial relationships that lead to significant consequences for poor performance and misbehaviour.

"There needs to be far greater visibility to government, parliament and the public about suppliers' performance, costs, revenues and profits".

Public Accounts Committee, 2014

Performance measurement

The new approach relies on accurate and objective measurements of performance to support the commercial agreements between the parties and to direct the efforts of the team towards continuously improving their performance. The scope of these measures and the systems used to measure them will evolve as the parties progress from a simple collaboration into a high performing enterprise.

The new approach uses two groups of performance measures. The first consists of the outputs and outcomes required by the owner. Alongside this it is important to establish process measures that can be used to track the day-to-day effectiveness of the collaboration. Without these process measures teams risk getting bad news about their performance when it is too late to do anything about it.

The ICG has been working with the construction industry to standardise performance measures and encourage more transparent reporting of performance across the large infrastructure projects and programmes. This initiative will be developed to support the new delivery model.

Organisation

Coalition of suppliers

Our project studies showed that engaging the right suppliers at the right time and integrating them into the team is critical to developing the right infrastructure solutions and to delivering value over the long term. This is more important than extracting the lowest price from suppliers through competition. A few percentage points saved in the price of a supplier's services pale into insignificance when they have a technology that can transform the solution.

Successful owners understand their suppliers' capabilities and know when to integrate them into their delivery teams to obtain the best results. They invest time in visiting their suppliers' offices and factories and in exploring the products and services they offer. They also commit management time to integrating people from different organisations, professions and backgrounds into a single high-performing team with shared culture, processes and practices.

Effective teams are networks of collaborative relationships that encourage an exchange of knowledge and capabilities to drive improvement and innovation. Owners should take the lead in designing coalitions of suppliers to deliver their programmes and should not allow their supply chains to be the consequence of a series of traditional procurement decisions.

"Your value will not be what you know; it will be what you share".

Ginni Rometty
President and CEO, IBM

Aligned commercial interests

The new approach relies on aligning the activities, behaviours and interests of owners and suppliers as they work together to achieve the required outcomes. All parties must commit to these relationships and work hard to maintain them. And the commercial arrangements between the parties must reflect this aspiration.

This requires owners to define the outcomes to be delivered by their suppliers. They must be able to describe what good infrastructure is, how it must perform and what it should cost. And they must be able to set realistic performance targets in terms of speed of delivery, efficiency and carbon reduction. Suppliers must be confident in their assessments of how they will achieve these objectives and what they want to get out of the collaboration.

Commercial agreements based on clear definitions of value and desired outcomes are necessary for aligned relationships but not sufficient to create successful teams. Enduring alignments of interests are developed through the long-term relationships between the businesses. They invest time in these relationships understanding each other's capabilities and working together to innovate and improve performance. They understand what each party wants to get out of their involvement in the programme and work together to achieve this.

Effective organisation

One of the most surprising conclusions to emerge from the consultations with suppliers was how often collaborative teams are hampered by poor organisation. Owners can go to great lengths to procure collaborative contracts and bring the parties together in an integrated team and then fail to provide the basics of reliable IT systems, a common email system and competent office administration. The things we normally do when setting up an office for our own businesses can get lost when we are establishing a collaborative team.

To ensure this does not happen, the owner's Property, HR and IT departments need to be engaged as early as possible in setting up the team. Collaborative teams have to establish themselves and deliver quickly and they need an organisation they can rely on.

Integration

The new approach to delivering infrastructure relies on getting the most out of all the parties involved through collaboration and integration. Collaboration works by softening the boundaries between the parties to an infrastructure programme and then integrating their capabilities, functions and activities to produce a better outcome for all. Integration does not occur naturally. Owners must take the lead in developing organisations with the culture, practices and systems appropriate to the programme being delivered.

The traditional delivery model has reduced most general contractors' abilities to integrate all of the activities needed to deliver modern infrastructure projects. Companies that once employed people with these diverse skills now rely almost exclusively on their commercial managers to coordinate delivery through their sub-contractors.

In the projects we have studied, the owners have stepped in and taken responsibility for integration either directly or in collaboration with their contractors. AW and LU have created alliances with their contractors, consultants and suppliers to provide a comprehensive integration service. The EA has focused on integrating its own functions and relies on its general contractors to integrate the production of its projects.

As with other features of the new approach, there is no single way of providing integration, but we can all learn from examples of where is has been done well.

Effective teamwork

The role of the integrator is fundamental to the success of the new delivery approach. It is a leadership role focused on creating an effective team to achieve common goals. It requires deep knowledge of the companies involved in the programme and their capabilities, methods, business models and objectives. And it needs expertise in managing the processes and information that links design and engineering with manufacture and construction.

The integrator owns the key planning and management processes that coordinate design, manufacture of components and production on site and ensure they aligned with achieving the required outcomes. The integrator has to be expert in these functions from owning the integrated engineering model to managing logistics and providing production systems to assemble the project on site.

Figure 2 sets out twenty-five core integration functions identified by the ICG in consultation with its suppliers. Not all of these functions will be needed on every project and on most projects they will be shared between the owner and the integrator

Figure 6.
Core functions of the owner and the integrator

Corporate functions	
▪ Governance ▪ Investment planning	▪ Finance
Programme development functions	
▪ Solution development ▪ Stakeholder management ▪ External communication ▪ Approvals and consents ▪ Organisation development	▪ Technology strategy ▪ Supply chain development ▪ Procurement strategy ▪ Risks and opportunities
Programme delivery functions	
▪ Programme management ▪ Programme controls ▪ Project management ▪ Access management ▪ Technical assurance ▪ Health, safety and environment	▪ Technical integration ▪ Planning and production ▪ Expediting and logistics ▪ Performance management ▪ Commercial management
Programme completion functions	
▪ Commissioning	▪ Operational readiness

Effective management of production

Construction is behind other industries in its use of modern systems to manage engineering, logistics and production. Consequently it has not yet created global value chains. On most construction sites in the UK, sub-contractors are left to manage their own logistics and production. Materials are often delivered long before they are needed and stored in the open and work is frequently held up whilst teams wait for missing components to be delivered or damaged components to be replaced.

Integrators must develop production systems that are fit for the digital age. Digital technologies have created the opportunity for the infrastructure and construction sectors to adopt open-source production systems that could be integrated with current BIM protocols and used by any project team. These systems would disrupt the current approaches to designing, procuring and delivering infrastructure. They would enable design decisions to be made at the right time, manufacture and delivery of components to be tracked in real time and construction teams to work with confidence that all of the pieces will fit together when they are brought to site.

Health, safety and wellbeing

The new approach to delivering infrastructure is all about creating high performing shared enterprises. High performing enterprises have high standards for health, safety and wellbeing. The performance of the construction industry has improved but it still lags well behind that of comparable manufacturers and industrial companies. We believe that this is explained at least in part by the high levels of sub-contracting in construction.

If we are serious in our ambitions to improve health, safety and wellbeing on our infrastructure projects, we have to establish modern standards in the way we employ and manage people across the sector. This will include consistent terms of employment, proper medical checks before people are employed, training before and during employment and modern medical and welfare facilities on construction sites. Our ambition is to establish standards that all ICG members will sign up to and enforce across all of their projects.

Capable owner

Our work has established that the role of a capable owner goes well beyond the traditional role of the client and requires an capabilities that are not always present in infrastructure companies. Consultations with the supply chains revealed a demand for an owner with the capabilities and willingness to:

- Define the outcomes needed from the programme.
- Articulate technical requirements.
- Manage stakeholders.
- Put infrastructure into operation.
- Work collaboratively with the whole delivery team.

In July 2015 the ICG completed a study of the role of the infrastructure owner led by Heathrow Airport with support from the Alliance Manchester Business School. The study concluded that the inputs required from the owner are as critical and complex as those provided by the companies that deliver their programmes. It highlighted six capabilities that all owners should aspire to have:

- Articulating the voice of the customer.
- Value driven mindset.
- Articulating the voice of operations.
- Relating to the supply chain.
- Creating complex systems.
- Recruiting, building and retaining talent.

Our ambition is to develop executive education and training programmes that will enable owners' senior staff to acquire these capabilities.

Digital transformation

"We need to focus on continuity of ownership of the investment that enables you to get the thing through into effective operation. Presently you get a bunch of people whose job it is to get the bill through Parliament who have no interest in construction, and a bunch of people whose job it is to build it who have no interest in operations".

Alliance Manchester Business School
Contribution to the study of the role of the infrastructure owner, September 2015.

Digital transformation is in its infancy in the UK infrastructure sector. There are however examples of new practices. Transport for London has used contactless payment technologies to improve passenger flows and transform its relationships with Londoners. Highways England is using its smart motorway technologies to monitor and control traffic flows in real time. The UK Government is using its Digital Built Britain initiative to pave the way for the adoption of Level 3 BIM on publicly funded projects. And it is encouraging the use of advanced manufacturing techniques in construction.

Much of the current debate is however focused on the technologies rather than on the new business models that will actually change the way we do things. To accelerate the process of change, we have to address four key issues:

- **The value proposition** – understanding how digital technologies can deliver value to the infrastructure sector and its customers.
- **Industry readiness** – understanding the skills and business relationships needed to implement digital technologies and the time it will take to acquire them.
- **The disruption process** – understanding how general purpose technologies like the internet, supporting technologies and new business models work together to deliver transformation.
- **Policies and standards** – identifying the changes in policies and standards needed to support digital transformation.

The new approach to delivering infrastructure has to facilitate the adoption of digital technologies within new infrastructure and the processes of designing and building it. To that end, the ICG will identify promising new technologies, encourage their use within the new approach and sponsor discussions about emerging technologies through seminars and other similar events.

Case study

Redevelopment of Bank station

Competing to deliver best value

London Underground's £625m upgrade of Bank Station in the heart of the City is one of the UK's most complex infrastructure projects. It has attracted attention because of LU's innovative approach to procuring the project based on best value rather than lowest cost.

Normally LU would have completed their technical studies of the station and future passenger demands and then engaged a consultant to design the project and estimate its costs. The design would have been used to develop a cost-benefit model for the investment and to invite tenders from contractors to build the project. The assumption would have been that the consultant's design and the winning tender represented best value for money.

Under the new approach LU provided the tenderers with details of the exiting station, their studies and their cost-benefit model but did not show them the design. Instead they asked them to develop their own designs to achieve the highest benefit to cost ratio. LU protected the tenderers' intellectual property by agreeing to compensate the unsuccessful companies for innovative ideas that were used in the project.

Spanish contractor Dragados beat three joint ventures to win the tender. From the outset they engaged with their Tier 2 suppliers and focussed on the cost-benefit model and on features of the design that would maximise the benefit to cost ration. Their winning solution increased the ratio from 2.4:1 to 3.5:1 and reduced the cost of the project by £61m to £563m.

"Tier 1 contractors engage very little with Tier 2 suppliers when bidding – if at all. So this is unique".

Don Houston
Byrne Group.


SP1296
TARE 625 KG
SP
SPECIALIST PLANT

5. Next steps

We have identified five features of successful delivery teams that set a clear direction of travel for infrastructure owners. The evidence we have gathered gives us confidence that infrastructure owners can apply these features to develop high performing shared enterprises capable of delivering infrastructure assets that provide more value for every pound invested.

Over the next year the ICG will work with the ICE to support the development and use of these features through three activities:

- **Peer review and support** – provided by ICG members.
- **Programme of activities and events** – arranged around the key themes in the report and led by colleagues in the infrastructure and construction sectors.
- **Dissemination of good practices** – through the ICE and related bodies.

Peer review and support

ICG members already participate in reviews of infrastructure projects and programmes carried out under the Procurement Route Map. We will use the same informal approach to support companies using the new delivery model with the ICE providing a point of contact for the companies and ICG members. ICG members have limited capacity and in time we plan to establish a panel of experienced people outside the ICG that companies could call on for support.

Programme of activities and events

Senior industry leaders have agreed to lead groups to further develop thinking on the five features. This work will be socialised via a series of events. We will look for opportunities to deploy ideas on live projects and share the results. Five groups are in place.

Governance
Led by Richard Threlfall, KPMG.

In changing our approach to delivering infrastructure programmes, we first have to develop systems of governance and procurement practices that are focused on maximising value to customers and stakeholders rather than on minimising initial capital costs. This theme will explore new ways of assessing investments in infrastructure that are aligned with Government's desired outcomes and new ways of measuring performance in project delivery and achievement of outcomes.

Organisation
Led by Dale Evans, Anglian Water Services
with Nirmal Kotecha, UK Power Networks

The new delivery model creates alliances and other shared enterprises into which the Owner and their suppliers deploy their staff and through which they share in the successful outcomes. Building on the ICG's successful work on alliancing, this theme will explore the issues that are critical in establishing and managing shared enterprises with the capabilities and behaviours needed to deliver success. It will recommend ways of creating appropriate coalitions of suppliers with aligned interests and effective relationships between business partners.

The new delivery model requires an effective organisation that enables all of the people who are deployed into the team to perform to the best of their abilities. This theme will draw on the experiences of the people who have set up teams for some of the UK's largest projects and programmes and set out a framework that defines the elements of an effective organisation, appropriate ways of providing them and some of the pitfalls that can be encountered.

Integration
Led by Mark Reynolds, Mace

The new delivery model requires an Integrator to bring together all of the participants and their activities and focus them on achieving a successful outcome for the investment. This raises important questions about the role and responsibilities of the Integrator, the capabilities they need and the processes and systems required to achieve effective integration in the digital age.

It challenges us to redefine the delivery process around value and efficiency and support it with an open-source production system that could be used by all infrastructure programmes.

The capable owner
Led by Phil Wilbraham, Heathrow Ltd

The new delivery model relies on a capable owner able to define the outputs and outcomes they require from their investments and collaborate with their suppliers. Building on the work that Heathrow has done with Manchester Business School on the role of the Owner, this theme will explore the capabilities required by an effective owner and the means of acquiring them through recruitment, development and training. An output from this theme will be a common approach to developing owners' staff supported by executive education and training programmes.

Digital transformation
Led by Mark Enzer, Mott MacDonald

Digital technologies are transforming the ways in which infrastructure companies deliver services to their customers. And there are signs that the construction industry is moving beyond BIM and embracing digital technologies as a means of disrupting business models and embracing more efficient delivery. This theme will explore the potential of digital technologies to transform the way we deliver infrastructure and encourage collaboration between infrastructure, construction and the Tech Sector.

Dissemination of good practices

The ICE will host the ICG website and use this and its other media to disseminate good practices that arise from the work outlined in this report. In the first instance we will continue to use these channels to share information with the infrastructure and construction sectors.

References

1. Hawkins, G. 1997. Improving M&E Site Productivity. BSRIA Technical Note TN 14/97.

2. Material Logistics Plan Good Practice Guidance. WRAP, December 2007.

3. Margins, cash and order book. KPMG Construction Barometer, September 2014.

4. Pink, Daniel H. Drive. The Surprising Truth About What Motivates Us. Riverhead Hardcover.

5. Ariely, D. et al 2005. Large Stakes and Big Mistakes. Federal Reserve Bank of Boston Working Paper.

Appendix A
Leadership and support

Project 13 Task Force

Miles Ashley (Chair)	Wessex Advisory Ltd and formerly Transport for London
Martin Buck	Formerly of Crossrail
Peter Adams	Highways England
Nick Baveystock	Institution of Civil Engineers
Professor Andy Davies	University College London
Dale Evans	Anglian Water Services
Mark Hagger	Environment Agency
Dr Richard Holti	Open University Business School
Nirmal Kotecha	UK Power Networks
Simon Murray	Acumen7 Network
Alasdair Reisner	Civil Engineering Contractors Association
Phil Wilbraham	Heathrow Airport
Professor Graham Winch	Manchester Business School

Stakeholder Review Group

The following companies were represented in the Stakeholder Review Group

Arcadis	Mabey
Astins	Mace
Atkins	McNicolas
Bachy Soletanche	Morgan Sindall
BAM Nuttall	Mott MacDonald
Byrne Group	N G Bailey
C A Blackwell	Osborne
Carillion	Otis
Cleshar	Skanska
Costain	Speedy Services
Expedition Engineering	Tarmac
Keltbray	Toppesfield
Kier	Turner & Townsend
KM Decorating	Waterloo
Lafarge Tarmac	Wilson James
Laing O'Rourke	WSP

Appendix B
Consultations

The proposals in this report are based on consultations with infrastructure owners and the construction industry and on studies of three pairs of projects taken from current infrastructure programmes. In this section we present the findings from the consultations and in the following section we present a summary of the studies. The full results of the studies will be published over the coming months in a series of academic papers and articles.

The consultations began in June 2015 with three facilitated workshops with owners, Tier 1 consultants and contractors and Tier 2 suppliers. The idea behind the workshops was that for the new delivery model to be sustainable, it has to enable all parties involved in the delivery of infrastructure to be successful. The participants were asked two questions:

When thinking about infrastructure projects that have been successful for your company, what are the criteria you use to judge that success?

For the same successful infrastructure projects, what are the features of the project teams that enabled that success?

Facilitators led the workshop, recorded key points from the discussions and used simple textual analysis to identify the top five success criteria and the top five features of successful teams. It was notable that all three workshops came up with the same criteria and features summarised in Figure 3. The only exception was **Effective management of production** that was introduced by the Tier 2 suppliers.

Most suppliers have processes and systems for managing design, delivery of materials and manufacture but when they arrive on site their experience can be very different. It is rare for contractors to provide an effective system for coordinating engineering, logistics and production across all of their suppliers with the result that suppliers are often brought to site too early and put under pressure to begin tasks they cannot complete.

The success of the workshops led us to bring together the suppliers, consultants and contractors with other representatives of the construction industry in a Stakeholder Review Group (Appendix A). We have held one formal meeting with the group to review the results of the studies and the emerging conclusions and three further workshops to discuss subjects proposed by the review group. We have also held private meetings with smaller groups of consultants and contractors to discuss the likely impacts of digital technologies on their businesses.

The picture that emerges from these consultations is of a construction industry that is keen to engage with new approaches that enable them to build their businesses and their relationships with their customers. This enthusiasm is conditioned, particularly amongst the suppliers, with concerns about the willingness of infrastructure companies and their contractors to implement the new approach and share the rewards of more efficient working down the supply chain.

Most of the people involved in these consultations were aware of the threats and opportunities presented by emerging digital technologies and possible new entrants that could provide infrastructure companies with a more efficient delivery service. It is recognised that consultants' and contractors' existing business models, based on turnover, will have to change to enable them to benefit from new approaches to delivering infrastructure and emerging digital technologies.

Figure 7.
Industry vision of success

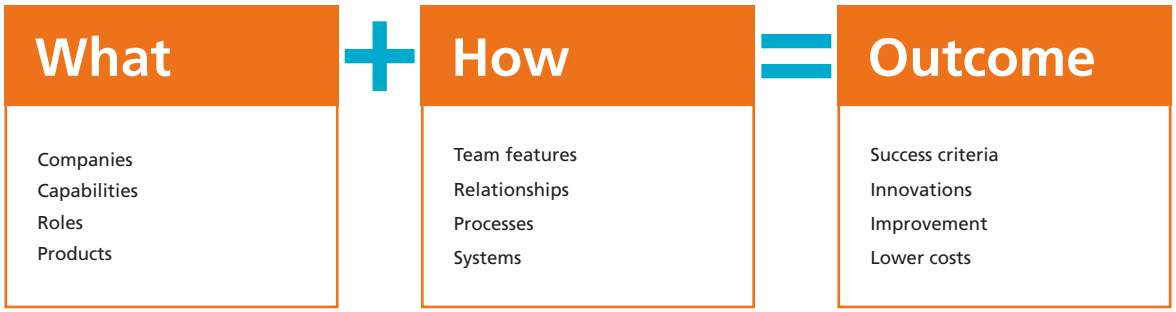
Success criteria	Features of successful teams
■ Relationships and reputations ■ Common purpose, culture and behaviours ■ Fair financial rewards ■ Health, safety and well-being ■ Achievement of owner's objectives	■ Shared values and common purpose ■ Effective organisation and processes ■ Effective teamwork ■ Aligned commercial relationships ■ Effective management of production

Appendix C
Project studies

Design of the studies

The studies were designed to explore across a group of infrastructure projects the causal relationships between the teams, their roles, how they worked together and the outcomes they achieved (Fig. 4). By understanding these relationships in the context of specific innovations and improvements we tested the outputs from the workshops and identified the factors that are critical in creating successful teams.

Figure 8.
Schema for studying causal relationships



The studies investigated three pairs of projects provided by AW, the EA and LU. The projects were completed recently and were chosen to represent three versions of integration between the owners and their suppliers (Fig. 5).

UCL collected and analysed three sets of data about the projects and the teams that delivered them:

Projects and supply chains – the owners' project managers collected information about the projects and their supply chains using standard spreadsheets and generic terminology. The data was analysed to understand the evolution of the supply chains and of the relationships within them.

Questionnaires – seventy-eight leaders from across the project teams and supply chains completed the questionnaires online. The results were analysed to determine the causal relationships between the features of successful teams and successful outcomes. The questionnaires also identified specific innovations and improvements to be explored in the interviews.

Interviews – UCL interviewed forty-three leaders from across the project teams and supply chains to explore the factors that enabled and inhibited innovation and improvements in performance on the projects. The interviews were recorded, transcribed and analysed using textual analysis.

Figure 9.
The projects in the study

Owner	Project	Integrator
Environment Agency	**Broomhill Sands** £30m coastal defence scheme at Camber Sands. **Mersey Warrington** £6.5m investment in flood defences to protect homes and wetland habitat..	Integration of planning and design by EA's own staff. Integration of procurement and construction by EA's framework contractors.
London Underground	**Embankment Station** £14.5m upgrade of the existing station. **West Hampstead Station** £3.4m investment in extensions to platforms.	LU's STAKE Programme. LU's SWIP Programme.
Anglian Water Services	**Cambridge WRC** £20.7m expansion of an existing treatment plant. **Pulloxhill** £8m investment in a new water treatment works.	@One Alliance formed by Anglian Water in 2005 with a group of six consultants and contractors.

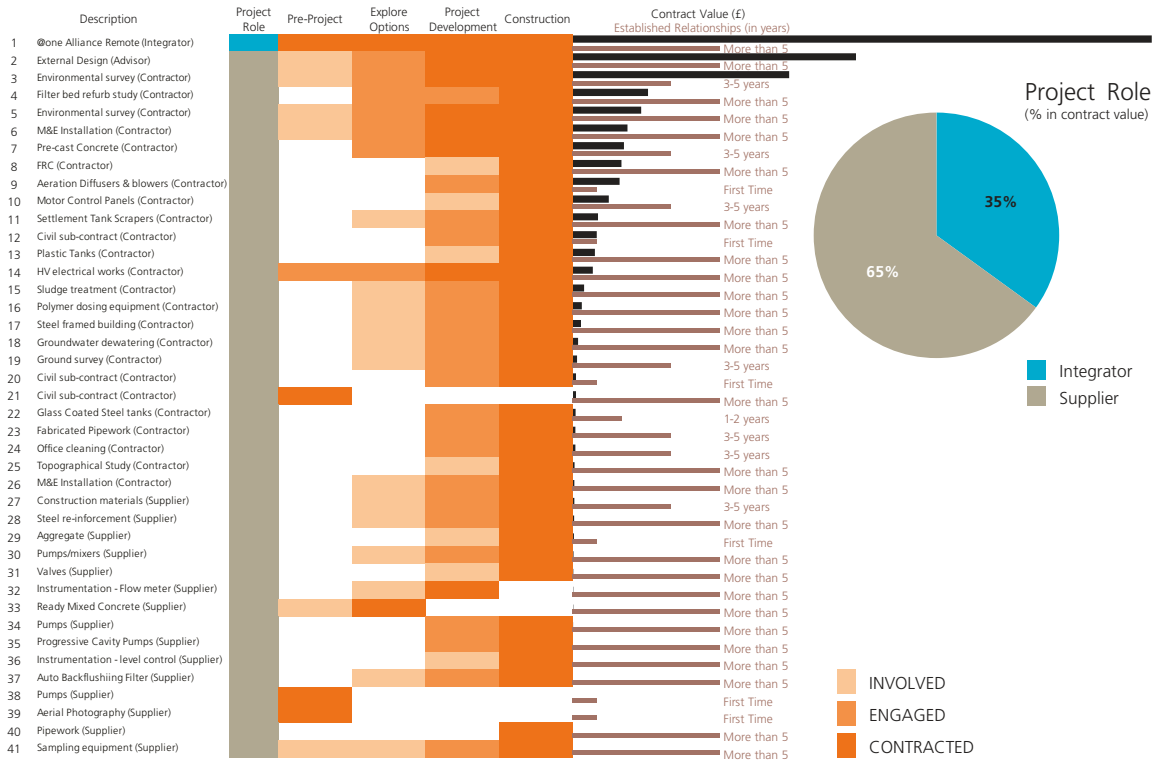
Projects and supply chains

UCL analysed the data from the projects and their supply chains using generic terms for the roles of the participants, the stages in the development of the projects and the degree of involvement of each. By presenting all of the data for each project on one page (Figure 4), they enabled comparisons between the evolutions of the supply chains for the three pairs of projects.

The analysis highlights the need to design the evolution of the supply chain to meet the needs of the project rather than allowing the evolution to be the consequence of established procurement practices. This is particularly important in the early stages of developing collaborative teams when owners might assume that by involving their contractors at the start of projects they are also engaging the suppliers.

The AW projects represent a mature alliance that has established relationships with key suppliers and can bring them into the team before the project has been defined. The two LU projects were amongst the first to be implemented through the STAKE and SWIP programmes and represent an early stage in the evolution of their supply chains when they still rely on consultants to make key technical decisions. The EA's objective was to integrate their own core functions that impact on the projects so as to improve coordination with their framework contractors.

Figure 10.
Evolution of the supply chain
Cambridge Water Recycling Centre Project



Questionnaires

The questionnaires invited the respondents to evaluate the performance of their project teams in terms of the degree to which the five success criteria had been achieved and the relevance of the five features of successful teams. The evaluation was done on a scale of 1-7 and the respondents were given the opportunity to suggest other success criteria and features of successful teams. UCL analysed the results using standard statistical methods.

The analysis endorsed the success criteria and features of successful teams that had been derived from the workshops. Although this is a small sample from project teams working with owners that are already committed to collaboration, the analysis suggests that suppliers and their staff are motivated to improve their performance and are looking for rewards beyond immediate financial returns. The prospect of long- term relationships that lead to continuity of work seems to be more attractive than short-term gains on individual projects.

The analysis confirmed that it takes time to develop collaborative teams and their working practices. The results from LU's STAKE and SWIP programmes that are still in development showed that whilst the teams had strong common purpose and were attaining their objectives, they had not yet achieved full maturity in ensuring that their commercial agreements aligned all parties rewards with the success of the projects.

The most significant result from the analysis was that the two most important features were judged to be **Effective organisation** and **Aligned interests**. The analysis showed a likelihood of 53% that these two features would lead to a successful outcome. This result suggests that when companies and their staff join collaborative teams their principal needs are for an organisation that enables them to do their jobs and that aligns their efforts with achieving the owner's overall objectives.

Interviews

The interviewees were drawn from across the organisations that delivered the six projects in the study. By encouraging them to speak openly about the innovations and improvements that had contributed to the success of these projects, UCL obtained a rich set of data about the participants, the ways in which they worked together and the contributions they made to the successful outcomes. The relative maturity of the organisations that delivered the six projects enabled UCL to relate the data to different stages in the evolution of collaborative teams and provided important insights into the development of these teams.

A common theme running through the interviews is that people are motivated to work collaboratively with colleagues from other companies in pursuit of a common objective. Whilst there were many negative comments in the interviews, they tended to be associated with frustration at some of the barriers to collaboration that still existed within the project teams. There were few instances in which the interviewees preferred the traditional delivery model. And whilst there were many comments about the fairness of payment terms or rewards for the companies involved, there was no mention of personal financial incentives.

It should not surprise us that people like working in collaborative teams. In his book *Drive* (Ref. 4) Daniel Pink reported on a series of academic studies that showed that when people are working on creative or cognitive tasks there are three factors that increase their performance and satisfaction: autonomy, improving skills and doing something that has a meaningful purpose. Studies done at the Massachusetts Institute of Technology for the Federal Reserve Bank of Boston (Ref. 5) have shown that for tasks that require even the most basic cognitive input, monetary rewards can sometimes have detrimental effects on performance.

"It makes a difference to us if we have made a difference".

Participant in the workshops with suppliers, June 2015.

An important insight from the interviews is that collaborative organisations and their practices evolve over time with new relationships, behaviours and methods of working emerging as the teams become more integrated and more focused on improving their performance. Through the studies we have identified three stages in the evolution of these organisations:

Simple collaboration – at the outset the participants set up the collaborative team, establish a common identity and begin to work together using traditional project management practices and systems. At this stage most of the improvements in performance are delivered by challenging existing standards and practices and by sharing ideas that the participants bring with them

Integrated functions and relationships – once the team is established, the participants can begin to integrate functions within the team, remove duplications and functions that add no value and streamline their relationships with the owner's organisation. At the same time they begin to create long-term relationships with key suppliers and standardise products and processes across the value chain.

High performing enterprise – when the team is fully integrated it can move on to improving performance through carefully targeted incremental innovations and improvements commonly know as "marginal gains". By this stage innovation and improvement are embedded in the way the organisation works.

Institution of Civil Engineers

One Great George Street
Westminster
London, SW1P 3AA

policy@ice.org.uk
ice.org.uk

Published March 2017
Registered charity number 210252