Developing a new procurement model, using behavioural economics, to enable continuous improvement of productivity and better value in large UK infrastructure projects.

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Content

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ABSTRACT

Global construction has been blighted by productivity inertia caused by behavioural bias for decades. While other industry sector productivity has grown more than fifteen-fold since 1960, construction has stagnated with no more than a seven to ten percent overall growth. McKinsey Global Institute's report *Reinventing Construction: A Route to Higher Productivity*, reported infrastructure construction amongst a small group of outperforming market sub-sectors at 15 to 20 percent. This research, which results in a unique procurement model designed for high productivity, builds on that performance using behavioural insights to counter damaging biases. The new model changes trading relationships from traditional 'opt-in' to a nudged 'opt-out' contract structure creating a different responsibility dynamic between client and supplier.

This research builds known behavioural economic and insights theories into the recognisable but different infrastructure construction procurement model to improve productivity. Highways England, set up to run England's strategic road network, recognised a need to accelerate productivity change. The procurement model that resulted, Regional Delivery Partnerships can be refined for any infrastructure sector and supplies a key step forward in contracting based on integrated project delivery.

Using a combination of counter bias strategies built from loss aversion and nudge theory a new procurement model focuses on 'opt-out' to drive higher productivity. By setting up an integrator, to create an integrated project team, Regional Delivery Partnerships uses loss aversion as the key to better innovation. It empowers the integrator to counter uniqueness bias and find and eradicate waste (time and money) to enhance productivity. Reward is aligned to both optimised efficient design and high productivity working. As 100% of budget underspend can be kept rewarding the integrator, the potential of not achieving this triggers loss aversion and motivates change using the principles of escalation of commitment in favour of the client. Performance data is also used to motivate by

allocating future work to reduce acquisition costs from secondary competition, long held as a wasteful market inefficiency.

Using wideband Delphi workshops, facilitated model-building, thought trials, and constructionism; choice architectures were remodelled into a new outcome and value focused procurement model. This applied research charts the process and techniques used to develop, build, test, and deploy the model in open market competition. It can be used by any infrastructure sector client to replicate a sector specific version of Regional Delivery Partnerships that changes trading choice architecture towards higher productivity.

Change is hard to do. Practitioners sponsoring such change must manage the expectations of business and investment decision makers. This is evolution and not revolution and requires patients, tenacity, relentless education for participants, and dogged determination that, with time, the change and associated benefits will emerge. National Highways in deploying Regional Delivery Partnerships planned this timeline as 15 – 20 years.

Key words

Productivity, infrastructure, highways, procurement, behavioural economics, nudging, choice architecture, change.

1 Introduction

1.1 Background and context

In 2020 the Government, through HM Treasury, stated in its *National Infrastructure Strategy 2020* (Gov, 2020)

> *"The government wants to deliver infrastructure projects better, greener, and faster. That means addressing longstanding challenges such as complex planning processes, slow decision-making, and low productivity in the construction sector".*

In Build UK's *National Infrastructure and construction procurement pipeline 2021/*2022 it projects investment of £200billion to 2024/2025 with 35% (£70 billion) in transportation. In this report is reiterated:

> "The Government is committed to using its position as the single largest construction client to support adoption of a more productive, efficient, and sustainable business model within the UK construction sector. This innovation is a key part in reaching the Government's goal of net zero emissions by 2050." *(Smallwood, 2021a)*

Indeed, in Nick Smallwood's introduction to Infrastructure Projects Authority *Transforming Infrastructure Performance: Roadmap to 2030*, he states:

> *"At the heart of the TIP Programme lies the need for a step change in productivity and efficiency in the ways we plan, design, manufacture, construct and operate infrastructure." (Smallwood, 2021b)*

And in its review *Highways England's capability to plan and deliver its RIS2 capital enhancement programme in 2021,* Nichols stated:

> *"Our view is that Regional Delivery Partnerships (RDP) [the subject of this thesis] and Smart Motorways Alliance (SMA) delivery models are key to the successful delivery of RIS2 and will also have an overall positive impact on Highways England's project development capability for sub-Tier 1 projects." (Nichols, 2021)*

Since 2015, the output of the construction sector in the United Kingdom has been escalating from its original £90bn. In the same year, Gross Domestic Product (GDP) was £2,044bn, which means that the sector accounted for around seven percent of GDP. However, construction has lagged in productivity improvement in the early half of this century.

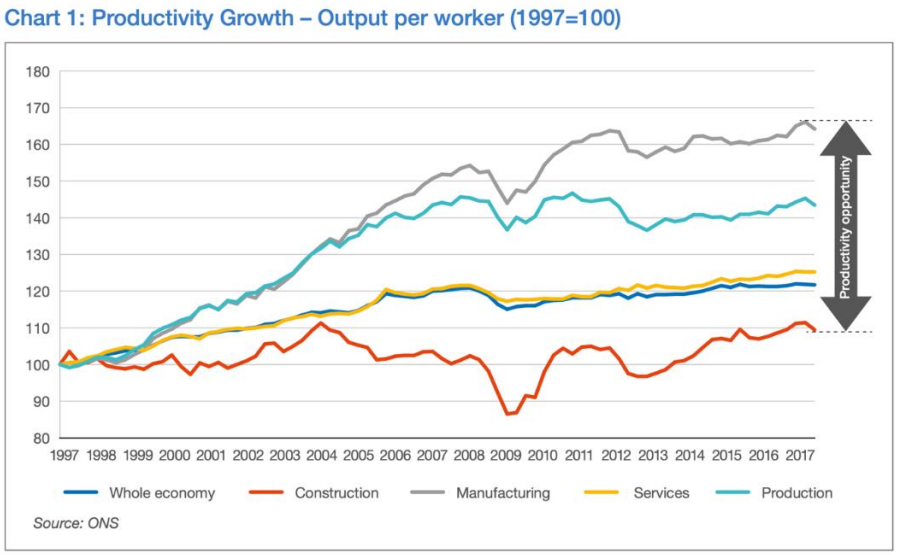


Figure 1 Productivity – output per worker – *Transforming Infrastructure Performance* (IPA, 2017)

By any analysis, the infrastructure sector including road, rail, and other forms of transport, accounts for a significant and important amount of the construction market. This research focusses on the delivery of the UK Government Road Investment Strategy (DfT, 2015) in the period 2015 onwards.

The UK government commissioned a review of long-term infrastructure planning and investment in 2013 in: *An independent review of long-term infrastructure planning* (Armitt, 2013). In 2016, under the *Nation Infrastructure Development Plan (IPA, 2016)*, it set out an intention to commit to £100billion of investment for the long-term, out to 2050. As part of this it set out an intention to commit investment of £88billion into transportation confirming investment of £15billion 2015-2020 into the strategic roads network.

In 2015, the UK Government set up Highways England Ltd granting it a license under the Infrastructure Act (UKGovernment, 2015). Informed by and responding to Alan Cook's review *A fresh start for the Strategic Road Network* (Government, 2012) the Act is the basis for 5-year Road Investment Strategies (DfT, 2015) having an investment plan, and therefore market continuity through a committed pipeline of work. Highways England, in response, set up its delivery model, *Collaborative Delivery Framework* (Cuff, 2015) with a procurement cap of £5billion. This business wide route-to-market for all road network enhancement work created streamlined access to its

supplier market for five years. In 2017, at its mid-point, market wide research showed that after 2019 network enhancements would be better served by a new specific route to market for each of its four active enhancement programmes: Regional Investments, Smart Motorways, Complex Infrastructure, and the National Infrastructure Programme. The research focuses on a procurement model for Highways England's Regional Investment Programme.

The researcher held the position of Commercial Programme Director for Regional Investment programme in Highways England providing him a privileged position in terms of historic and collected feedback data. This enabled the research to consider data that would have otherwise been difficult to access. All data of a commercial sensitive nature has been redacted but included to assist the reader in understanding the research.

The Regional Investment Programme predicts to deliver £7.6 billion of road investment is one of the largest programmes; equating to 12% of UK transport infrastructure spend 2015 - 2021 outside London (Armitt, 2013). When agreeing its delivery plan in 2015 totalling £15.2 billion, Highways England responded to a challenge to reduce actual expenditure by an efficiency target of £2.4billion over ten years (£1.2bn 2015-2020 and £1.4bn 2020-2025)(England, 2015).

The Regional Investment Programme was targeted to respond proportionately to this efficiency target (£116m 2015-2020 and £600m 2020-2025). McKinsey highlighted in its report *Reinventing Construction* (MGI, 2017) construction's productivity shift in western economies over the last 15 years has been constrained to an improvement of approximately one percent. This compares to the manufacturing sector that exceeds 600% for the same period. The challenge for Highways England, given the government's expectations on improved efficiency, was to accelerate the improvement in productivity on the projects it commissioned. Its response was to drive better value, through improved safety, improved customer service, and delivery of commitments.

In 2008, Highways Agency, Highways England's predecessor, introduced lean construction with the declared aim of improving project delivery performance. The resulting lean interventions generated

a significant amount of transferable knowledge and isolated productivity improvement. However, not at the rate needed to meet government monitor's expectations for its future investment (Nichols, 2017). Consequently, an innovative approach was needed to counter the inability of the construction industry to grasp the change in mindset needed to turn on the tap of latent productivity, highlighted in the *Transforming Infrastructure Performance (IPA, 2017)*, and available from design for manufacture (DfM) thinking (Fernández-Solís, 2008, Highways_England, 2017, IoED, 2020).

Transport infrastructure enhancements involve large-scale complex projects. Enhancements to England's strategic road network are no different, with schemes typically ranging from twenty-five, to hundreds of millions of pounds. Between 2014 and 2017 prompted by becoming an arm's length government company, Highways England's trading model saw maturity improve from 'transactional' to 'simple collaborative' behaviour (ICG, 2017). This behavioural shift was driven by changes in policy, governance, and project management practices, and supported by a procurement model called *Collaborative Delivery Framework* (Cuff, 2015). This maturity, while material, stagnated into an operational status quo: a way of working. To allow change, to deliver a planned work programme, this way of working needed to be un-frozen to meet a delivery ambition of integration. Analysis of the UK's highways construction sector workforce suggested that this status quo could result in failure of the planned programme to deliver sufficient productivity improvement. Primarily because of a visible skill demographic 'time-bomb' combined with slow or no investment in supplier innovation to unlock this paradigm. This issue was confirmed by independent reviews of construction, seen in the Farmer review (Farmer, 2016), the Nichols reports (Nichols, 2007, Nichols, 2021, Nichols, 2017), and various reports by Infrastructure Projects Authority (IPA, 2014) and National Audit Office (NAO, 2017).

A particular problem for highways has concentrated in the delivery of regional investment projects or operational capital enhancement schemes. A new procurement model was needed, before expiry of *Collaborative Delivery Framework*, in March 2019.

This conundrum is described as two issues:

1. Can a new choice architecture change productivity behaviour and improve outcome performance?
2. How to find suppliers capable of embedding productivity change sustainably across design and delivery ecosystems.

1.2 Defining the problem

The growing government ambition to improve England's strategic road network and speed economic growth focused in 2017 on investment in transport infrastructure (Transport, 2017). This focus on the road network and highway construction created a critical mass of activity. As productivity in construction has all but stagnated in the last half century (Renz and Zafra Solas, 2016) a shift was needed in how transport infrastructure enhancement work is bought and delivered. This shift would allow the sector to meet the expectations set for it as a condition of continued investment, closing in on the productivity opportunity.

As trading agreements have evolved the impact of learned behaviour caused large-scale regression to a mean, based on the availability heuristic. This is exemplified by the highly specialised technical workforce and control exercised by professional institutions. Profit margins in the construction industry are typically around two to three percent (Corey, 2011), which leads to a low appetite for risk taking through innovation.

Poor productivity, output per worker, has been well known and defined since the mid 1940's (Simon, 1944, Egan, 1998, Latham, 1994), with insufficient change. The industry has regularly initiated focus and action groups such as the Construction Leadership Council, Get It Right Initiative, Civil Engineering Contractors Association, and Sustainable Supply Chain School to increase capability, to improve productivity. All these organisations were progressively initiated to address the same problem and, while making incremental changes, have concluded that change must be driven by the

way clients procure for productivity. The researcher considered the issue of change driven by the client's procurement and how this could be used to change practitioner behaviour. The drive for change must incentivise a shift. The shift needs to be in behaviour away from habitual practices across the sector which constrain productivity improvement. Changing the procurement model to remove perceived and actual constraints on productivity improvement by combining behavioural economics and construction economics did not appear to have been considered previously in historic procurement models.

There is widespread rhetoric in transport infrastructure construction markets articulated in numerous reviews sponsored by government (Gruneberg, 2019) with no meaningful shift in productivity.

Construction focus continues to be 'on time, and within budget' continuing to miss the main point in production thinking of customer pull. Other industries experiencing triple digit growth have focused on 'end user value', and 'failing fast: learning quick', as well as operational strategies (Syed, 2015).

The defined investment in the UK Roads sector, aimed at economic growth, presented a unique opportunity to change procurement to realise productivity growth ambitions. As highlighted by delivery organisations and their productivity improvement initiatives, in a competitive environment the client's procurement model sets the boundaries for activity.

In response to this the focus of this research is to develop a procurement model as the primary enabler to improving productivity. This research includes reflective practice (Schön, 2017) and action research (Erro-Garcés, 2020) amongst professionals in the highway enhancement construction market. It will review elements of construction productivity, from inside and outside highways, and review wider academic literature. It will review current practice to determine what works and what does not. These reviews will be designed to determine the behaviours brought about, or expected, because of current procurement models that constrain productivity. Reviewing existing highways

construction behaviour and assimilating it to behaviours experienced in other infrastructure may highlight areas for change.

It will then build the parameters of a solution using facilitated modelling. This will capture practitioner contributions to develop the boundaries of ambition and finally develop and build a new procurement model. Using a select team, the model will be tested before deploying it into a live market competitive tender with the aim of awarding Framework contracts to successful bidders. The deployment of the model into a live tender, under which the market can commit to a new way of higher productivity working, will determine if the improved procurement model is accepted by the market and offers benefit. Further research can focus on the success or otherwise of the changes designed through this research.

Highways England faces a unique market segment problem when undertaking highways enhancement and highways operational capital replacement schemes. Research will review detailed confidential reports (Josten, 2017), McKinsey (MGI, 2017), PA Consulting (Constulting, 2018). These contain practitioner experience and anecdotal evidence of potential causes of low productivity and high process waste. Research will identify the potential for significant productivity improvement. Referencing civil engineering practice over the last 30+ years it will reference recognised productivity constraints from across civil engineering infrastructure not just those confined to highways (MGI, 2017). It will examine previous attempts to improve construction outcomes, especially in highways, and identify themes to constraint (Nichols, 2021). It will identify how underpinning theories might contribute to a fresh and disruptive approach to a recognised problem.

The key to productivity transformation, as evidenced by other industries (MGI, 2017), is:

- Recognition of, and learning from, failure
- Innovation in technique
- being value driven

- not using input-based performance metrics.

As the highways supplier market is small normal manufacturing market forces do not apply in the same way to drive down price.

Because the highways construction supplier market is small, unlike manufacturing, competition is not achieving transformative change in productivity. So, to drive productivity improvement the question this research sets out to answer is:

- *What form of new procurement model needs to be developed to use with the existing UK highways construction market, that will accelerate improvements in productivity of project design and delivery ensuring greater predictability of outcome?*

1.3 Aim and Objectives

The application of this research will establish a new procurement model. It will be designed to improve productivity in major infrastructure highways enhancement projects. It will focus on the potential for changed choice architectures to counter cognitive bias. It will apply behavioural economic thinking within a recognisable construction contracting model to test and deploy into the market.

To describe this the aim is:

> Develop and deploy a new procurement model with unique choice architecture to motivate a change in decision making in the existing market hierarchical ontology to achieve tangibly higher productivity.

1.3.1 Objectives

To deliver the aim the research objectives are:

1. Establish the current state of practice, evaluate its performance, and define the problem.
2. Establish the current state of knowledge around cognitive bias in those areas that could help shape the new model.

3. Develop a prototype new high productivity procurement model.

4. Evaluate the model prototype, modify, and publish a new, higher productivity, procurement model.

5. Deploy the new higher productivity procurement model.

1.3.2 Structure of this thesis

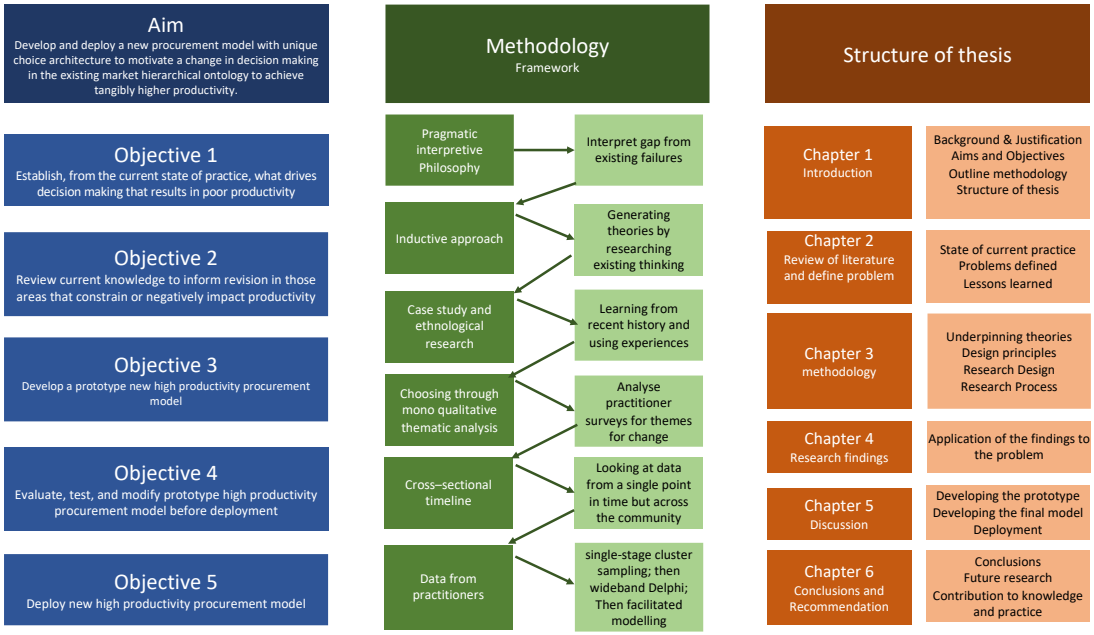


Figure 2 Research process map

This structure articulates the aim and objectives of the thesis and shows them transposed into the methodology. This takes the aim fragmented into objectives and then structures the work to achieve the objectives into a progressive and logical framework mirroring Saunders 'onion' methodology (Saunders et al., 2016). This was chosen because it shows how the philosophy used pragmatism to interpret existing performance of procurement models in the highways market to identify potential value and productivity eroding gaps. This gap analysis forms the basis for identification of theories which might provide innovative approaches to address the gaps. By adopting a series of case study approaches based on ethnological and auto-ethnological examples, the potential to apply these theories to the gaps was researched. Data from a cross sectional mono-qualitative study of the highway construction community was analysed in a single stage cluster sample to create problem

statement. Using 10 functionally unique wideband Delphi workshops, panellists estimated the impact of potential improvements to identified gaps, supported by case studies, and evidenced through data analysis. Using the outcome of estimated improvements, a select group of practitioners participated in facilitated modelling, in three workstreams, to create a prototype procurement model that address the gaps.

The structure of the thesis then moves logically through each chapter using the content to build from theory into prototype, through its testing and assurance into deployment of an artifact. The thesis concludes with a discussion on closing the gaps in value delivery and improved productivity. It records how this achieves the aim and makes recommendations for future research that might follow on as the outcome of this thesis.

2 Reviewing literature to refine the problem

This review of the UK highways construction sector considers antidotes to poor productivity from four perspectives. The client; UK government for this strategic asset class; external opinion from institutions; industry think tanks; and practitioners. The review then moves onto looking at new thinking considered relevant to productivity improvement from public asset investment.

Practice reviewed relates to commentary on infrastructure since 2010 as most representative of major highways projects. Opinion from other types of asset ownership or the built environment, whilst informative were considered either too remote in chronology or dissimilarity in the challenges that exist.

2.1 Client Perspective

Clients in the public sector are constantly challenged to achieve value for money in their use of public funds. In HM Treasury's *Managing Public Money* (HMTreasury, 2018c) there are a series of fiduciary duties bestowed on accounting officers to control the way money is used. This is supported by a series of guidance documents from the Infrastructure Project Authority, central to which is *Transforming Infrastructure Performance (Smallwood, 2021b, IPA, 2017)*. Within all public funded projects the UK Government has for a number of years, urged the construction industry to achieve greater levels of productivity and has more recently been driving for Fairer, Faster, and Greener outcomes from its investments (Gov, 2020).Ever since HM Treasury published its first *Transforming Infrastructure Performance* (IPA, 2017) it has been calling for the construction market to close the production gap evident at a macro level between manufacturing and construction.

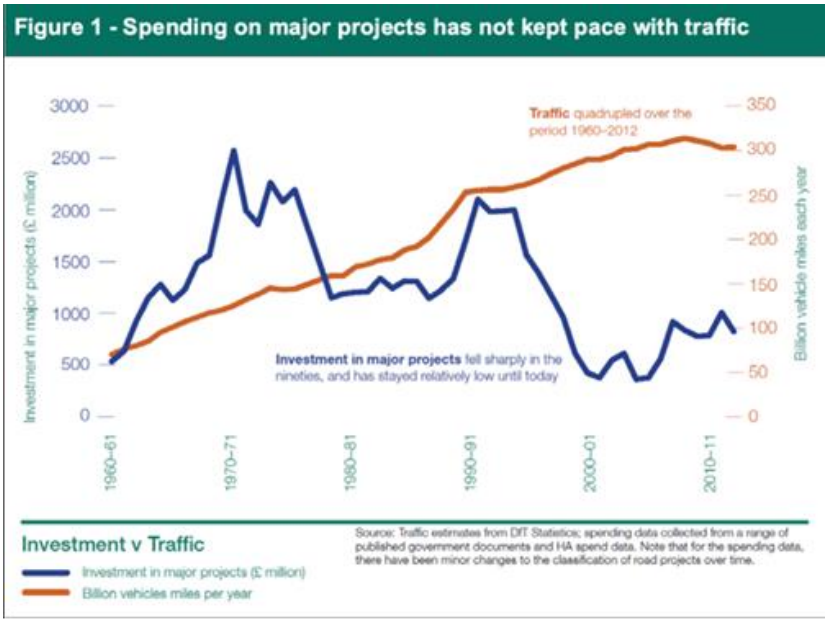


Figure 3 Spending on Major Projects (IOG 2014)

2.1.1 The Political Economy of Infrastructure in the UK – Institute of Government [2014]

With gross underspending in the UK road network from 1997 through to 2014, how to unlock investment and boost economic growth was a question explored by the Institute for Government (Coelho et al., 2014). This paper suggested that public infrastructure investment in the UK created productivity constraint caused by annualised funding and bureaucracy. It explored the cause and identified some UK sourced innovation from large scale infrastructure projects as well as some international innovation. The paper focused on policy level of infrastructure investment and not the mechanics of delivery. It built on a report commissioned by the UK Government from Alan Cook (Government, 2012), recommending a highways investment strategy should be established to decouple long-term high value complex roads infrastructure investment from annualised funding.

Whilst not pivotal, this paper indicated an undercurrent towards a change in the way highways investment policy could shift. It was representative of several thought leadership pieces on infrastructure (Coelho et al., 2014) indicating to government that more efficient growth required radical reform in management and funding of infrastructure asset ownership.

2.1.2 Roads Reform [2014]

In response to the *Cook review* (Cook, 2012), the Department for Transport published *Transforming our strategic roads* (Transport, 2014) indicating a direction of travel and its intention of: '…changing the way, the strategic road network is managed and run.' by:

- Establishing a new, long-term 'Road Investment Strategy' [RIS], setting out a sharp vision and a stable, long-term plan for the network.
- Transforming the Highways Agency into a government-owned strategic highways company, able to operate more flexibly and efficiently and develop into a world-leading road operator.
- Putting in place a robust system of governance for this company, ensuring that ministers set the strategic direction for the network, giving the company the autonomy to run the network on a day-to-day basis, while ensuring it can be held to account for its performance in running the network in the public interest.
- Setting up an independent watchdog and monitor, to represent the interests of road users, and to monitor and improve the performance and efficiency of the company.
- Introducing legislation to underpin these reforms, creating the legal framework for the reforms, and providing a solid foundation that puts highways investment on a stable footing like other sectors.'

This review recognised challenges faced by infrastructure in general, but specifically in highways to implement efficiency through structural reform. No meaningful movement in delivery productivity had been evident since *Constructing the team* report (Latham, 1994) or *Rethinking Construction* (Egan, 1998). In setting a direction the Cook's report noted:

> *'Stop-start funding: short-term changes to annual budgets and the lack of a long-term plan create an unstable delivery environment for the agency and its supply chain, making it difficult to deliver efficiently. This hinders their ability to plan, slows delivery and increases costs, for example by preventing the agency from entering lower cost long-term contracts with suppliers. Recent evidence shows inefficiencies in the current system of 15-20%.' (Government, 2012)*

The Roads Reform (Transport, 2014) set out the way for government to establish Highways England as an arm's length body under the Infrastructure Act (UKGovernment, 2015). It set the expectations of government in partially releasing it from hard-line government departmental annualised funding and investment constraints.

By signalling its intent the UK government, through the Department for Transport, created an expectation of how England's strategic roads network could operate to stimulate economic growth. This was the basis for a radical sector change. In its first five-year roads period Highways England was challenged to deliver a 3:1 benefit to cost ratio (HMTreasury, 2018a) whilst developing capability to achieve a rationalised set of commitments. The expectation for it to deliver more efficiently targeted ~£1.2 billion savings from an investment of ~£15.2biillion within five years. The ambition of *Road Investment Strategy two (DfT, 2020)* was to set a further ~£2.305billion of efficiency from ~£27.2billion of investment on top of the first road period's efficiency [1.5% year-on-year]. To achieve this network enhancements, being ~50% of the expenditure, must embody the ambition of the roads reform. To meet this challenge Highways England must release capacity in the market and create the right environment for improved productivity. This productivity improvement challenge was modest at 1.5% per annum, but over the foreseeable period of 25 years will realise a 45% reduction in cost.

2.1.3 Infrastructure Act 2015

In 2015, the UK government took decisive action in its ability to release capacity in the UK highways market. In the Infrastructure Act (UKGovernment, 2015), it established a licence (DfT, 2014) for its company, Highways England, to own and operate the strategic road network as an arms-length government company. In doing this it also established five-year investment cycles via a *Road Investment Strategy* (DfT, 2020, DfT, 2015) releasing highways investment from the constraint of annualised funding. The Act created a licence delegating authority necessary for the effective ownership, operation, maintenance, and enhancement of the network. With it came an enhanced expectation of capability to meet current and future strategic road network demand. In line with

treasury funding requirements for the management of public money, publicly funded investments must meet value for money criteria set out in the *HM Treasury Green book* (HMTreasury, 2018a). This defines what benefits contribute to value when investing public money for highways infrastructure enhancement.

By empowering Highways England as an arm's length organisation, the Act represented the government's ambition to accelerate productivity and efficiency in running major infrastructure assets. However, establishing the company and the ambition of the Act were not aligned. The first road period was designed as a period of mobilisation but still contained a serious stretch target and reputation building commitments.

The delegated powers under the licence agreement are specific and designed to create capability and capacity in the highways market. Highways England was challenged to organise its supply chain to respond to this unfamiliar environment, controlling threats to economic growth and realising opportunities offered by the licence. A five-year cycle of funding agreement, as recommended by Alan Cook in *A fresh start for the Strategic Road Network* (Cook, 2011), allows for portfolio management of programmes of schemes as recommended in *Portfolio, Programme, and Project Office Management Maturity Matrix* (OGC, 2006). Any new procurement model should allow for this and optimise outcomes as a result.

Under its licence Highways England has delegated powers for tier two schemes [under £500m]. This is designed to allow more agile decision making. Any new highway enhancement procurement model must be designed to realise capacity and capability in the market and create the right environment for improved productivity by incentivising value improvement. This would, if captured, improve effective decision making and lead to enhanced value capable of being used to incentivise the market against the asset owner's core objectives and investor performance targets.

2.1.4 Improving Infrastructure Delivery: Project Initiation Route Map [2016]

Infrastructure UK was a HM Treasury sponsored group of government and infrastructure practitioners. Its mission was to consolidate and promote industry practice from across infrastructure to enhance economic return from publicly funded investment.

HM treasury, along with Infrastructure Client Group commissioned a publication in 2010 called *Infrastructure Cost Review* (UK, 2010). In it the reviewers investigated the principal reasons for excessive cost across the major projects landscape concluding that a substantial number of projects were failing because of unsuitable project initiation. The National Audit Office (NAO, 2011) published a consolidated view of its findings from major capital scheme audits in which it too determined that project initiation was a critical part of a project cycle most likely to improve outcomes.

Infrastructure UK's review called for industry to urgently develop an implementation plan. The *Project Initiation Route Map* (IPA, 2014) resulted. Infrastructure UK identified that clients, in assembling a project, focused on meeting various governance process criteria but failed to focus on necessary delivery environment risk evaluation. This often resulted in schemes being procured and delivered using a convenient route to market and not necessarily the correct risk-based route. This was also noted in the *Nichols report 2017*, point 8.(Nichols, 2017)

Consequently, schemes often did not reflect best value for money for investors. Convenience led to significant cost and time overruns and very rarely offered asset solutions to meet the needs of the wider community. In 2013, the National Audit Office issued a report *Over-optimism in government projects* (NAO, 2013) that reinforced its earlier conclusion. The closeness of these reports and bodies publishing them [HM Treasury as investor and National Audit Office as auditor] is considered to reflect consistent issues at a point in time, from two aligned perspectives with a common intent: value for public money.

In response to this shortfall in planning major schemes, Infrastructure UK recommended a decision tree form of route map to drive better project outcomes focusing on three main themes.

1) Assess complexity using a consistent base assessment tool,
    a) Is it a new venture for the organisation?
    b) Is it like previous but more complex?
    c) Is it the same complexity but an innovative approach?
2) Assess capability using a consistent assessment tool,
    a) Sponsor
    b) Asset manager
    c) Client
    d) market
3) Align for success from the outset by.
    a) Properly defining the outcome requirements
    b) Adhering to appropriate and robust governance
    c) Creating an execution strategy
    d) Designing the organisation to succeed
    e) Choosing the appropriate procurement route

Publication of an overview handbook, and comprehensive route-map modules, to enhance participant understanding established this as a cornerstone of UK infrastructure mega and major project delivery.

In assembling these generic exemplar guides, Infrastructure Project Authority informed and equipped infrastructure clients to meet an aspiration of its 2010 infrastructure cost review. It commented,

> *"…find ways for government and other infrastructure providers to work effectively with the construction supply chain to develop new business models that will improve productivity, achieve better supply chain integration, and promote innovation. Addressing these issues effectively will help reduce the costs of infrastructure and deliver significant benefits in performance and value for money. There is a clear opportunity to realise savings of at least 15 percent,*

which can deliver sustainable benefits of £2 to 3 billion per annum. This is £20 to £30 billion over the next decade." (UK, 2010)

Infrastructure Project Authority's *Project Initiation Route Map* (IPA, 2014) supplies guidance on the principles of undertaking a series of pre-development reviews in all project cycles. Project initiation is central to knowing what is being bought and how to buy it. Clarity on these issues enables clients to better equip supply communities to understand how best to align capability to meet project aims effectively. This shows a deficiency also spotlighted in Highways Agency's approach in the *Nichols Review* (Nichols, 2007).

Project initiation stages contained in the route map are undertaken in a linear series to achieve an efficient outcome. First is understanding each delivery environment's complexity; by analysing it against a set of 27 considerations. These have been categorised into either low, medium, or high threat enabling a project's delivery environment complexity to be given holistic consideration. This pre-emptive assessment sets a direction of travel for following stages and informs expectations.

This 'decision-tree' style route map is designed to encourage a project owner to make decisions on a risk basis to optimise protection for an investor throughout delivery.

This work has been adopted by Highways England's principal investor and funder the Department for Transport. However, it had not immediately been adopted across the supplier market. Highways England in response must build a risk-based project assessment tool for larger scale schemes to determine the optimal route to market. The decision to design and implement this is driven by investment and procurement assurance group recommendations from the Department for Transport. If adopted, it will strengthen predictability of schemes by informing project management teams of threats and opportunities requiring action. This information should increase success in exceeding investor expectations.

Project initiation on highways schemes may result in assessment of low complexity in many cases. However, there is a significant benefit to making assessment of capability and concentrating time

and effort on definition of requirements. It could also be used for reviewing and observing governance as well as creating execution plans and project organisations for success. This plethora of publications between 2007 and 2018 relating to project costs, and project initiation, highlights that this issue has been front and centre of governments collective project investment thinking for more than ten years.

Translation of these issues into active threat management, to achieve scheme budgets, timescales and quality while managing reputation, will be a significant benefit if it results in more predictable scheme outcomes.

2.1.5 Nation Infrastructure Delivery Plan 2016-2020 – Infrastructure Projects Authority [2016]

HM Treasury's Infrastructure Projects Authority (IPA) generated the *National Infrastructure Delivery Plan* (IPA, 2016) predicting investment between 2016 – 2021 with an intention to invest in total over £100billion. This infrastructure wide coordination plan signals the overall investment its supplier market needed to prepare to service. It highlighted that collectively the announcements of the government set in train a significant infrastructure operation, maintenance, renewal, and enhancement programme for all strands of key national assets. The investment delivery plan was designed to boost national economic growth through effective investment in infrastructure overseen by the IPA. Its role was described as:

> *"The new organisation is better placed to measure and improve the performance of major projects, to intervene earlier and more effectively through robust assurance processes and to ensure projects are set up to succeed with properly tested plans. It will continue to build and maintain the government's own project management profession and capability, for example through the successful Major Projects Leadership Academy."* National Infrastructure Delivery Plan (IPA, 2016)

In drawing together all public finance announcements the plan sought to highlight the government's priorities, identifying how these investments generate economic growth. In the context of overall UK investment, the plan identified strategic roads as a major recipient of public funding. Putting it high on the government's priority list for generating economic growth,

substantiating its establishment of Highways England as an arm's length body. It also signalled bringing the ownership of the strategic road network into sharp focus of road users, by government's longer-term ambition to fund road schemes using a road investment fund linked to vehicle excise duty. This reinforced an ambition to create a closer relationship between road customers, tax payments, and the performance of the asset licence owner.

The plan reiterated the governments ambition to use the strategic road network to generate growth and its importance to economic sustainability. The plan reinforced previously made commitments to long term road investment and measurement of outcomes against a series of five-year investment strategies.

The National Infrastructure Delivery Plan highlighted several aspects to the governmental ambition to create value; be more accountable to the customer; be continually improving efficiency; and be ever mindful of its impact on the environment and its neighbours. The intention of the government is explained as not only to use road investment to stimulate growth, but to eventually link road investment directly to customer paid road tax. This link accentuates the connection of cost and benefit, generating a heightened desire to be able to prioritise expenditure based on customer value. This created a need for future enhancement procurement models, especially for regional investment, to have value creation through effective decision making as a key feature.

2.2 Other Government guidance and constraints

2.2.1 Public Sector Contracts Regulations

All construction work funded by public money is governed by requirements of a statutory instrument for public procurement - the *Public Contracts Regulations* (Government, 2015). These conditions constrain design and implementation of tender and contracting documentation. They also set requirements for the status of projects being tendered by publicly funded organisations. This instrument includes information that defines rules on activity and commerciality around

procurement as well as exclusions and constraints. It also sets out conduct of tendering for contracting authorities as well as performance requirements and processes that must be followed in reaching award of a contract. As a UK instrument, in 2017, it reflected European regulation and is subject to consistent spend thresholds (Dallas, 2018) that determine the applications of some practices. The conduct of contracting authorities also covers provision of feedback to successful and unsuccessful tenderers. In large part it reflects expectations of European contracting regulations and is considered unlikely to change because of UK's subsequent departure from Europe.

These regulations apply to Highways England. Investments in its strategic road network are approved based on an obligation to adhere to these regulations. Any proposed new contracting or tendering model is scrutinised, by legal experts in *Public Contract Regulations*, based on extensive precedent in interpretation. Tenderers can expect that, if followed, the regulations guarantee a fair competition. If in the process of a competition a deviation, from a process determined by regulations is detected, a tenderer can mount a challenge based on process unfairness. In considering new contracting or tendering model options clients are acutely aware of the threat to programmes of work posed by such a challenge. If made, a challenge will incur six to nine months at best and 12-18 months at worst, schedule delay and potentially significant reputation damage to a client. For these reasons extreme rigour is given to tender plans and documentation prior to issue of invitations to tender, especially those based on new delivery models.

The Public Contracts Regulations (Government, 2015) provides a framework within which Highways England must operate. However, there is latitude to improve outcomes of procurement. Several components, while necessary, are left to the Tendering Authority's discretion. In making judgements around these components, Highways England has a legal subject matter expert review process in place to protect itself from risk of challenge.

Components Highways England determine are:

1. Scope of tender and timescale its open for acceptance

2. Duration of tender and evaluation periods
3. Reimbursement or not of unsuccessful tenderers
4. Extent, media, format, and content of return documentation required,
5. Quality / Price evaluation split
6. Quality questions and weighting
7. Commercial structure
8. Financial workbook structure and evaluation mechanism
9. Contract duration, structure, and particularisation
10. Extent of feedback information more than minimum requirements

In normal, non-complex major projects circumstances, a formal tender process takes between nine to twelve months to complete and is implemented against Chartered Institute of Procurement best practice. A typical £100m project is estimated overall, when combined client and market cost of a standalone open tender are taken together, between one and four million pounds. Any new model should be designed to minimise these costs and contribute to the overall Road Investment Strategy efficiency target. A new procurement model might consider leveraging any initial tender and subsequent performance to allow allocation of future work rather than implementing secondary competition, a noted constraint in predecessor delivery models.

2.2.2 Use of Public Money

HM treasury, as part of UK Government, has a set of rules when *Managing Public Money* (HMTreasury, 2018c). The rules contain an expectation around commercial and ethical use of public funds in creating wealth and growth for the UK economy. The document, as issued and amended from time to time, is applicable to all employees of the government and its arm's-length companies. It explains.

'…standards expected of all public services; honesty, fairness, impartiality, openness, accountability, integrity, transparency, and objectivity carried out in the spirit of, as well as to the letter of the law in the public interest, to high ethical standards, achieving value for money, accuracy, and reliability.'

Managing Public Money (HMTreasury, 2018c)

As a government owned company using public funds this document applies to all officers acting on behalf of Highways England in delivery of network enhancement schemes. It is therefore a cornerstone of any new procurement model constructed for network enhancement.

2.2.3 Evaluation of Benefits when spending public funds

Public funds are deployed by Government to generate economic prosperity and growth (Abadie, 2015). HM Treasury published its *Green Book* (HMTreasury, 2018a) in 2003 with subsequent updates, to set a standard for evaluating value for money. This sets out guidance, to all public-sector bodies, on how proposals should be appraised before significant funds are committed – and how past and present activities should be evaluated. It… 'incorporates revised guidance, to encourage a more thorough, long-term, and analytically robust approach to appraisal and evaluation.' *Green Book* (HMTreasury, 2018a) It is relevant to all appraisals and evaluations.

In 2011 HM Treasury issued the *Magenta Book* (HMTreasury, 2011) to set a standard for evaluating benefit from investments. In 2015 a review by Major Projects Association *Determining and Delivering the Benefits of Major Projects* (Association, 2015) assessed how processes for post implementation evaluation reflected the pre-investment assessments of value. It recommended adoption of the *Magenta book* and concluded that there was room for improvement, not only in the way that consultation and engagement pre-investment was undertaken and assessed, but the need for wholesale improvements in undertaking post implementation reviews.

All UK highways scheme investment is subject to a value for money evaluation prior to each decision stage and to a one and five year post operational performance evaluation. To date responsibility for value measured as a derivative of benefits realisation compared to cost has resided in Highways England as the asset owner and developer. To realise an ambition to involve suppliers in design and

associated value-based decisions around the solution, careful consideration should be given to using incentivisation models incorporating value in any gain-share mechanism. Value must be consistently measured throughout development and delivery. Highways England alone carries investor liability to evaluate post completion based on contemporary measurements. Any delta that may exist at each evaluation, in some cases ten years after the initial evaluation, cannot be transferred through a procurement model.

2.2.4 Aligning incentivises - Common goals

Right from Latham's Report in 1994, following in its predecessors' footsteps in 1940s and 1960s (Gruneberg, 2019), the construction industry, and these observers, have known a foundation stone of performance is the alignment of common goals. This was articulated by Latham as *Constructing the Team* (Latham, 1994). It highlighted a need for 'the team' to have consistent outcomes focused on end user value. Commentators since Latham, to recent reviews by the National Audit Office into performance of government construction activity, have noted the same thing. Simply, that a key contributory factor to change in performance is a client's ability to articulate its objectives and wants clearly enough for suppliers to focus, reduce waste, and provide better value for money.

Feedback from practitioners indicate that clarity of objectives for client, designer and constructor is a fundamental requirement to improve highways projects. This is emphasised in different language in *The Nichols Report* (Nichols, 2007) as a need for clarity of purpose, identification and visibility of benefits, and ambition to move focus away from price and on to quality of outcome.

This is also clear from comparisons made with the automotive sector where focus on "value add to the end product" and "customer delight" is such a high priority. We can see the themes of Latham and Egan remain unresolved even in industry wide conferences such as the 2018 Constructing Excellence with Building Research Establishment conference called *20 Years of Rethinking Construction* , and in its industry, review *Never Waste a Good Crisis* .

2.2.5 Defining value

Throughout the last century UK construction has been examined by commentators with some of its leading thinkers attempting to articulate key ingredients that will springboard change in output and productivity. It is no coincidence that in every relevant report and every review, including a bespoke and specific highways sector review in 2017, one consistent message comes through loud and clear.

'Value-based decision making is leading to better outcomes' the Construction Innovation Hub (CIH, 2021).

Without it a delivery team is left to focus solely on an asset's cost and, as a result, that becomes the measure of success, '…on time, budget, to the right quality' (Flyvbjerg, 2017a).

By understanding value, in investor, customer, and social value terms, success can be redefined. When an investor decides to invest, be it government or private sector, it invests against a backdrop of beneficial outcome. Without this a client's ability to measure impact of decisions in development, design, and delivery against the defined benefit model is hampered. The client cannot identify if it enhances or detracts. It cannot determine if a change by the appointed integrated project team is enhancing value.

Infrastructure and Projects Authority, in *Transforming Infrastructure Performance (IPA, 2017),* proposes an investment scorecard at inception and options stages of a project. A baseline for investment decisions and controlling development and design within a procurement scorecard that improves outcome by procuring what an investor sees as valuable in the simplest format. This is a critical and a transformational change that should be included into any new procurement model.

2.2.6 Customer focus

In development thinking throughout the last 25 years construction has been increasingly focused on the end user, its ultimate customer. Right from early thinking in Latham, referencing 'customer delight.' (Latham, 1994) in the automotive sector, commentators have been trying to get

construction to focus on asset user value, not asset delivery value. Productivity is, in its rawest sense, resource needed to deliver an outcome, be it product or service.

A revision to focus on 'exceeding investor's expectations' could be used to realign productivity to customer value and client objectives. [In this case customer is any road user.]

This triangulation of purpose is a missing link to this long running puzzle, of productivity through behavioural change. Any new model needs outcome reassignment from, delivery tangibles, to customer tangibles. Do not measure how cheap or how fast; measure how effective to meet the customer value objectives.

In undertaking any network enhancement, as a responsible owner, Highways England is endorsing disruption of its network. It grants access to a delivery partner to undertake the enhancement. In doing this it has to align the objectives of its customer, delivery partner, and its supply chain with available rewards by answering the following questions.

1. what is necessary as an enhancement?
2. What's optimum disruption?

To focus suppliers on this any new incentivisation model, in both gain and pain, might consider being up to 80% focused on customer to change the tangible focus to customer value.

2.2.7 Behavioural Insights Toolkit

In 2011 the Department for transport, in association with Government Social Research unit, published its *Behavioural Insights Toolki*t (O'Rilley, 2011). This, built on Government research Units *Practical guide to behavioural change models* (Darnton, 2008) and GCS's *Guide to communications and behaviour change (Aiken, 2014) ,* it provided guidance to transport bodies on how to influence traveller, or user [customers] behaviour in the use of its assets. While focused on customer groups the research into behavioural economics and insights to achieve policy outcomes stimulated awareness into the potential for greater levels of nudging traffic behaviour. Many of the theories, principles, postulations, and strategies can be applied equally to people engaged in infrastructure

construction. Recognition of rational choice theory planned behaviour theory, interpersonal behaviour theory, and Attitude – Behaviour – Context [ABC theory] (Tan, 2011) is as applicable in the work communities as communities at large. A considerable proportion of the negative behaviours exhibited in Highways England's study from Collaborative Delivery Framework were formed as Habits. These manifest in a confirmed community as 'custom and practice' and as a result elicit cognitive dissonance which paralyses the community and prevents it from kicking the habit. When, as in the case of the highways construction sector, that habit is waste, there is a catastrophic and damaging impact on productivity. As with the habits of road users to opt for the use of a personal motorised vehicle, instead of say cycling, this leads to all sorts of social norms which further embed the behaviour and is extremely hard to change through policy or trading agreements.

This toolkit goes on to review the existence of sociological theories [social practice theory (Darnton, 2008)], in the habits of travellers, and road users. It describes the need for an individual to make personal decisions which appear to be free will, but which are overtly influenced by the choice architecture of socially acceptable ways of travelling. These are defined by the social, and cultural conditions within which the choice is made.

One interesting theory referenced in the toolkit is that of the principle of 'moments of change' (O'Rilley, 2011). This is when the conditions have been reorganised, actors have a different driver, behaviours are being questioned, and the context is shifting. As these factors converge the ability to shift the behaviour of a culture, and its habits exist and create unparalleled opportunity to realise the desired benefits. The journey of changing the infrastructure construction market to behave in a unique way has been estimated to be 15 to 20 years throughout which there will be 'moments of change'. For a new procurement model to be effective these 'moments of change' need to be planned for, managed, and implemented effectively. The policy of the community has recognised these and communicated the clients' expectations effectively.

2.2.8 Applicability

Client bodies involved as national asset class owners, have been struggling with how to achieve greater productivity in construction for years. The UK government has, in this space between major projects and mega-projects, been advising and strategizing, again, for years. Principles, strategy, and theory is great advice for the sector, but it has not been translated into practical commercial or procurement models. It is evident that there is desire from the UK government, international asset owners and a latent willingness from the market to do this. However, no single organisation seems to have been able to translate this into actionable change. This pent-up desire for actionable change and investor stimulated margin improvement through improved productivity, starts to frame the problem. To be effective Highways England will need to plan its transition and recognise and model its 'moments of change' with key stakeholders to be successful.

2.3 External Reviews

UK's construction market has been aware of a need to transform productivity for some time. In 2017 McKinsey (MGI, 2017) undertook as worldwide review of infrastructure construction productivity. This report highlighted that in comparative timescales since 1960 the construction sector's productivity growth has all but stagnated and failed to even keep up with inflationary increases. Over the last 25 years several studies have reached similar conclusions. Even as far back as *Constructing the Team* (Latham, 1994) 30 recommendations seeking to galvanise the construction sector; domestic, commercial, civil engineering, and industrial markets, have been lingering. Latham provoked the industry to meet client expectations and improve productivity. It was the first time that the construction sector had been considered as a whole and not functional parts to consider improvements (Green, 2011).

Latham's call to action, albeit for the first time as a sector, said the same thing as Simon's report on the state of the industry post World War II (Simon, 1944) and *Placing and Management of Contracts for Building and Civil Engineering Work* (Banwell, 1964). All called for widespread change to

processes. Latham's report, as with its predecessors, reflected a frustration that industry rhetoric wanted transition to higher levels of performance but lacked capability to work in unison to achieve it. In calling for unity across the construction team Latham's report was part of a serious and widespread UK construction industry conversations. Despite significant improvements being made to organisation, and integrating the supply chain, (Annan, 2012) productivity in construction has stubbornly remained below ten percent. Stuart Green, in *Making Sense of Construction Improvement*, (Green, 2011) explores the fragmentation, and silent sources of stagnation, highlighting the underlying issues despite how this market has changed in 30 years.

Originating from Latham, all government highways work is consistently undertaken using NEC forms of contract. As a direct result of Latham seeking to create consistency in the government and infrastructure market, Highways England is a member of Infrastructure Client Group (ICG) and following its practice of regularly selecting suppliers using a split of quality and price to differentiate capability. Latham's report influenced construction processes mechanically but, as with its predecessors failed to change behaviours towards enterprise, the hardest thing to do.

2.3.1 Farmer Review (2016)

Mark Farmer, Chief Executive Officer of Cast Consultancy, was commissioned by The Construction Leadership Council to look at critical labour issues facing UK's construction market. His report, *The Farmer Review; of the UK Construction Labour Model: Modernise or Die, Time to decide the industry's future* (Farmer, 2016), sets out a stark message for construction.

Farmer predicated, as does a follow up Highways England specific report, that if volumes of work increase at predicted rates; work is done in the same way; and natural demographics around skills persist; there will be insufficient skills for a sustainable market. These variables are interlinked but not inter-dependant. If techniques and innovation, especially meta data management and design for

manufacture, take hold and are effectively implemented, work will be done differently. 'Done differently' means a need for different skills and potential to dilute what Farmer calls "a demographic time-bomb" with observations it is not now so much lurking but coming into full view.

Farmer provides a medical analogy concluding,

> *"The medical comparison is unfortunately apposite as this review concludes that many of the features of the industry are synonymous with a sick, or even a dying patient."*

Farmer laments that the root cause of the 'cliff edge' construction is teetering on can be annotated by ten symptoms.

Farmer's review, as with Egan, focuses on housing for its data. Highways England, prompted by this report, commissioned a diversity forum group to review highways construction suppliers, and alarmingly arrived at similar findings. In its 2018 status, assuming no change in working methods and existing resource profiles, highway construction was predicted to become constrained in delivering its ambitious enhancement programme: "An anticipated shortage of 55,000 workers in transport infrastructure (construction and construction engineering) is predicted by 2020" (Bond. S, 2018).

This is a serious cause for concern. It raised immediate questions around how innovative ways to deliver can be adopted, rapidly, through competition and with sufficient long-term support to

facilitate investment. It also poses the challenge to change the way construction work is procured and delivered prompting a change in the model used to secure capability.

Farmer's conclusions about slow technological take up, as a factor undermining productivity and therefore the impending resource time-bomb, is validated by an international review of construction by the World Economic forum. In its industry agenda paper; *Shaping the Future of Construction; A Breakthrough in Mindset and Technology* (Renz and Zafra Solas, 2016) it concludes,

> *"…it seems the entire world knows this is a problem but has limited ability to steer the ship away from the rocks?"*

Impending workforce constraints and unsustainable supply is a real and tangible concern across highways construction. In undertaking its own review of workforce, considered as a steady state supply community, Highways England identified a need for several definite, radical, and challenging actions.

1. Establish, and take soundings from, an industry wide equality, diversity and inclusion forum designed to inform attracting and retaining talent.
2. Design and publish an employment and skills maturity matrix to allow participants, including clients, to assess maturity in planning for a future workforce for targeted work.
3. Measurement of supplier performance in effective employment, skills, and workforce planning.

Future procurement models must include workforce-based performance indicators linked to incentivisation. Metrics should assess a supplier's appetite to mature employment and skills planning at pace. Any measurement should not be prescriptive, but relative based on self-assessment and self-targeting of pace to change and direction of travel. Working together, delivery models should influence a supplier to mature effectively and create a sustainable workforce for future programmes of work including for innovation and technological advances.

2.3.2 Nichols [2017]

Concurrent with a National Audit Office review of *Progress with the Road Investment Strategy* (NAO, 2017), the Office of Road and Rail commissioned Nichols Group to update its findings from 2007 with a *Sample based review of Highways England's major schemes* (CITI_Limited, 2017). Its report focused on Highways England's internal capability to achieve set objectives. It was commissioned to stimulate change at a midpoint of Road Period One if findings suggested that a better outcome could be achieved from increasing the pace of change.

Nichols Group, led by Mike Nichols, had undertaken a review of Highways Agency in 2007 (Nichols, 2007) levelling criticism, in a range of suggested improvements, at Highways Agency's inability to accurately estimate scheme outturn cost. Estimating accuracy was also later highlighted in reports from both HM treasury (UK, 2010) and National Audit Office (NAO, 2013).

Nichol's 2007 report focused on four key issues:

1. Estimating; there was a lack of cohesive data and inconsistent use of that data in estimating to give robust and predictable outcomes for major projects. The report called for a root and branch review and change to the way estimating was undertaken.
2. Risk management; was inconsistent and uncoordinated leading to unsatisfactory levels of risk identification and management.
3. Method of procurement; Highways Agency had adopted Early contractor involvement contracting (Managed Motorways) and was using the initial stages of Partnering contracts although their administration was still transactional. This was levelled at internal capability and calls for better capability in commerciality.
4. Delivery capability: in anticipation of an upsurge in work, called the targeted Programme of Investment, up-skilling of the internal capability was considered a critical issue.

Nichols 2017 report used sample schemes from Road Investment Strategy One, some overlapping from a targeted programme of improvements announced before Road Investment Strategy One. The findings of this review focused on.

Finding	Topic	Purpose
1	Project definition, scope;	defining what was to be built and why, the purpose of the scheme, lacked clarity restricting understanding of delivery teams.
2	Business case:	the review found good practice but inconsistency of application and use
3	Project development and management;	project control framework was consistently evident but inconsistently applied. Risk identification and management was inconsistent and not reflected in the estimating process. The capture and reflection of key assumptions expose programmes and capital portfolio to unmanaged and opaque risks. Opportunity management is inconsistent
4	Procurement process:	concerns relating to the use of collaborative delivery framework based on availability and not risk assessment of the delivery environment complexity. Concern around the adoption of 'templated' forms of contract in future procurement that do not manage business risks effectively
5	Statutory process;	good evidence of learning lessons around the development consent order process and evidence of a development consent order Toolkit
6	Estimating and investment decisions;	Cost estimating, and the investment decisions based off them, were found to be robust and satisfactory
7	Identifying and realising opportunities, efficiencies;	some evidence but a need to make efficiency plans visible across the business
8	Outcomes/outputs/costs/delivery variances from business case/baselines;	there are poor relationships between baselines and outcomes. The level of uncertainty and risk assumptions is unclear and causing frustration in an inability to accurately forecast, leaving portfolio management at risk
9	Linkage to RIS Performance Specification KPIs (key performance indicators) and PIs;	The immaturity of Road Investment Strategy one planning is manifesting in uncertainty of Highways England's ability to meet some of the Road Investment Strategy one commitments. This reflects a similar observation to that made in the

		National Audit Office review of Road Investment Strategy one performance
10	Wider portfolio, maintenance, and renewals	still evidence of major projects and operations acting unilaterally to the detriment of the overall business
11	Business enabling capabilities;	focuses on the inability of the business to recruit in a hostile market and highlighting the impact of an excessive buy rather than make decision
12	Lessons learnt;	good evidence that lessons are being learnt in pockets. Requirement to coordinate lessons and make them available across the community

Nichols 2017 report, and its predecessor, seeks to guide Highways England on its journey to a client able to manage and deliver a significant portfolio of work. In highlighting areas of strength and potential weakness, action plans inform improvement activity. Specifically, for Regional Investment Programme the second Nichol's review highlights some issues raised in a market wide review of practice. Finding one, three, five, six, eight and nine formed a platform to respond positively highlighting areas any new procurement model must focus on.

These reviews spotlight areas needing attention detailing what is working well and what a future procurement model needs to address. Without this distilled self-reflection it is often hard for a business to understand where to make effective change for good. The review highlights the areas for attention, as with most of the industry wide reviews before them. However, the review fails to provide any solutions to the perennial problem of stagnant productivity and embedded waste.

Any new procurement model must introduce a clear purpose for enhancement works to enable delivery teams to have a clear understanding. It is described by Nichols as '…defining what is to be built, and why.' Finding a way of reducing assumptions that expose programmes to risk is also an essential component of future procurement. This may be correctly allocating design responsibility, so assumptions are made by the party with commercial responsibility for delivery. Client decision makers must understand and create an environment where efficiency can be gained from clarity, and supplier teams can understand how, and where, to apply value engineering most effectively.

Procurement must relate baseline information to outcome. Achieving the baseline requirements for the budget is a fundamental component of outcome accuracy. *Highways England Performance report* (CITI_Limited, 2017)

The 2017 National Audit Office's review of Highways England's' performance acted as a catalyst for change in how schemes are procured and delivered. There are several significant factors contributing to potential success or failure of Highways England in meeting its Road Investment Strategy One commitments.

The reports ambition, in response to Parliament's desire to investigate and report on *Progress with the Road Investment Strategy* (NAO, 2017), established how confident Government could be in Highways England's performance. Moreover, whether it could be confident to delegate a second five-year investment strategy through UK Government Investments and Department for Transport under Road Investment Strategy Two.

This report was well received and considered to be a fair reflection of Highways England's first two years in operation. Its findings have been used as a stimulus for increasing pace of change in Highways England's capability.

There are in total eleven key report findings but highlighted here are the most relevant four:

1. Finding ten - Highways England is now reviewing its enhancement programme to improve value for money and deliverability, and make sure it is affordable.
2. Finding twelve - Highways England met its efficiency savings target of £33 million in 2015-16 but meeting its overall target of £1.2 billion over five years may still prove challenging.
3. Finding sixteen - Highways England is at an early stage in implementing systems and processes it needs to manage its enhancement portfolio effectively.
4. Finding seventeen - The Department and Highways England will need to ensure that risks are being managed effectively as the enhancement portfolio increases in scale and complexity.

The report focuses on Highways England's performance as a government owned company. Consequently, recommendations are targeted at the Department for Transport enabling Highways England to do what it is set up to do. Its recommendations assume Highways England can only improve performance if permitted by its shareholder representative to change how it works and how their relationship is managed. Of all the main recommendations just four are highlighted here as influential.

1. The Department and Highways England should agree an updated delivery plan for the remainder of Road Period One, including an updated programme of road enhancement projects that is deliverable, affordable and represents value for money. The plan should include:
    a. the latest cost estimates compared with available funding, and plans for how cost pressures will be managed; and
    b. a clear statement setting out the impact of this updated delivery plan on the work that is to be undertaken in Road Period Two.
2. When announcing the second Road Investment Strategy, the Department and Highways England should be clear about:
    a. which projects they are committed to, and which they intend to deliver subject to further development and analysis.
    b. the level of certainty around estimated costs, scope, and delivery schedule of the projects; and
    c. the impact on future road periods.
3. Highways England and the Department should ensure that the second Road Investment Strategy marks a step towards establishing a stable, rolling programme of investment. It might not be possible for this to be fully achieved with the second strategy, but the

Department and Highways England should have a clear long-term plan for achieving a smooth profile of capital investment in the road network.

4. The Department should re-evaluate its approach to the oversight of Highways England as the scale and complexity of Highways England's investment portfolio increases. The Department should consider:

    a. how it gains assurance about the affordability, deliverability, and overall value for money of the enhancement portfolio, including, for example, considering establishing a joint portfolio board like that which the Department now uses to monitor Network Rail's portfolio; and

    b. whether it and Highways England should monitor and govern large-scale, complex, and transformational projects outside its main portfolio.

This report was very influential in promoting a need for change. There were several issues relating to Highways England's ability to fulfil its obligations under the Road Investment Strategy One funding agreement. Some were focused on how the DfT established and managed Highways England, and some on how Highways England operates. The report noted any procurement model should be designed to respond to:

> *"…the latest cost estimates compared with available funding and plans for how cost pressures will be managed." Progress with the Road Investment Strategy (NAO, 2017)*

Models using a Budget incentivisation strategy as part of a programmatic contracting model might, if linked to appropriate behavioural decision-making stimulus, create a way of resolving this issue. In addressing

> *"…how it gains assurance about the affordability, deliverability, and overall value for money of the enhancement portfolio." Progress with the Road Investment Strategy (NAO, 2017)*

There appears to be a gap present in public sector construction infrastructure contracts as they fail to link incentivisation with improved value. Doing so would be unique creating an opportunity to resolve a long-term issue of connecting value to cost, first highlighted by Simon in the 1930s and later Latham in the 1990s.

Overall, National Audit Office's report, although critical, was helpful in supporting stimulus for change. This is important to this research as it establishes external support for a novel approach to trading and market engagement.

2.3.3 What is wrong with infrastructure decision making? – Institute for Government [2017]

This thought challenge (Atkins et al., 2017), prompted by the Institute for Government, identified six factors to poor infrastructure decision making in the UK. In what appears to have been an overlapping piece of commentary with the *National Infrastructure Deliver Plan*, the first finding was an uncoordinated investment plan. While this is an observational piece based on several case studies from high profile UK infrastructure projects there are several similarities from those observed from practitioners in Highways England's *Collaborative Delivery Framework (Cuff, 2015)*. Focus on the pace of a scheme through options and development into delivery has been identified as a source of misalignment. In highways it led to early contractor involvement as a solution. While well intended, the risk profile of agreements did not create an environment to hold contractors, responsible for early involvement advice, to account. The report also found that models determining benefits had a correlation between ambition and frailty of a model. It also identified that senior decision makers ability to understand risk was poor and more aligned to programme commitments than to reality. Of the last two observations, the first is a tension in project decision making relating to concentrated loser groups. Large schemes often attract highly vocal and influential protest groups that disproportionately influence the process, despite the impact on benefit of most customers. Last on its list of issues is the inability of large, long-term projects to harness lessons to improve future schemes. This is in part because of their duration. It is however also a consequence of transient

management from government where the people who start a scheme are never the people who complete it. This causes systemic knowledge loss. It was also noted by Flyvbjerg as stemming from bias, both cognitive and political in his papers relating to underestimating the cost of major projects (Flyvbjerg et al., 2002).

While focused on infrastructure policy making, all the findings from the Institute for Government's paper resonate in the highways sector. While the paper was side-lined by clients and the market alike it has some valid points. Its observations have been reinforced by several higher profile reports. This does not diminish the importance of the paper in coordinating the issues faced by continuous improvement of infrastructure decision making.

Future procurement of large-scale highways schemes to enhance England's strategic road network should consider issues raised by these papers. They concisely articulate the issues and explain them in the context of contemporary case studies.

2.3.4 Applicability

Numerous reports and findings from reviews and investigations have thrown up the same issue, no cohesion, active bias, and constraint of potential productivity in construction. The evidence is plain to see; a constrained talent pool, low diversity, poorly equipped resources, bespoke models for no good reason, cognitive bias; optimism around time, cost, quality and not value of work, poor decision making from policy makers and a dis-organised market offering poor visibility for investment. Whilst described as a 'time bomb' by Farmer, its more accurately described as a stagnant and unsustainable sector stubbornly regressing to the mean of working practices that require major systemic surgery. In short, the only thing keeping the market alive in its current form is the lack of disruptive innovation to act as real competition.

2.4 Practice - Previous procurement models

2.4.1 Managed Motorways Framework

In 2010, Highways Agency anticipated an upsurge in investment towards making network “hotspots” more agile and able to activate fourth lanes (the hard shoulder) as a running lane. Several trials were undertaken and following commitment to the initiative by Department for Transport, Highways Agency set up a framework of suppliers to design, construct, install and upgrade technology to manage traffic dynamically, according to demand.

The ambition was primarily to concentrate knowledge and capability in a select group of suppliers by procuring and operating a Framework as a programme of works. Agreements with suppliers were entered into using the New Engineering Contract Edition 2 (ECC) amended for specific client requirements and managed motorway scheme specifics.

During trials Highways Agency collected historic cost data and, by the implementation of a framework, considered it could reliably set a scheme’s Statement of Funds Available. This set the level of required investment and, given that cap, allowed negotiation with competing suppliers to reduce cost in its quest to improve value for money. The procurement model used was a form of target costing. Reliant on its historic knowledge of supply chain operation Highways Agency followed a 4-step process:

1. Set an expected budget
2. Seek a price from suppliers under secondary competition
3. Negotiate between budget and preferred supplier’s price
4. Set a stretch target price.

A significant factor in the ability of a supplier to achieve this stretch target price was quality of information relating to the preliminary design and any affected existing asset. In large part this was vague, incomplete, or poor and contributed to significant cost overruns. On several schemes, the

construction supplier was engaged on the same piece of network separately to act as managing agent for maintenance and renewal works and delivery partner for enhancement. In these instances, the supplier held more contemporary records of existing asset condition than the Highways Agency. During negotiation, the client's overconfidence bias took an optimistic view of existing asset condition creating an expectation gap and generating an opaque commercial risk within the agreement with the supplier. This was then counteracted by the supplier taking commercial liability of completion to target, with the supplier tending to operate under a pessimism and uniqueness bias.

An asymmetric set of information accentuated by diametrically opposed bias proved to be a major flaw in this procurement model and led to some, more complex, schemes being significantly overspent at final assessment (Mcintyre, 2018). Rather than working collaboratively in target setting, partly because of speed, Highways Agency chose to take liability for asset condition when it was not equipped to do so. Supplier commercial management of such schemes quickly resorted to large scale change management and, as a direct consequence of the tension from this data asymmetry to damaging and transactional behaviour.

The due diligence and price negotiation process employed added on average six months to Highways Agency's Project Control Framework stage five, detailed design, prior to *commitment to contract*. Contracts were exclusively entered into based on a Target Cost NEC2 (ECC) Option C, amended, form of contract.

The Managed Motorway Framework had at its core, an intention to collaborate, in mutual trust and cooperation (Clause 11, NEC (ECC)), but due to conflicting bias by the parties to the contract resulted in regular conflict. As the framework was designed and commissioned based on delivering a programme of similar works, it was designed to counter uniqueness bias providing an incentive mechanism related to repeatability and overall programme success called a Programme Level Incentive Fund.

The fund was, at framework level, managed by the client to drive performance over five years and contained a sliding scale of negative and positive incentives. The Client accepted a progressively greater proportion of overspend the higher actual cost went, and a sliding scale of reward for underspend went to a supplier achieving increasing efficiency by removing uniqueness. 50% of any underspend was retained in this fund. The fund was designed to act as a client risk pot against which it alone could manage overspend from an anticipated set of unknowns related to asset condition. Surplus cash from schemes underspending throughout the framework's five years could be used to balance schemes overspending, so protecting the suppliers and the client from surprises.

Realisation of surplus from this fund could be drawn down, 'on account,' by suppliers annually with reconciliation at the end of the last project let under the framework. One of the attractive features of this for the client was the joint accountability it brought to the programmes of works let under it. All suppliers could benefit if they collaboratively performed, but all had the potential to be partially protected if they individually experienced overspend on a scheme. A fundamental requirement for such a fund was that all participants act fairly and responsibly. In some instances, the allure of 'mopping-up' underspend to reduce an individual supplier's overheads on a defined cost contract, rather than have underspend go to a pot perceived to help competitors, proved too great for some. The model suffered from predictably irrational behaviour consequently leaving the parties at commercial risk. So, the incentivisation strategy was flawed by behaviour (irrational decision making) and failed to achieve its ambition.

The Project Control Framework and working practices, standards and regulatory controls were consistent across all schemes. However, from the lessons learned gathered from participants after the completion of the *Managed Motorways Framework* (9.2.1), asset condition data contributed to uniqueness bias on behalf of the suppliers and overconfidence bias in the client. Integrity of both client and supplier's actions was not common. This was accentuated when one supplier went into administration and the administrator no longer had relationships, community sustainability, or future work as balancing considerations.

The incentivisation philosophy appeared, by framework midpoint, to be successful and was cash positive. Suppliers were able to draw down significant shares of underspend. However, as this money was declared as unplanned profit, two unintended consequences arose:

1. Money was visible to shareholders as “super profit” and caused PLC supplier issues in shareholder expectations in following years,
2. As gain money retained the liability to the risk of future loss, by a supplier but also performance of all other suppliers, under standard management accounting practices it could not be taken ‘to book.’

Because of these issues otherwise well-intentioned incentives drove counter intuitive but predictably irrational behaviours. Some of these outcomes were contained in the review of Highways Agency performance in the Nichols Review (Nichols, 2007):

1. Framework organisations requested an ability to undertake work in unincorporated JV groupings. This spread threat and opportunity across as many schemes, from one supplier, as possible to influence as many schemes as possible in a convoluted attempt to manage extended risk despite the framework construct.
2. Schemes that might have otherwise gone into underspend were flooded with ineffectual and unnecessary defined cost labour and plant creating significant uneconomic working which proved almost impossible for the client to police. This ‘mopped up’ what otherwise would have been held by businesses as overhead not profit. By deploying resource across a range of schemes in joint venture, potential underspend was redirected into turnover and declared profit contributions maintained for shareholders. A secondary issue was the deployment of the same resource to multiple schemes meaning additional burden on the client to implement multi-project audits to avoid paying for every hour of such labour or plant multiple time.

3. This “mopping up” of underspend fund had a knock-on effect; causing schemes that went into overspend, and would have been supported from the fund, suddenly needing support from Highways Agency as prime funding on an escalating basis. This inevitably led to several schemes incurring not only scheme cost overruns, but programme cost overruns.
4. In drawing down incentive fund surplus at framework mid-term suppliers committed to hold a corporate risk of supporting schemes in overspend later. As with many programmes, easy schemes are first to be undertaken as they are easiest to organise but are also most likely to generate an underspend. Later programme schemes increased in number and volume and overspend increased with a diminished fund to support cost overruns leaving Highways Agency exposed.
5. Because suppliers were spread across all schemes in unincorporated joint ventures tracking, policing, and holding suppliers to account and combat predictably irrational behaviour was too big a burden for Highways Agency.

Cumulatively these behaviours lasted for eight to ten years due to the scale of trailing project completion dates. This subsequently prejudiced planned behaviour changes in the next set of agreements under Collaborative Delivery Framework. The limited market used by Highways Agency, and later Highways England, exhibited consistently negative behaviour. In effect this market had created a custom and practice (an availability heuristic) resulting in a behavioural social norm within its commercial community. The outcome suited the market but put Highways Agency at a significant disadvantage in containing expenditure within estimated levels of funding and negatively impacted how Collaborative Delivery Framework performed.

Managed Motorways framework focused specifically on changing three operative lanes into four lane enhancements inside existing network land ownership. While all works were undertaken by civil engineering principal contractors, 40% of work undertaken was to upgrade network technology to allow dynamic all-lane running. The extensive technology supplier framework contracts awarded by

Highways Agency and used for this were not involved or engaged in the incentivisation being used to change supplier behaviour. These relationships (Client / delivery supplier / technology supplier) exacerbated its failure and allowed delivery suppliers to use client appointed technology providers, and other key category suppliers, as leverage against the philosophy of the framework.

Most schemes undertaken under this framework lasted between three to six years depending on complexity and traffic demand. The framework eventually overspent by circa ten percent.

Post operational reviews of Managed Motorway Programme schemes, and results from the Nichols review (Nichols, 2017), observed:

1. Asset information is essential in understanding work to be undertaken. Site Investigation and asset inspections are necessary before setting a fixed, incentivised Budget.
2. The consequential indirect costs of network traffic management during enhancement work, when unknown conditions are discovered and cause delay, is excessive compared to capital spent early on intrusive investigation works cost.
3. Budgets should be whole scheme cost not simply a target construction price.
4. Sliding scale used to share pain / gain incentive models are not effective in incentivisation of suppliers. They can be gamed in a pain scenario by the supplier to offset pain.
5. Programme level incentive funds do not work if money cannot be taken into management accounts because of continuing risk. If interim drawdown is instigated a financial instrument supported by the suppliers drawing down funds must be put in place, either to facilitate set-off or reimbursement of future overspend.
6. Suppliers can, and do, burden scheme costs unnecessarily. These costs are extremely hard to define as ‘disallowed’ when working on multiple schemes in unincorporated joint venture arrangements in parallel.

7. Mutual trust and cooperation do not take long to break down where self-interest is a predictable irrational behaviour.
8. Civil engineering contractors have limited capability to manage effective delivery of technological enhancement works.
9. Target costing, as a procurement strategy, works only under the right circumstances.
10. Where the focus is cost, no consideration is given to value of customer service.
11. Programme level incentive fund arrangements are complex if a framework supplier fails,
12. Unincorporated joint venture arrangements can provide resilience when a single supplier in that joint venture fails.

Several highly informative lessons have been distilled from the operation of the managed motorway framework. These lessons should be adopted into any future delivery model as appropriate.

2.4.2 Collaborative Delivery Framework

Highways Agency in 2013 reviewed the prospect of a five-year funding cycle proposed by Cook (Cook, 2011) and a planned transition from Government Agency to Government arms-length owned Company through The Infrastructure Act 2015 (UKGovernment, 2015). To manage a forecast forward programme of eight billion pounds for enhancement works described in Road Investment Strategy One over road period one, it established a five-year, five-billion-pound framework as a route to market based on New Engineering Contract Edition three [NEC3 (ECC)] with option A, B, C, D, and E available. Procurement of the Framework was based around limited feedback from a select group of practitioners used as a focus group. The procurement process did involve people from Major Projects, and client users, but as a limited group. This led to the procurement model being dominated by the procurement process and not commercial delivery. This created unintended consequences in its operation. Collaborative Delivery Framework (Cuff, 2015) was designed to:

1. Create a pre-selected capability for rapid secondary competition.

2. Create market pipeline visibility without committing to award schemes.
3. Establish consistent contracting terms across all suppliers aligned with Highways Agency's Project Controls Framework.
4. Establish a Highways Agency "way of working."
5. Deliver against government's ambition for:
    a. 25%+ small and medium size enterprise spend.
    b. One apprentice per one million pounds spent.
    c. Recognise benefits of Equality, Diversity, and Inclusion.
    d. Allowed supplier continuity and engagement in common briefing and knowledge share.
6. Create an enabled, banded, pre-selected set of Lots:
    a. Lot 1; Designers.
    b. Lot 2; Small to medium size contractors.
    c. Lot 3a; Large contractors.
    d. Lot 3b; Exceptionally large contractors.
7. Create the environment for simple collaboration.
8. Reward innovation in design leading to efficiency.
9. Create a consistent performance framework. [Collaborative Performance Framework]
10. Incentivise performance by linking it to gain-share access.
11. Allow agile changes in supplier against deficient performance or quality.
12. Use target costing.
13. Enable collection of reference forecasting cost data from consistently contracted schemes.

14. Create a mechanism to exclude systemic poor performers from secondary competition.

The Framework was procured and let with six to nine suppliers in each Lot. Work was awarded through a restricted competitive bidding process amongst framework providers using secondary competition as a preference and as an enabled procurement vehicle, performed very well. Single action tender to suppliers was not permitted. All safeguards of Public Contracts Regulations (Government, 2015) applied, and the Framework was designed to terminate either because of time lapsed or exhausted capacity whichever happened first.

Design ambitions have been achieved and Highways England has met its capital portfolio commitments to deliver against Road Investment Strategy One in Road Period One. The market has engaged in delivery of schemes and improved performance through collaboration, reducing costs. Highways England's cost intelligence unit has collected reference cost data and has been effective in establishing a target cost function (Nichols, 2019). This function, alongside centralising cost estimation information, has analysed hundreds of projects from inception to actual cost of delivery. This data has established a robust 'should cost' data base for highways works and informs the target outturn cost position of a post efficient schemes budget.

The enabled framework has been used by other government agencies in a limited fashion. Work has been awarded in accordance with Lot structure and cost escalation has been contained within business portfolio risk provisions. Governance processes in the Project Control Framework have been followed. An analytic assurance process has been supported by suppliers from Design - Lot One. Lot One however, has been the poorest performing in terms of cost escalation. Widespread adoption of cost reimbursement [NEC PSC Option E] in Lot One contributed to four major recurring issues in decision making:

1. Defining design contract performance outcomes has been treated as emergent, for co-creation, in collaboration. This created time and cost 'at large' situations in most contracts as performance outcomes were never fixed.

2. Designers and Project Managers alike misinterpreted Option E cost reimbursement. This has resulted in failure to control cost escalation and delivery schedules.

3. Misinterpretation of cost reimbursement resulted in payment of all incurred cost. This transcended into abdication of contractual duties around quality control and change. This has created a custom and practice that ignores budget and schedule in favour of robust 'future proofed' detailed designs submitted for statutory permissions. In many instances this has delayed progress unnecessarily and constrained value engineering when suppliers challenged affordability.

4. Schemes, as well as design contracts, do not have decisive performance criterion and "emergent budget exceeding desired outcomes" have become customary practice. This resulted in emergent design, leading to emergent costs in delivery, as well as design stages. There are several examples of this evident to the researcher in confidential internal project management reporting of schemes. Some poor design management leading to 600+ variations during construction and ~70% project cost escalation compared to the competitive price at tender.

However, there are some positives. Performance measurement has been brought to an effective baseline and is commonly understood by suppliers (Josten, 2017). Performance has been linked to incentivisation in situations of underspend. Performance, especially around quality management and safety, is used to exclude suppliers from bidding for future work and has been used to effect changes in inferior quality and safety performance (Josten, 2017).

Consistent and assured investment has established visibility of a work pipeline and a consistent way of working for asset enhancements across Highways England's portfolio. This framework has been used for every programme in every region of England. Valuable lessons can be taken from the activity and issues in operation of Collaborative Delivery Framework (Nichols, 2017). These lessons should be used to inform the development of any new procurement model let as a Framework.

In the final stages of its use a review of its operation was undertaken, in a 360-degree feedback, as preparation for establishing new routes to market. Feedback is contained at 9.2– Report One (Josten, 2017).

Feedback indicated that stronger links between behavioural decision architectures and commercial risk and reward may counter biases driven by competing forces. These have, at times, overwhelmed the ambition and personal decision making of participants. In effect, client tribe conditioning was so great, participants 'gamed' agreements based on asymmetric data and group think for supplier's unilateral benefit. Pluralism in supplier and client tribes is flexible across employer markets causing boundaries of behavioural decision making to become very blurred. As people, move between employers over time there is a tendency for commercial potential, caused by the gaming of known and perceived biases, to be magnified.

Collaborative Delivery Framework procurement processes unintentionally maintained a gap between people who decided how things are bought and intended delivery users. These users "client departments" were peripherally involved in design and operational framework governance. Involvement was by nomination of representatives participating in design stages and governance of both development and tender to award. Procurement and commercial professionals took a predominant role in designing and securing Lot suppliers. This strategy, designed to protect core business from distraction, and if challenged, from protracted procurement process, created a perception amongst operational user groups of being excluded. In handing over an awarded framework to users, subsequent feedback indicated that greater benefit might have been derived had procurement involvement and handover been better controlled (Josten, 2017).

A perceived lack of continuity between conceptual design of contracts, procurement, and operational administration, allowed practitioners to self-interpret how to use the framework and ignore the facts. In turn this created opportunity for all the known biases to re-establish and eventually a regression to the mean of transactional operational behaviours. Too little effort was

focused on establishing and training contract administrators, both client and supplier. This was a lost opportunity to embed change. Two years into framework operation Highways England triggered extensive training with a framework management team put in place, but too late, damaging decision-making behaviour had set in. Consequently, this team spent all the remaining framework duration attempting, with only moderate success, to counter irrational decisions and damaging behaviour in favour of a decision-making architecture informed by its original ambition (Josten, 2017).

People move employers regularly as supply of capable and effective practitioners is small and diminishing (Farmer, 2016). Construction in general, and infrastructure particularly, is not perceived as an attractive career to new non-vocational entrants at any level. This perpetuates a constraint because of a closed circulation of learned behaviour in bad practice creating an environment of stagnation, not development. This incestuous vocationally driven employment market is a contributory factor of low productivity. Successful gaming of agreement terms no longer resides with one or two suppliers. By micro-diaspora of people within a limited market, every supplier adopts damaging, or irrational, behaviour predicated on bias decision making creating a self-fulfilling co-dependency between client and suppliers alike. Consequently, Highways England's Project Managers compound the impact of biases by acceptance of what had become uncontrolled common practices resulting from lack of briefing or training when Collaborative Delivery Framework was used to either design or deliver (Josten, 2017).

Widespread irrational behaviour became predictable. This framework had three major documentation changes in the form of deeds of variation during its life. They attempted to change decision-making architectures to arrest counter-productive and irrational behaviour. As most requirements under this model form part of the contract, any such variation had to be agreed by all parties to the Framework. Resistance to changing terms was informative where asymmetric commercial advantage in risk and reward imbalance was considered to have been established through practice. In some instances, this had been established by custom and practice, constrained

by regression to the mean of former practice, rather than educated administration of agreement terms.

The Collaborative Delivery Framework was a progressive move from a transactional Managed Motorway Framework. It established an intention to move towards increasing behavioural based trading, defined by infrastructure client group, as *simple collaboration* (ICG, 2017). In this the Collaborative Delivery Framework has been at least partially successful.

2.4.3 Specialist Professional and Technical Services Framework

Road Investment Strategy One funding allowed the business to undertake work in steady state. To support its in-house capacity, where buying-in capability was considered appropriate, an independent framework was established with capacity to buy ~£400m of Specialist Technical and Professional Services over four years.

In this context, Project capital programme support is termed “Technical” and central business revenue activity support “Professional.”

This framework was established through open market competition against six lots defined by specialism:

1. Technical consultancy, engineering advice, research, and innovation.
2. Commercial Services, including Project Management.
3. Commercial and dispute resolution.
4. Insurance advice.
5. Procurement advice.
6. Post-implementation evaluation.

Under each framework Lot up to six suppliers were awarded with work let through works orders under secondary competition by preference. Single action tender was permitted in exceptional circumstances up to £100,000. All safeguards of public contracts regulations apply, and the

framework was designed to terminate either due to time elapsed or exhausted capacity whichever happens first.

The Framework can be characterised as:

1. Access to skills and services needed to deliver a programme of activity in renewal, maintenance, and network enhancements.
2. Engage principal supplier with the ability to access, manage, and assure 25%+ of supply from SME's where specialism may exist.
3. Establish a consistent way of rewarding suppliers that demonstrates value for money
4. Bring the specialist skills supplier community to a single consistent form of agreement, terms, and conditions.
5. Allow for emergent briefing where scope definition required contribution from specialist.
6. Allow for appointment of specialists where competition may not meet business interests.
7. Buy services not simply contingent labour.

This framework was based on NEC edition three: *Professional Services Contract* with access to all options. In operation most works orders used Option E: cost reimbursement. Initially the framework was used to place single action tenders for specialist activity but through its life work has progressively been more competitively let. In its later stages there has been a transition in some work onto Option A: Lump Sum and away from Option E: Cost Reimbursement.

Lot One has been used extensively [40% of spend] to investigate and support research into improved design and construction standards along with monitoring and assurance of existing standards.

Lot Two has been used extensively [50% of spend] to meet project management service needs as well as commercial services. It has been used to support growth in capital portfolio schemes by buying support to outsource selected schemes or functions.

Lot Three to Six, the remaining 10%, have been used less.

This framework has supported a pattern of internal transition. Framework administration has been difficult. It has suffered from extensive misuse supplementing staff capacity through use of supplier labour rather than compliant outsourcing. This was not its intended use. Again, procurement model success being completely dependent on the decision making of practitioners. Education and training to bring it into proper use has been a challenge. It has only been in the final 18 months of the framework's duration that users have been able to optimise its use.

The framework has allowed business support services to be acquired in an efficient way. Principal suppliers had capability to access, manage and assure 25% of services from and by small and medium size enterprises, where specialism is thought to lie. However, predictably, 83% of work was undertaken in-house to drive business contribution, even where this did not benefit product quality or constrained innovation.

This framework has been unable to align risk with reward. Quality management, being part of a supplier liability and scope, allowed non-recoverable management time to be reimbursed in its commercial mechanism. Failure to accurately describe need, and define scope of service, means sponsors could not manage supplier outcomes effectively. Poor management of supply, or receipt of deliverables, established a set of irrational behaviours reducing benefits and, in part, eluding ambition. Through poor participant behaviour, suppliers have been able to dilute liability at the expense of unrealised outcome benefits. This has meant that without effectively delivering the clients objectives suppliers have been able to optimise turnover and business contribution.

Learning from this framework shows that without defined outcomes and a clear alignment of risk and reward framework objectives are not met. This model was aligned to Collaborative Delivery Framework Lot One – Design. They reflect market wide feedback for closer integration by cost reimbursement based on co-development and management of outcomes. It has however proved that without defined outcomes there is no commercial tension and so trading relationships fast

descends into practices that rob the client of its ambition while creating a hard to break habit of 'paid for every hour' from suppliers.

2.4.4 Applicability

In truth procurement models in the UK construction highways sector have been paralysed by lack of external original thinking. Only attempting to extract the best out of what current supplier communities are perceived to be able to offer. This has not been satisfactory for either the investor, client, or supplier (Nichols, 2017). All previous procurement models have failed to achieve any significant difference in productivity. Poor visibility of future work has hampered investment needed to change. The constraint of secondary competition and lowest price award has created a continuation of productivity inertia. New models have attempted to change the paradigm but have simply reverted to a different description of the same thinking. This inertia is given a new badge but does not change the fact of poor productivity generated by damaging behaviour.

These features are all consistent in identifying a gap in the way procurement models have been assembled. The focus has been on legal precedent, liability transfer, and competition. The smart thinking in the sector has highlighted the principles of collaborative, and integrated working. The fault lines show up around transactional relationships and who is liable for what, when, and where. This gap appears to revolve around the singular failure to recognise that people are driven by social norm compliance to be accepted and, without sufficient motivation, regression to the mean of doing the way they know how, and always have. Positive research in this gap may result in a more successful outcome.

2.5 Principles in practice

2.5.1 From Transaction to Enterprises; Project 13 [2017]

The Infrastructure Client Group, publishing *From Transaction to Enterprise*(ICG, 2017), represented contributors from all sorts of physical infrastructure business. As a group it set out to clearly articulate the client's voice in a market that urgently needs reform to deliver higher productivity. By

recognising this as an industry wide issue, the Institute of Civil Engineers coordinated and focused energy to make recommendations towards principles it believes are required to achieve this ambition. Its *Project 13* paper sets out to:

1. Encourage innovation
2. Produce better outcomes
3. Reduce waste.

It wanted to "…identify more intelligent ways to organise competition, generate more value for end users, and provide the right structure for suppliers to invest in capability building."

To do this Infrastructure Client Group reviewed extant and "leading edge" practices to assemble a series of recommended principles.

The group's findings are characterised into five key action areas.

1. Governance: developing systems of governance and procurement practices that maximise value for customers rather than simply minimising initial capital cost including new ways of measuring performance.
2. Organisation: what is critical in establishing and managing shared enterprises with the capability and behaviours needed for success. How do all people, for whichever party, work together in a quasi-single project or programme entity to a single set of outcomes and a single purpose?
3. Integration: Looking at the roles and responsibilities of an integrator, the capabilities needed to integrate in a digital age and how this all works within a delivery process and a temporary management structure
4. The capable owner: what skills are required to be a capable owner, how are they acquired, trained, and continuously improved. Can these skills be consistent across infrastructure clients?

5. Digital transformation; Consider the use of digitalisation as a disruptor to not only construction but for asset owner's business models encouraging consistency across owners and better integration with the tech sector.

The paper concludes that transition from transaction to high performance enterprise takes time and consistent commitment from clients and owners. It maps this journey as moving through simple collaboration, into integrated delivery and finally transitioning into high performance enterprise. It defines principal characteristics of these stages and sets out a series of future objectives for Infrastructure Client Group to further investigate and build upon. It establishes the principles and characteristics but not how to incorporate them into a model for delivery of programmes or schemes.

As an infrastructure client, and a participant on Infrastructure Client Group, Highways England contributed to the principles, findings, and recommendations for this paper. It reflects the outcome ambition in capital project delivery. Characteristics described in this paper are recognisable within the highways sector and recommendations of this paper set the direction of travel in core business capability of major projects and operations directorates. It does not however, provide a client body information on how to achieve the characteristics.

This paper is a useful narrative to a journey to what might be possible, but it only defines the journey's characteristic and principles. In establishing any new procurement model for Highways England these characteristics should be adopted, and principles adhered to. The desired outcome is to create a unique detailed narrative of how to achieve, embed and change a status quo surrounding these principles in the highway's environment. This change to trading then needs to achieve industry validation, through tender and then operation.

2.5.2 Transforming Infrastructure performance [2017]

Infrastructure Project Authority is a Treasury think tank empowered to assemble forward thinking from industry and distil it into advisory guidance. In December 2017, the culmination of 18 months

of field studies and industry intelligence gathering, it published a thought paper *Transforming Infrastructure Performance* (IPA, 2017). In overseeing expenditure of public money into national infrastructure, this paper sought to influence procurement and delivery of large-scale infrastructure projects. Its ambition is to secure better return for the investor, in this case UK government, on behalf of UK taxpayers.

This publication builds on previously referenced Infrastructure Client Group guidance on establishing a *Project Initiation Route map* (IPA, 2014) and sets out guidance to improve effectiveness of investment in infrastructure. The paper's ambition coordinates infrastructure from digital capability to productivity, in macro-economic terms, for transport and other key utilities infrastructure. It aligns performance of integrated infrastructure by focusing on predictability of integrated activity. It promotes shifting from cost to value-based decision making. The paper also calls for a greater emphasis on whole-life-cost thinking rather than on initial cost at investment stage where benefit v's cost calculations emphasise "now cost" over potential disruption to economic growth because of poor lifetime planning.

Findings focus on a series of guidance themes for action to achieve high performing infrastructure in future.

1. Benchmarking for better performance; promoting collection of data from across the infrastructure market in a consistent format to allow comparison. Using comparison to establish benchmarks in productivity and digitalisation to drive sustainable change. Use consistent asset data to drive asset performance measurement and feed a consistent benefits realisation data base rather than simply cost.
2. Alignment and integration; seeking to drive integration between types of infrastructure such that it does not only work in the context of its own network but achieves benefit from being integrated better with other infrastructure networks.

3. Procurement for growth; seeking to engage with suppliers more effectively before the start of formalised procurement processes to build better understanding, capacity, and appetite from the supplier community. This improves relationships allowing better alignment of objectives to achieve better outcomes, boosting productivity in delivery as well as delivering assets that better meet community needs.
4. Smarter infrastructure: using governments focus on smart construction, off-site manufacturing methods of construction and digital technology as a driving force for change. Government clients can facilitate knowledge sharing and set continuously improving standards of practice.

This paper is designed as guidance and information relating to measuring effectiveness of investment. In setting out what 'we will do,' it indicates intended measures in assessing the capability of government and non-government agencies and companies when determining the effectiveness of infrastructure investment. In setting these expectations Treasury raised expectations that investors think carefully about the sustainability of investment as part of integrated infrastructure; across Great Britain, not simply as a contained network only serving the needs of its distinct customers.

As a national infrastructure asset owner Highways England had to consider how its investments sustainably develop the network it owns as part of the whole transport network. This must be done in context of the non-strategic network in England and other strategic and non-strategic transport networks across England.

Highway asset owners are challenged in this paper to not only create benchmarking data but contribute to and learn from a coordinated approach. They are urged to align ambition to the rest of the asset ownership market and consider investment actions in context, considering customers and infrastructure neighbours. In development of a procurement model owners are called upon to consider changing market practice for the better. Highways England was, as a government owned

arms-length body, urged to recognise its market leading role. Using it to transition and set standards for industry practice towards improved value for money and predictability in safety, value, and customer service. It also gives a government green light for initiating wider use of factory manufacturing techniques and methods in construction to improve safety, wellbeing, and drive-up productivity. It is down to Highways England to determine the best way of achieving this in the highways sector and across asset performance and life. These challenges are clear; creating an environment where behavioural decision-making supports and progresses this aim, it is a formidable but achievable ambition given time and corporate willingness.

2.5.3 Applicability

In observing conditions and outcomes in these examples of new thinking there is a strong emphasis on making sure the incentives are right. To do this the project or programme structure must be right and for this to happen clients and investors, and their agents, must clearly understand what they want. In all the thinking is based on existing capacity, it is a matter of releasing that capacity and its latent productivity through a changed capability. This capability is being constrained by contracting and delivery arrangements, supported by legal constructs that fragment the team, creating constraint because of unnecessary and unhelpful interfaces with unrealistic risk and liability transfer. This has exacerbated the situation and created a continuum of suppressed productivity. As a gap, it suggests again that research in behavioural economics and the means of changing professional and project based social mores, so that participants make more rational decisions, is an opportunity.

2.6 Conclusion

Across the construction sector, and particularly highways, it is recognised that poor productivity persists despite ever increasingly long-term pipeline commitments. The industry is littered with rhetoric relating to the principles and characteristics of what needs to be done. Reviews and reports consistently cite the same aspects of the construction market that detract from productivity improvement. The infrastructure construction market in the UK is no different, albeit a little more

responsive to investment in change based on visible pipeline. Highways England's challenge to create additional capability and capacity is matched by enablers; a release from annualised funding; a five-year Road Investment Strategy; delegated powers with oversight from a monitor. Over the years spectators have continually changed focus, from clients needing to change delivery environments to suppliers needing to invest in, and initiate, change.

Since the reports of Simon, Banwell, Latham and Egan; procurement models have evolved. Organisational theory has evolved. Supply chain approaches have evolved. Technology and construction techniques have evolved. Materials and plant have evolved. But practice shows all appear to have evolved either in isolation from each other or without the behavioural drivers to change the production outcome.

To stimulate this long aspired for change in productivity, a gap exists to combine guidance, principles, characteristics, and rhetoric to identify common and all-important behavioural connections. A common but poorly explored thread, across all this aspired for change, is people and the way procurement models motivate decision making.

The answer to this gap may exist in combining knowledge from social science, behavioural economics, and construction economics, where human factors create the dynamic for a unique way of motivating decision making.

In several studies throughout the last 15 years, suppliers have been urged to trigger a change and improve production outputs. Why then have they remained elusive? If as the rhetoric proclaims it is in everyone's interests, why so ineffective? In many industry reviews, despite there being a looming demographic time-bomb, productivity inertia persists. Market fragmentation focused on by Latham and Egan, still, after 30 plus years, exists and there is no integrated team. Several factors are cited, competing interests, isolationism, and lack of a viable disruptor; UK construction market is notoriously difficult to access by European competition, education has not changed, and corporate self-interest persists. The industry continues to teach vocational entry to this market and operate a

market wide conscious, or unconscious, bias towards new entrants. If the paradigm does not change, we will continue to get what we have always got, to paraphrase Einstein. The questions are:

- are forms of contract wrong or, the way people react to them caused by a misperception of outcome and value?
- Are participants allowed to make the right choices for productivity improvement, or are they unintentionally constrained by the very agreement designed to release them?

To formulate answers to these questions the research will consider evident elements of current practical behaviour and postulate reasoning for that behaviour.

Practice	Reasoning
Incentive models should closely reflect a visible link between risk and reward.	If an incentive model is not balanced it will stimulate an asymmetric outcome including predictably irrational behaviour
Incentives work in integrated project delivery ONLY when the client is engaged.	The Clients actions in a project are critical to any supplier being able to perform and redeem an incentive.
Integrated project delivery is more efficient than transactional trading.	Transactional trading generates waste in large schemes as the fragmentation and transfer of liability causes transaction points which incur non-value adding activity.
Performance must play a major part in incentivisation and linking performance to future opportunity is a powerful incentive in a market driven by consistent turnover and low acquisition cost for its sustainability.	Whilst the allure of addition cash from undertaking a scheme efficiently may appear attractive, it is not. Sustainable business through lower future work acquisition costs is much more motivational to suppliers and sub-suppliers.
'Opt-in' procurement models do not work.	Psychologically asking for compliance has been established as less motivational than assuming compliance and providing a loss for non-compliance.
Simplicity of delivery structure, rule change, and outcome connectivity assist the people engaged in delivery to understand how to enact change.	Construction projects are complex and establishing a procurement model that is effective requires simplicity to enable it to be understood by the thousands of people that will be engaged in its delivery.

Contracts are not read by the majority, so strong messaging needs to reinforce key themes on the intent.	While the contract is there as a record of the agreement that was signed, most people involved in the scheme never read it. The themes of change need to be relatable to widespread practice but with strong key messages to how they are different.
Incentivisation must release innovation opportunity to remove people from processes to:	To improve productivity (output per worker) any incentive must support reducing hours worked to achieve the outcome.
Avoid compromise in sustainability due to a demographic time-bomb	Reducing numbers of people in the construction sector has been forecast, any new procurement model must recognise the ability for suppliers to innovate to reduce reliance on worked hours in favour of modern methods of construction.
Increase productivity.	The procurement model must provide the opportunity for the supplier community to increase output per hour worked.
Change will only happen because of education and in a commercial environment this must be driven by clients releasing investment to allow it to happen and persistently maintaining demand.	Clients must realise that market transition requires investment. Creating incentives around cash for investment in improved competency while providing a sustainable pipeline of work is essential for transition.

If a new model is to be designed and procured to improve on ten plus percent shift in productivity it will need to change the way people work overtly and significantly.

To achieve this effective change several key issues can be drawn from current practice:

Investigate	Why?
Biases impact outcome, how?	Counter damaging bias.
Management of change must be controlled to be successful.	Transition is a complex thing and structured and organised change will be needed to shift a critical mass of decision making.
Transition from 'opt-in' to 'opt-out' and the wider use of nudge theory.	Behavioural economics around the power of loss aversion may have some answers to drive a change in decision making.
Use of loss aversion rather than gain as an incentive mechanism.	Opt-out case study

Means of countering predictable irrationality by reducing remoteness between action and consequence.	Creating a golden thread between action and consequence is essential as part of any motivational strategy
Harnessing the power of self-organisation.	Once the model is released and in action there is too greater scope in its use for command and control, the application must drive self-organisation.
Understanding the impact of social norms and tribal behaviour – seeking acceptance from group familiarity with decisions.	People make the best decisions when they feel safe. So, the changed decision-making pathways need to be social norms for the community.

These require a rethink to shift engrained habitual decision making, both corporate and individual. These changes must be supported by proper contracting agreements within a new procurement model to stimulate the will to change by all parties.

So, the problem is how in the existing ontology, to improve to continuously improving productivity on major infrastructure projects. Previous attempts have only had marginal success. Studies have shown that individual behaviours can negatively affect productivity. The researcher's conclusion from this is that action from the buyer, Client, is required in the form of a new procurement model to stimulate change and give permission to the market to address this problem.

Project teams in infrastructure construction are established as a temporary management organisation and then disbanded regularly. Interaction between actors and groups of actors is the basis of project delivery. To change the habits of these communities, built up over many years, will require some time. However, to create the perception of empowerment to allow change to begin, Highways England as the client must design a new procurement model to facilitate it.

Can knowledge, drawn from behavioural sciences be applied to and incorporated in a new procurement model with the expectation that this will enable improvement in productivity?

To discover the answer to this, several underpinning theories were reviewed to determine if effective mechanisms might be translated around an existing complex ontology.

2.7 Summary and link

People's habits and sublimes can be seen from research to be at the heart of the problem in failing to improve productivity in infrastructure construction (9.1.1.) So, influencing decision making by changing habits and sublimes to continuously improve decision making practices, triggered by a new client requirement, could be the key to arriving at a solution. For this reason, the focus of change developed in this methodology is the client's procurement model.

3 Underpinning Theories

To investigate the questions arising from practice and the market response in principles of practice, a series of underpinning theories were reviewed to see if they explain sub-optimal performance in practice. Analysis of data revealed procurement agreements consistently underplay the importance of prompting and motivating behavioural change. This is evident in contractually irrational decision making. Sub-optimal performance results from poor, contractually irrational, decisions made when carrying out construction works. The survey data from *RtM lessons identified* (Josten, 2017) clearly shows that what is widely considered as procurement model failure is in fact a failure by practitioners to follow the construct of the model. Underpinning theories might offer some insight into how to structure and motivate more compliance in decision making. This may create the difference between high and low productivity while protecting investor, client, and supplier working under a public sector construction contract?

Behavioural insight 'Nudges' can create measurable impact when used to changes UK government policy (Halpern, 2015). This research investigated if productivity-based decision making can be changed in this market by learning from the field of behavioural science. The review looked for underpinning theories to influence how to redefine decision making pathways, that lead to behaviour, to improve productivity. Social science and herd, or tribal, behaviour was also investigated to understand why people seek social approval before being able to change behaviour and embed a sustainable shift in output per hour worked.

Whilst embedding a new way to work is important, how we work, and why we work also informs behavioural choices. To illustrate this the review again reaches into behavioural economics to assess what drives collaboration and informs the context of integrated working. It also looks at why people do things, take decisions, and what motivates or not, people to act. Looking at theories, to better align risk and reward through incentive mechanisms, also touches on the importance of motivating the right things, at the right level, and creating visibility through the community. Motivating an

individual is important but so is corporate motivation. Investigating if they are different will also inform the procurement model towards improved productivity.

One attribute of the defined problem is a need to manage change more effectively when shifting behaviour. So, this review also looks at the basics of change management through change theory. It looks at the principles of self-organisation by groups as a more, or less, effective way of making changed ways of working sustainable. And finally, to avoid repeating past failure, the review looks at research done into why mega projects fail or succeed, what are recognised sublimes and biases and how they impact on key decision making.

For the purposes of this research, the underpinning theories were contained to the direct relationship between client and primary supplier. Other theories such as supply chain management, complexity theory, uncertainty management theory, motivational theories, or theories contained under management science, were not reviewed. Whilst in the context of their influence on the theories reviewed, they are acknowledged, this review does not try to investigate them. It is contained in its focus on influencing productivity-based decision making to counter-act known bias (Kahneman, 1982). It does not review judgement making, psychology in general, or the cognitive abilities for decision making in general. It is focused on how to create specific nudges within a UK highways construction specific community.

Specifically, it looks at issues highlighted from practice, namely:

1. Generating buy-in to a new way of working using an opt-out policy; rather than traditional procurement models based on opt-in.
2. Loss-aversion as the basis for motivation. Traditional incentives based on stimulating opt-in to improved outcomes are seen not to be working. To support the opt-out policy, stimulating better performance and productivity using loss-aversion may be more successful in changing ways of working.

3. Cognitive dissonance and damaging biases are widespread and every project that does not achieve its objectives is riddled with reasons why all party's involved could not perform. When setting up a procurement model all parties confirm their understanding by signing the contract of the decisions and behaviours necessary to succeed. Following the rules in an agreement would demonstrate rational behaviour. Contemporary evidence shows that commercial advantage is sought by gaming the outcome of contracts (Ahmed et al., 2016). This can be labelled predictable irrationality. Seeking strategies and thinking in the correction of predictably irrational behaviour may transform performance under any new procurement arrangements.

4. Once the procurement process has run, and the suppliers selected, all decision making and behaviour management transfers to contract administration. The people behind the model become less influential and operational teams take charge, growing to 40 – 50 times the people involved in modelling and bidding. At this point delivery teams need to be able to maintain the ethos of the procurement model for it to work. As such the idea of self-organisation, running contracts, in temporary (project) management organisations, over many iterations, is important. Reaching into the self-organisational theory from industry may assist the development of this.

5. People deliver everything in construction. People are herd animals at origin and follow the traits of needing social acceptance. Looking into the science of tribal or social norms as well as the influence of well recognised sublimes, and bias may illuminate some of the tensions experienced in the multi-faceted decision making under a construction trading agreement. To be able to motivate performance, predictability, and productivity it is important to be able to understand how these sublimes, biases, and social norms play a part in enabling or constraining change.

3.1 Behavioural Economics Theories

3.1.1 Rational Choice theory

In construction projects people undertake all actions. They all believe, or are instructed by someone who believes, in the potential to convert design into reality. Participants with a common belief in a story, or an imagined reality (Harari, 2015) determine that an aggregate effect of all individual acts, at a defined rate of productivity, aligned to a planned design and methodology, will create a physical asset by a time. This belief, and adoption of processes and actions to achieve the asset, becomes a particular social norm amongst a project community. When making any change based on understanding behavioural decision-making what is considered social normality, and drives behaviour, is essential (Earls, 2009). Any formalised agreement or contract, the story used to bring people together to achieve a commonly imagined reality, influences their belief and so what they do and how they do it. It sets the Field (Lewin, 1947). The story is of what will be if they all act together in a desired behavioural decision-making architecture. What is considered rational in this story, how to act between parties to this common goal, is context in which we seek belief to transform actions into reality through change of our environment. To effect change a commonly consented to story forms an agreement. We know people make individual decisions as a rational choice, (Kahneman, 1979). To successfully influence behaviour any agreement must first form a common narrative which may contain incentives that align to outcome, purpose, and desired behaviours. Everyone involved must believe that if we all “do” action, processes, procedures, things, at an agreed rate, the outcome is going to be “this thing” which is the imagined reality of the design. The story, for construction work is usually in the form of a contractual agreement with a scope, purpose, and design. It forms an imagined reality and establishes the common rules for “doing” based on belief that such a “thing” is commonly desired, both by buyer and supplier although for distinctly distinct reasons.

Sociological research has long recognised that context informed by imagined reality, in which people make rational choices, is as important as choices themselves (Lewin, 1947). People will, because of aligned and unaligned influences, choose to act both rationally and irrationally around behavioural

rules contained in an agreement irrespective of the complexity of the agreement. Such influences are driven by a particular imagined reality driven from one or other tribal influence; (Earls, 2009) being a professional; working for a company; an industry or construction sector; a project; or a team within a project community. A person's tribal influence will also inform which of the 4 common sublimes (Flyvbjerg, 2017a) they align to. Behavioural choices are made based on this contextualised reality as an influence or pull. These pulls are prioritised and re-prioritised by everyone depending on emotions, informed by one's own sublime alignment to the imagined reality informed by each influence, sometimes many times a day. In *Field Theory* (Lewin, 1947), Lewin argues that without understanding context, which influences behavioural choices, the opportunity to change behaviour is reduced.

Organisations work to business plans. Employees, within it are driven by their imagined reality, so perform in context of values and operational protocols established by the story telling of a corporation. This overtly influences how people choose to behave, usually as an attempt to protect the corporate story, and how others in the corporation measure their loyalty to that story. They seek to align individual behaviours to manage perception of personal loyalty towards this tribe's story. Behavioural choices are also heavily influenced by authority, legal, moral, and charismatic. Authority can influence rational choice (Kahneman, 1979) as well as personal emotion or perceived commercial consequence. Authority needs to be carefully aligned to defined values.

Max Weber in *economy and society* (Weber, 1920) considered influence on people's choices as derived from an authority model of either: rational-legal authority; traditional authority; or charismatic authority. The idea of "free will" in an economic setting, such as a contractual relationship, in Weber's view is questionable. Actions, behaviour-based decision making, can be significantly influenced positively or negatively by authority. Developing this idea, of people making rational choices as part of belief in an imagined reality, assumes people respond to positioning of authority and understand social, personal emotional behavioural decisions in the context of each corporate, or project, story using choices to flex around group adherence. They steer

a course using their feeling of belonging overlaying situational contexts to remain part of the Herd (Earls, 2009). A formal contractual agreement, e.g., employment conditions, articulate the story, type of authority, and choice consequences so a group of people consistently and clearly understand them. Any legal agreement is constructed to formalise a commercial consequence of honouring or dishonouring the story. The behavioural decisions required must be reasonable to have any likelihood of successfully influencing known and perceived authority over choices made by individual participants acting in their own, or corporate, interests.

Using standard forms of agreement draws on Weber's rational-legal authority to describe rules and contractual mechanics based on statute and agreed precedent of interpretation. These include outcomes from settled disputes, under similar circumstances, i.e., civil engineering construction. Agreement outcomes, group imagined reality, can be diluted by either non-existent or weak communication of a story or its rules. This potential, to dilute or frustrate a group imagined reality, increases likelihood of traditional or charismatic authority being prioritised with all the consequences of it positively or negatively influencing choice. Without an agreement being understood, by participants knowledgeable enough to follow the rules, outcomes described by it will more likely not be achieved. The story, the project in an agreement, needs to create a sustainable common imagined reality. It must be clear to influence participants into achieving the desired outcome despite their sublimes and biases.

To create an authentic basis for rational choice a contractual agreement must consider authority in decision making, sources of influence and bias, to make choices rational. In his book *The Upside of Irrationality* (Ariely, 2011), Daniel Ariely argues that understanding human propensity to act irrationally can inform how we understand the choice architecture people are most likely to follow. That fact, that humans seek out irrationality, is instrumental to remodelling of behavioural choice architecture in construction agreements seeking to describe an imagined reality, based on a productivity outcome, for a known price, in a known time.

Predictable irrationality, as a social theory, describes how people believe they make rational choices (Kahneman, 1979). They are unaware of the extent of contextual influence they are under and retain a notion that they are acting rationally even when they are not. Authority is important in contextual influence as it affects behaviour, people act differently if there is a low probability of "getting caught" when acting outside defined, or undefined, rules. Authority also plays a part in decision making if risk is balanced not on "getting caught," but remoteness in consequence. In *The Honest Truth About Dishonesty* (Ariely, 2013) Ariely explores the notion of predictable irrationality. He analyses a series of experiments to determine conditions under which people choose to act dishonestly or not. The book goes on to describe conditions that influence (increasing and decreasing) this behavioural choice; to act dishonestly. This research indicates something particularly interesting and relevant to our ambitions to change behavioural choices taken under rules contained in a construction contract. Particularly the notion of remoteness from consequence against a backdrop of a fragmented contracting structure with modelling of risk and responsibility transferring down a supply chain [contracting and subcontracting reflects this degree of remoteness]. In effect, fragmenting delivery by multiple levels of supply, as with prime suppliers, sub-contractors, sub-sub-contractors, and component suppliers, if not constructed effectively, creates an unintended remoteness from consequence. This principle, "increasing irrationality created by remoteness," informs how integrated project team involve all participants in decisions within a joint enterprise environment. To increase effectiveness there must be visibility of consequence from behavioural decision-making when aligning risk management and reward.

In *Herd* (Earls, 2009) Earls explores how to change mass behaviour against the backdrop of people's instincts to "stick with the herd". The book focuses on humans, a herd animal, desire to get social confirmation of choices, whether they are rational or not. Most construction, and especially large-scale infrastructure, involves integrating large groups to act towards a common purpose: an imagined reality. Understanding social norms in and around projects, influencing herd behavioural choice strategies, is important to be able to understand probable outcomes. Choices will be biased

by social structures (Choi and Lee, 2017) of tribes within communities, sub-groups within The Herd. Choice ratification by a social group, using common perception of a social norm, confirms belonging and conformance often framed as rational choice. This validation of someone's actions or behaviour, through perceived compliance, enables each person to be more comfortable that their choice conforms with its herd's social beliefs, even more so if it complies with traditional or charismatic authority. To make change sustainable this reinforcement must be targeted at being asymmetric towards the changed way and away from the mean.

3.1.2 Motivation Theory

Motivation theory (Vroom, 1964) was considered to inform the strategies of the model. The principles of motivating people to act based on a state of free will, but in line with a desired outcome, is complex and has been the subject of much research in the field of marketing and social change. Smith discusses an interesting perspective in his paper *Maybe I will, maybe I won't: what the connected perspectives of motivation theory and organisational commitment may contribute to our understanding of strategy implementation* (Smith, 2009). In determining the ability for people to act, at will, the paper seeks to separately consider motivation theory and goal setting theory (Locke and Latham, 2002). Motivating people to act in a work setting is another issue researched (Meyer et al., 2004) and explores this amongst many other issues. In the manufactured setting of a project's temporary management organisation, where many interests are coalesced this complexity becomes even greater. The convergence of theories and the use of this thinking to deploy a project strategy is akin to that of a marketing strategy. In his paper Smith postulates that motivation to implement a strategy is more effective where the activity is discretionary rather than non-discretionary, i.e., compulsory. He also concludes that motivation of an individual varies with the commitment of the organisation that individual is working for. This aligns with the principles of wider behavioural economics where the ability to make decisions using free-will is more powerful than decisions forced upon a person. It also can be developed into Nudge theory that suggests that the motivation is greater if a decision architecture conveys the perception of free will decision making even though

the architecture is designed to create choices that result in the desired outcome. Variability of motivation due to organisational commitment also aligns with thinking and research in social norms and mores.

3.1.3 Expectancy Value theory

Expectancy theory (Vroom, 1964), and Expectancy value theory (Eccles and Wigfield, 2020) is also known as utility theory (Kahneman, 1979). Value is, as they say, in the eye of the beholder. Delivering value, say for an infrastructure market client, has not traditionally been seen as value for an asset user i.e., road user, but value to the asset owner. Introspection has become the norm, led by people owning an asset, not related to people who benefit from using it, i.e., not customer focused. The influence that value (utility) has on a person's choices is relative to a reference point, or benchmark, of value as they understand it. Value, in the case of a construction supplier, may be contribution project related income makes to its capability, portfolio, turnover target, profit, or targeted contribution to the business. To an aspiring professional it may be gravitas from working on a project, based on learning, or growing political capital around their personal brand. (Liu, 2018) To an insecure employee it may be demonstrating usefulness and utilisation to an employer. And to a client it may be an ability to meet its obligations to an investor. There is a correlation here to the sublimes referenced in *The Iron Law of Mega-project Management (Flyvbjerg, 2017a).*

Preferences, determined by what otherwise does not seem like important wording in choice questions within documentation, can overtly bias, and in some cases corrupt, an outcome. Any new model must create the ability for a participant to align authority, purpose, perceived utility, and individual behavioural decision-making. Expected value theory (Kahneman, 1979) is used by people in a process to judge the value of a decision, this judgement contributes to the emotional response needed as a component of loss aversion. Because of this it has potential in improve incentivisation modelling by accentuating the emotional link of the loss in value for the decision maker to poor or damaging behaviour.

Consequences of any action can be seen through the lens of utility theory. The utility a person sees informs how that decision maker's value perception influences their choices. This model builds on principles from Prospect Theory (Kahneman, 2011c), which is used to judge the action a person will take based on what they consider as consequent gain or loss, based on their snap-shot perception of utility.

Reference points for utility theory include value expectations and influence on decision making by companies as well as individuals. [Companies are a collection of individuals where there is a single aggregate choice of behaviour.]

Utility is relative to base wealth, investment to the review point, or expected value and is therefore influenced by the prospect or risk of loss in achieving outcomes. Where a base value is high, creating greater threat from loss, so greater potential for loss aversion exists. Base value is relative to the decision makers perspective. Value may lie in reputational enhancement or damage, financial sustainability, commercial risk, human capital investment, environmental impact, or social value. Where a lower risk of loss exists, or is perceived, less loss aversion incentive can be achieved.

3.1.4 Theory of reasoned action

Reasoned action theory relates to the relationship a pre-existing attitude has to a contemporary behavioural choice. Reasoned action is particularly relevant to the influence custom and practice has in behavioural choice. Martin Fishbein and Icek Ajzen's research into the relationship between attitudes and behaviours, has potential to influence a model's need to change from turnover generation, as a decision driver, to value delivery (Ajzen and Fishbein, 1980). Their theory relates to intention to undertake a behaviour, and actual behaviour. Ajzen and Fishbein modelled the relationship between belief that a behaviour will result in an outcome and the likelihood of someone carrying out the behaviour. Theoretically someone who plans a certain behaviour based on a reasoned outcome will undertake it. However, in practice there is a counter-model called reasoned action approach. The relationship between planned behaviour and actual behaviour is the basis of the theory of reasoned action. Attitude and belief inform how brave someone will be in their action

and their intention to either follow a social norm or act outside of it. In their research intended behaviour precedes actual behaviour. And personal or corporate intended behaviour may not correspond to declared intent. This also relates to the belief in the realisation of an outcome from a behaviour. The stronger the belief in the outcome, the greater the intention to carry out the behaviour and the more likely the actual behaviour will follow. Creating belief in the efficacy of an outcome to be in a participant's interest, and better still in everyone's interest, increases the planned intention to act and in turn increases the likelihood of actual action that follows the plan. This theory does not recognise the influence of known biases within the construction sector. Within this theory belief in the benefit of behaviour, or dis-benefit, will affect the attitude a person has towards the action. How a story is told, what perception is created and its consequent influence on belief, impacts attitude. This theory builds around the attitude to the potential outcome of an action and how it impacts on the plan as well as the reasoned action taken by someone. This research was in the healthcare sector relating to promiscuity of adolescent girls and in dietary behaviour. It does however have a real resonance in project delivery under new and challenging models that are intended to change the social norm of delivery groups. Belief in the outcome of individual and group actions being beneficial or not, given the tribal social norms of corporates, projects, and individuals, heavily impacts the attitude a decision maker has, relative to planned and actual decisions. To succeed a tribe's social norms must be aligned to the desired outcome otherwise at best an asymmetric decision will occur and at worst, complete misalignment between decision taking and a project's objectives.

3.1.5 Prospect theory

Core behavioural economic thinking is epitomised by Prospect theory (Kahneman, 2011c). Its basic premise is extremely relevant to changes needed if a new procurement model is to improve the level of productivity generated in projects. A core component will be transitioning project delivery teams from, "…on time and budget…," to improving end user and asset owner value. With a high potential for resistance to change, a new model needs to create perception of an asymmetric

balance of potential gain over potential loss to be able to change attitudes to planned and actual actions.

Most delivery models use incentivisation relating to gain from action. There is no existing standard construction procurement model that creates context for loss aversion. Instead of considering the beneficial outcome of changed behaviour to remain with the client (buyer) and to create a mechanism to bestow a share of benefit onto the supplier (seller), a loss aversion model must align and identify surplus (gains) as available to the seller on entering a contract. This construct visibly creates the potential for loss of that surplus to be within the sellers' control – theirs to lose. A supplier needs visibility of a benefit to create real belief in the possibility of beneficial underspend against a fixed budget. Otherwise, commercial tension from pessimism bias will create an attitude of disbelief, changing the attitude of the supplier and changing intended behaviour at the point of decision making. This change in intent to financial survival is likely to cause regression to the mean of transactional behaviour and not collaboration to enhance the opportunity. These aspects: understanding common value; belief in an outcome informing attitudes; the intension of planned action; following through to actual action; and how these are used to motivate changes in productivity, appears to be a gap in recognised contemporary procurement model design.

In *Thinking Fast and Slow* (Kahneman, 2011a), Kahneman explores the human ability to react to situations based on availability heuristic. In research human brains were recognised as reacting using an ability to process data based on availability of an answer. In assessing a situation, the brain will first seek an available answer, then if unavailable alternatively process data and draw on logic. A brain thinks fast; availability, automatic, and highly susceptible to environmental influences, and slow; logical, processing, reflective, and considers with explicit goals and intentions. There are similarities in commercial life where delegated authority may create a similar fast and slow demarcation but across a temporary management organisation for a project. Kahneman's work is limited to decision making of a single human and does not extend to considering this corporate phenomenon. There is a wealth of research and theories on organisational culture or climate,

amongst others are (Willness, 2016, Schein, 1990), but little in the way of fast and slow decision making by project teams remote from the centre.

Leaping from a single brain to an entity or company is both attractive and fraught with vagaries. If the simile is correct, our brains decide based on solution availability in a defined period. For a brain this may be milliseconds. If the same relative decision-making structure exists corporately, but around delegated authority, there is an interesting accuracy v's speed analogy.

Infrastructure construction companies assemble and dismantle temporary management organisations to delivery geographically disparate projects, for a variety of clients. They are designed to reflect a client's requirements but because of this may suffer from uniqueness bias. Project teams last on average between 2 and 5 years. They are equipped to make delegated decisions fast relative to a project. The extent of delegation depends on project agreement structure, relationship to the client, and corporate attitude to risk.

Continuing this thought exposes a similarity between thinking activity of a person and that of a company. A company, and a project team, is a group of people with similar purpose and decision-making rules. So, in aggregation of the people involved, a company head office function represents *thinking slow*, logic processing, etc. A temporary management organisation or project team *thinking fast*, using availability heuristic based on project team capability in context of a specific agreement. There is a connection with rational choice theory. Rational logical authority being head office, and traditional and charismatic authority leading projects.

Prospect theory (Kahneman, 2011c) proposes that in decision making, an individual creates psychological value of loss as twice that of attraction or gain. This phenomenon causes decision making to be asymmetrical. The power of this as a decision driver could create a contractual dynamic that is unique in infrastructure construction.

Incentivisation in this regard could be focused on not only loss of cash but also future work. If the power of loss aversion found in Kahneman's social experiments transposes to the commercial model

of construction, it could double the effort made by suppliers to improve productivity. Attitudes might change as productivity improvements could directly affect belief in their ability to benefit by both outperforming the budget and securing future work opportunity.

3.1.6 Predictable irrationality

Traditional economics is based on rational choice theory (Kahneman, 1979), determined by a need to satisfy self-interest above everything else. To be able to assess irrational behaviour one must first appreciate rational behaviour. Within economics, rational behaviour is informed by participants making rational decisions based on self-interest using expected and discounted utility (Moscati, 2018). Choices are made by evaluating potential for gain and loss in pure terms, selecting the choice that best suits a desired outcome. This does not however consider how people use emotions when making decisions and how they are often required to make those decisions inside boundaries of, social norms, knowledge, information, and available time. The idea of bounded rationality was proposed by Herbert A. Simon in *Models of Man*, (Simon, 1957) and from there the Nobel prize winning work to unpick standard economics thinking of the *econ* by Amos Tversky and Daniel Kahneman (Kahneman, 2011b). Their work considered how individuals make decisions using heuristics and biases (Kahneman, 1982). The works refers to a few indicating factors. The first of these is Reference dependence: When evaluating potential outcomes, the decision maker considers a "reference level". Outcomes are compared to a reference point and classified as "gains" if greater than the reference point and "losses" if less than the reference point. This is evident in the choice making by commercial people in construction environments. It is also evident in the context of design work, minimum viable design exposes a designer to the risk of loss, so solutions are considered as optimised when the design risk is removed. As a double consideration if they include future proofing, the work will generate more fee than the minimum viable design. In this example, in most cases the designer would opt for a future proofed design justifying additional fee against the asset life benefit to the asset owner. The second factor in decision making is loss aversion: the effort expended to avoid losses are more than effort spent to achieve gains. In their 1992 paper,

Kahneman and Tversky found the median coefficient of loss aversion to be about 2.25, i.e., losses hurt about 2.25 times more than equivalent gains reward. And combined with loss aversion is a non-linear probability weighting: Decision makers over weigh small probabilities and under weigh large probabilities — this gives rise to the inverse-S shaped "probability weighting function". In making decision, in economic terms, some decision makers also experience diminishing sensitivity to gains and losses: As the size of the gains and losses relative to the reference point increase in absolute value, the marginal effect on a decision maker's utility, or satisfaction, falls. So, if the gain is too big, or remote from the decision, the decision maker is less sensitive to its importance.

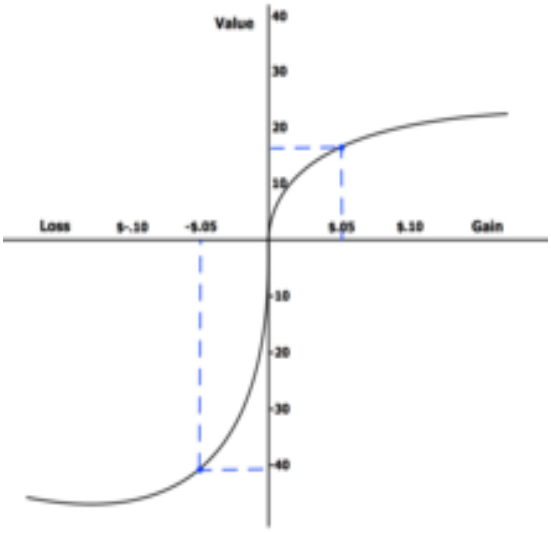


Figure 5 Loss aversion model (Kahneman, 2011c)

The natural progression from conclusions drawn from Kahneman and Tversky's work on heuristics and bias is that there is need, in the desire to achieve consistent predictable outcomes for capital construction works, to define a choice architecture to nudge behavioural decision making. Simon (Simon, 1957) defined the bounded rationality that can be relied upon to make the same free will decisions. Without formally educating every participant within a community, any new model is likely to have 15-20,000 participants, it is safe to assume that decision making will take place in situations of uncertainty. So, it is likely, due to poor communication and education in the details of any new model, that few behavioural decisions will be "rational," ergo, most will be "predictably irrational."

Expected levels of productivity built into project schedules do not provide participants the luxury of lengthy periods of decision-making time. It is highly likely that without an effective decision-making architecture, communicated to become social mores, little decision consistency will exist. Heuristics are based on relatability and availability from historic experience or training based on historic outcomes. For successful operation of any new procurement model participants must simplistically be encouraged to focus on four key areas: efficiency, predictability, scheme outcomes, and customer

value improvement. These in turn inform the design of nudges that allow a practitioner to rationalise the relationship between their immediate action and their company's commercial success. However as always, the size of schemes in infrastructure risks creating a desensitised decision process because of remoteness of the decision to the loss. As success is perceived differently by each pluralist postmodern (Hatch, 2018) tribe each will establish its own benchmarks of behaviour. Specifically, to drive consistent adoption, social acceptance is incredibly important to enable participants to reach a satisfactory decision rather than what the community may consider rational, but in terms of the model is an irrational decision. Calculating an individual's capability to determine an optimised satisfactory decision requires a rational model based on nudging decision makers away from predictable irrationality.

Construction projects are undertaken by contained communities in which decisions should be focused on similar objectives to achieve a common imagined reality. Client and supplier, including designer, first or sub-tiered supplier, are made up of people. Those people's focus is defined by conditions of their employment and, in the case of the supplier, terms of their contract. Few, if any, participants will be voluntary and so all are driven by commercial sustainability. Each person and group will be briefed by respective employers on their organisation's ambition from each commercial engagement. People, when being employed, will be assessed for competence in a chosen field assessed on the potential to apply learning from historic performance to future events. Specific task requirements will be described after they are employed, when a project is secured and starts. It is then constraints and standards, to which a project outcome must conform, are known. Each person will be aware, through briefing, of the commercial implications attached to allotted tasks and activities. This briefing should include identified threats and opportunities considered when each company enters into its agreement commonly termed 'understanding the deal.' This, basic and common approach to project initiation is a consistent process of boundary setting. It creates a regular bounded set of group dynamics, rules by which effective decision architectures can be informed.

Knowing all these factors improves the potential of designing a model attracting decisions that are more rational than irrational. But decision making is more than 85% based on heuristics and biases, including a status-quo bias. We know this from work done pursuing libertarian paternalism (Thaler and Sunstein, 2008). Decisions will be influenced by social acceptance “mores” of satisfactory decisions rather than optimal or novel decision-making. It is this creation of a more (social norm) within a scheme community that motivate an integrated project delivery team.

As well as defining a decision-making architecture to combat, amongst many other biases, status quo bias, any high productivity model should establish nudges based on irrational historic, and socially acceptable, decision-making experiences from the Collaborative Delivery Framework. Feedback can be informative in design of a new model as it is from people, with similar capability, in similar situations, working for similar companies, under similar pressure. There is cross over between status quo bias and availability heuristic in this area. However, predictably irrational behaviour, informed by other biases such as uniqueness, overconfidence, and pessimism bias, has similar characteristics. Scenario testing during a design research cycle could identify these similarities to test and challenge prototype choice architectures using a simulated actor.

In contractual arrangements, based on transactional behaviour, clients hold a supplier to account, and visa-versa, against contracted commitments. Shifting risk under terms of a contract assumes that capacity to control a risk will sit with the party best equipped to exercise that control. In entering a contract both parties assess and value the required management of these risks. This, in turn, prompts behavioural decisions some of which become counter intuitive to the desired outcome. Transferring responsibility for control also changes the dynamic of information provision and required capability of both parties. The more risks transferred in a contract, the more a client has responsibility to ensure that a supplier can be informed about and manage those risks. With more transferred risk the greater the need to be specific and definite about boundaries and conditionality of outcome. The more risks transferred, the more complex and expensive (time and

money) post contractual change becomes (Egan, 1998, Hughes et al., 2012, CITI_Limited, 2017, IPA, 2013, Nuno et al., 2004).

In designing a new procurement model, an opportunity exists to create a unique environment of self-organisation amongst a delivery ecosystem of client and multi layered supplier communities. This is called an Integrated Project Team. Adoption of a new choice architecture for the whole integrated project team could use interrelated incentives and benefits as well as risks. Establishing an interrelationship across an ecosystem targets status quo bias evident from a reluctance to move away from current ways of working; availability heuristic. A new model provides opportunity to create a mechanism that generates a group dynamic that 'raises the bar' of acceptable behaviour across this social group and, through self-organisation, embeds self-policing within the ecosystem.

Any model seeking to deliver many projects across a programme is, by necessity, complicated. Effective communication of changes in decision architectures, away from common ways of working, is essential for participants to understand new decision boundaries and consequently provide an environment for self-organisation.

Contracts form the basis of an agreed decision architecture between commercially contracting parties. Contracts define who is responsible for what, and what happens between parties if this changes or in the event of commitments not being met. Building on legal precedent and experience, agreements in large scale infrastructure are in a standardised format to help people understand what to do and when to do it. This provides a 'standard' decision architecture based on a combination of rational-legal authority and traditional authority. Bespoke changes to standard forms of contract, by individual users, create a specific decision architecture between that client and its suppliers when entering into such an agreement.

Behaviours learnt by suppliers and clients in the highways market need to be reassessed and changed if necessary. The damage caused by these behaviours, evident in feedback from a review of

practice, signalled a need for urgent change but requires consistency of application. Change requires conscious decisions made to continuously improve alignment to scheme and business objectives.

The revised process of decision making must address the process of decisions within a set of culturally influenced behaviours. Realising that the decision-making behaviours that exist may, as in construction of highways, have been formed into individual and corporate habits is important. The cycle of decision making that inform behaviours can be seen in the diagram:

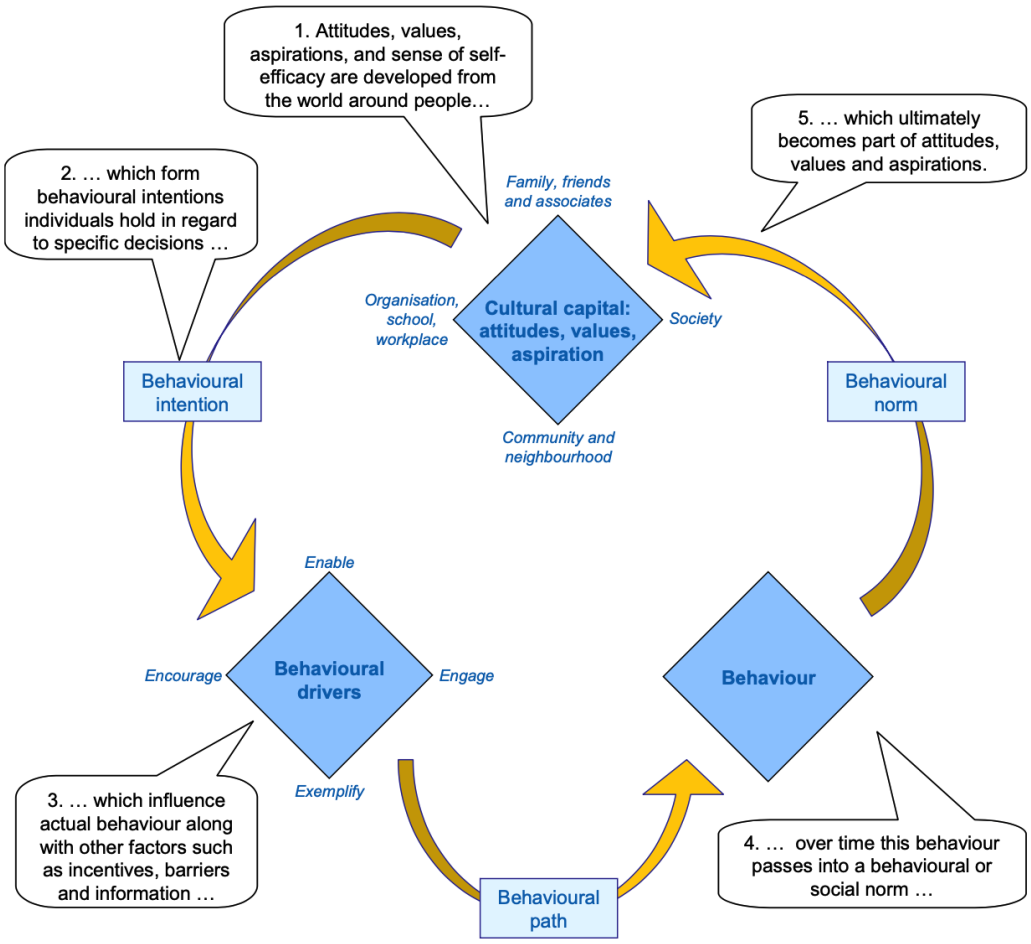


Figure 6 The cultural capital framework (Knott, 2008)

Alignment of risks, rewards and objectives provides an opportunity for non-value adding and inefficient behaviour to be removed. These behaviours will not be removed by active intervention, but by “nudging” decisions that empower individuals not to want to create waste. This brings the

decision and impact back to the individual and creates greater sensitivity in the utility of their decision making. These decisions can be informed by a belief that the benefit to them from integrated project delivery, in the form of saved cost and access to future work, is directly visible and relatable to their decision making (Kaplinski and Tamosaitiene, 2010, Atkins et al., 2017, Thaler and Sunstein, 2008, Kahneman, 1979).

3.1.7 Nudge theory

Nudge theory, developed in cybernetics by James Wilk (Wilk, 1993), was described by Brunel University academic D. J. Stewart as "the art of the nudge" (Wilk, 1999). In 2008, Richard Thaler and Cass Sunstein's book *Nudge* (Thaler and Sunstein, 2008): *Improving Decisions About Health, Wealth, and Happiness* brought nudge theory to prominence. This work describes how decision-making influences, conscious and unconscious, can be described in decision architectures, given appropriate conditioning of a decision maker. This conditioning is informed by aspects of social science and behavioural insights applied to economic decision making. Nudge is closely related to economic behaviours of Prospect Theory and Herd Theory. In pluralist, postmodern tribes, were cognitive boundaries, biases, or habits (Thaler and Sunstein, 2008) of the tribe are conceptual, as with communities that deliver highways enhancement schemes, mandatory changes are almost impossible to achieve. Social norms are required to effect sustainable change. These must be derived from common feelings and signs. It is hard to create ownership of sustainable change in groups where people are well informed and dynamic as they require reasoned arguments to make individual decisions. However, if social norms are created, and herd behaviour moves, then critical mass, required for sustainability, can be achieved. Nudge theory can maintain change most effectively by influencing a group's choice architecture. It alters the dynamic environment in which an individual's decisions

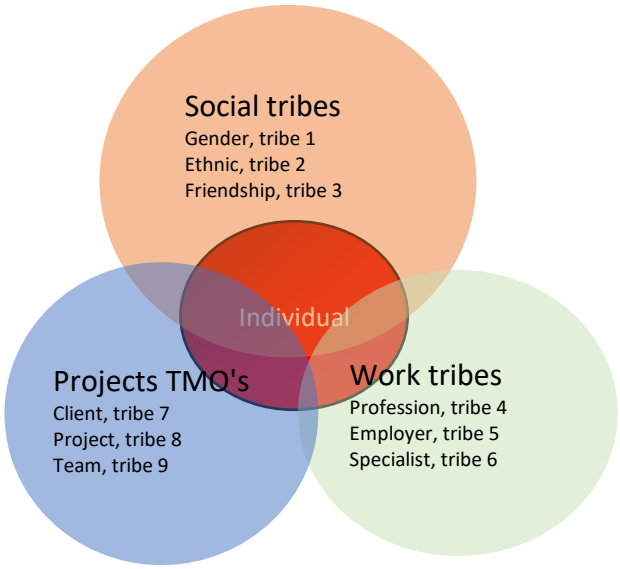


Figure 7 multiple Tribe influences

indicate its behaviour in a predictable way without mandating options. With construction contracts however, it may be necessary to rethink available economic incentives. A nudge consists of an intervention that is easy and cheap to avoid but has great economic potential if adopted. Nudges are not mandated, e.g., pension "opt out" schemes count as a nudge, compulsory pension schemes do not.

Hanson explores this is in his essay *Nudge and libertarian paternalism: Does the hand fit the glove?* (Hansen, 2016) where in defining nudges, he explains they sometimes:

> *"… may be combined with traditional regulatory approaches but work independently of the rational consequences of (a) forbidding or adding any rationally relevant choice options; (b) changing incentives, whether regarded in terms of time, trouble, social sanctions, economics, etc.; or (c) the provision of factual information and rational argumentation."*

This recognises a situation experienced in contracted supplier environments. The contract defines agreed actions and responsibilities, but participants often respond primarily to tribal or perceived economic drivers.

To design appropriate nudges, consideration should be given to counter intuitive, irrational, and damaging behaviours that have been experienced whilst trading with both designers and delivery suppliers under Collaborative Delivery Framework. Where a nudge, created by a decision architecture, is designed to change one behaviour it may also change others. An intimate knowledge of commercial strategy, contract documentation and operating behaviours of many "tribes" within this community will be needed to affect an efficient model design.

An effective nudge prompts a subtle, but determining, change in behaviour. It is considered participant choice, even when it is part of a designed change to their choice architecture. Key suppliers are all employers and use decision architectures in their businesses that are consistent and well defined. Training of most professional pathways across this community defines how to combine recognised practice with defined regulations, standards, as well as moral and ethical activities. This

elevated level of definition has been considered a constraint on change. Collaborative Delivery Framework relied on moral realignment of participant behaviour to break down interface tensions and cognitive boundaries, biases, and habits. While its moral direction stays intact its choice architecture has not been successful in preventing regression by participants to more transactional and traditional behaviour.

Hansen (Hansen, 2016) draws a distinction between nudges and nudging. A nudge is defined as "…we have always been using nudges, attempts at influencing behaviour; but nudging is the systematic and evidence-based development and implementation of nudges in creating behaviour change." Any new model, in changing the decision-making architecture of agreements, will be nudging as it should hold a series of interlinked and co-dependent nudges.

Creating the possibility for participants to choose different behaviour through nudging can be used to encourage changed behaviour to become a social norm. If successful this could set up a necessary quasi-equilibrium, (Lewin's step 3) necessary to embed change into sustainable practice.

In a highway's delivery community, there is a predominance of educated and motivated individuals. As previously described (Earls, 2009), these individuals form part of pluralist postmodern "tribes" with conceptual boundaries. In most instances these "tribes" have overlapping boundaries. A commercial manager may be in up to 6 recognised tribes simultaneously.

Figure 8 Tribal influence on one person adapted from (Earls, 2009)

All these tribes have learned and expected behaviours fixed as social norms. For an individual to remain acceptable to at least 4 of these 6 tribes, they must navigate a labyrinthine set of social rules and norms. The infrastructure construction sector, developed over many generations, has honed

each of these tribes and their inherent mores. To change this means overlaying change into the context of these rules and social norms. This change is targeted at affecting group dynamics. This may negatively affect performance whilst the new group dynamic is set up. The time this will take is not known and cannot be effectively estimated. Awareness of this impact on performance is key to keeping belief in the benefits of the change to the outcomes of schemes to maintain a positive attitude to change.

Some nudges rely on establishing anchors within a decision taking community (Thaler and Sunstein, 2008). Some nudges rely on availability heuristic using a behavioural decision architect's knowledge of trained responses in a participant cohort. Most designed nudges create asymmetry in a participant decision maker away from a status quo bias (Thaler and Sunstein, 2008). All known and professionally, or contractually, defined decision-making architecture depends on known ways of working and should be reviewed. If an established way of working does not support a desired outcome, the way of working will need to be nudged to align with the desired outcome.

To effectively create a sustainable decision architecture, that nudges behavioural decision-making, each potential tribes' social norms need to be considered. The model should treat these tribes in a system thinking strategy; how does each system work within itself and with each of the other tribal systems.

Not all behaviour is consistent across a community. The design of each nudge needs to consider how they will be viewed by different tribes within each community. Each nudge relies on a degree of rational behaviour and alignment to recognised authorities (Baiden et al., 2006). Each nudge is tuned to allow a participant to make a rational choice, regressive behaviour, or progressive behaviour. But there are only rewards for rational choice that progress the whole community towards integrated project delivery (Fischer et al., 2017).

3.1.8 Change Theory

Any new procurement model for highways enhancement work needs to be designed to generate improved choices in decision making, better performance, more predictable, and continually improving, productivity. From work by Kurt Lewin (Lewin, 1947) in the mid-20th century, successful change requires an understanding of context and then three clear steps. **Unfreeze**, where the status quo is disrupted; **Move**, where the change is controlled but happens; and **Refreeze**, to re-establish a steady changed state. There are challengers to Kurt Lewin's work, as discussed in *Kurt Lewin and the planned approach to change: A re-appraisal.* (Barnes, 2004) However, the premise of Lewin's work, around transient communities, and integration of community factions to achieve a changed set of outcomes, has relevance to this research. Most detractors (Barnes, 2004, Dawson, 1994, Dent and Goldberg, 1999, Hatch, 2018) use the premise of permanent management and organisational structure. From Barnes's re-appraisal it is evident that the combined work of Lewin should be taken as a whole. First, in assessing context of decision making, the Field; *Field Theory. (Lewin, 1947)* Second, looking at group mix in which decisions are being made (*Group dynamics*). Third, by development of solutions through trial and improvement (*Research Action*). This leads logically to implementing change in a controlled manner (*3 Step process*). This systematic process of alignment may be useful in the implementation of a more successful change across a supplier community using a new procurement model. The transient nature of a temporary management organisation, assembled and disassembled by participants for project delivery, is akin to communities that ebb and flow in society.

To improve the chances of success in implementation of a new procurement model to the highway's community, adopting a Lewinian change process could be helpful. When designing change as a process we must be mindful of the nature of construction projects and the likelihood of Framework team members ebbing and flowing throughout what can be six-year periods. Lewin recognised that behavioural choices are heavily influenced by environmental context, in this case a project, bounded by an agreement and behavioural expectations contained in it. This is influenced by *group dynamics*,

including authority, in all its forms, delegated to either a group or an individual. This is also influenced by accepted and understood (trained) knowledge and processes used to determine an available solution to many task-based challenges. *Group dynamics* are influenced by social norms within a community. These can work for change, and against it. So, an understanding of a community landscape is essential. In building a new model designers will need a first-hand knowledge of context and group dynamics to understand which nudges will promote or suppress sustainable change.

Lewin's *3 Step Model* (Lewin, 1947) could be used to implement change across the community from Collaborative Delivery Framework to operation under a new procurement model.

There may also be a correlation between attitude to change and constraints around knowledge transfer suppressed by competition. Participants with low levels of transferrable knowledge, or with a misplaced sense of authority or power from historic knowledge, are likely to simply regress to the mean of available knowledge from the existing model. Structuring the process of change loosely based on Lewin's findings may enable a more successful change in the behaviour of this community. Regression to the mean, fear of change, and misaligned objectives from company tribal behaviours will all pose a risk to the success of being able to change from one procurement model to another.

3.1.9 Self-Organisational Criticality

The Process Enneagram - Common purpose: In *Partnering for safety and business excellence* a spin-off from his book *The Leadership Dance* (Knowles et al., 2002) Richard Knowles explores the key to ownership of safety rules by a workforce (Dupont's chemical manufacturing community) to improve safety by reducing disruption to productivity and performance. Knowles focused on improving safety in a manufacturing setting, using the principles of self-organisational criticality transferred from biochemistry to business. He saw the similarity in people organisations to be complex, adapting, self-organising, networks, and subject to criticality. He observed an organisation develops when the people in it; feel like they belong; have a role to play; and decisions are made by the right level where the right information resides. In establishing his theory around the power of self-organisation

to improve performance in a business environment, Knowles describes a virtual 'crucible of decision making' around live activity enabling the organisation to 'self-organise.'

Knowles describes nine factors which influence optimal performance. In a competitive business environment teamwork is focused on the principal tenants of **Identity**; knowing your role, **Relationship**; understanding your role in the context of the organisation, and **Information**; ensuring that decisions are made by people with the all the right information. Taken from the Greek for nine-sided, an Enneagram is a nine-sided tool describing complexity and used as virtual boundaries which Knowles recommends as the basis for individuals and teams to self-determine operating rules for performance in a contained environment. In his experience rules described and defined by a team within itself are significantly more effective at changing critical decision-making behaviour than rules parachuted onto a team. The contained environment experienced in a construction project looks similar, if temporary in nature, to these conditions during the four to six years of intense activity through development, construction delivery, and hand back.

Parts of self-organisation philosophy may be able to be used to significant effect. Nudging, by challenging a community to set its own improvement 'rules,' would indeed establish ownership of a new social norm by the community. Connecting people on packages of work with their role, understanding how their role meshes with the temporary management organisation and project objectives, and creating effective information management may improve performance. If this enneagram format could be constructed within a procurement model it would, in effect, nudge the community to change, and perform, to what it perceives as its own rules. But in setting the parameters of this self-organisation the model might be designed so that those self-determined rules increase sustainability of the community in this market sector and achieve the clients' objectives. In Knowles language nudges set the boundaries of the self-organisation and the parameters of the pathway towards improved performance.

3.1.10 Selective literature review

3.1.10.1 New thinking in project delivery and support

Academic thinking in the development of infrastructure construction productivity is confined to integrating project delivery based on LEAN and six sigma methods of works. This is highly effective at changing processes and activities of people empowered by their employers to allow change. However, the issue faced by the UK highways market lies in procurement models that do not create integrated project delivery environments. New thinking is emerging from the practical integrating of project teams in the U.S., using healthcare as a commercial construction environment, where client value is used to define successful project outcomes. However, transition in the UK infrastructure construction market from transactional relationships, through collaboration and into integration, has been slow. This turgid pace is levelled at procurement models that create unintended consequences for suppliers and clients alike. New thinking in the restructuring of integration agreements may help in this but will only create traction if sufficient focus is given to changing decision making and significant reductions in damaging behaviour.

3.1.10.2 Misaligned incentive mechanisms and Integrated Project Delivery [2015]

Research done in 2015 into potential impacts of misaligned incentives on client expectations (Do et al., 2015a) identified that incentive mechanisms in U.S. Integrated Project Delivery / Target Value Delivery projects, led to unintended consequences through predictably irrational behaviour by participants. It found:

Cause	Unintended effect
Imbalance of overhead and profit	If by increasing turnover, a party can generate profit from inefficiency, it introduces an imbalance in risk and reward to the community
Not all profits are at risk	The greater the extent of a profit position is at risk, the more focus there is on success
Difficulty of moving budget and scope between cluster groups	Budget and scope must relate to the whole, and not be fragmented, to improve decision making behaviour

Payment by reimbursable time does not reflect the progress of the project	Earned value: must reflect the value of the work done not simply the cost to avoid misleading progress assessment
Untimely release of profits	Prolonged delays in realising gain-share based on delayed final assessments is damaging to trust and morale
Team members that have a major impact on the project's schedule and cost were not in the risk pool	All participants must have incentives aligned and coordinated
Members outside the risk pool did not attend coordination meetings	Mutual trust and cooperation based on a single version of data can only work if key participants participate
The target cost was set based on price rather than worth and is not shared with the team	The delivery partner community must "own" the budget for incentives to work
Owners who want the benefits of target value delivery/integrated project delivery (AIA, 2007)but were not willing to do the work	In integrated project delivery and target value delivery models the client / owner, as a full and participatory part of the team, must engage. Without this engagement the incentives will not work
Owners forcing the team to cut profits	In setting a budget the owner has determined that is what it is prepared to pay, excessive gain is not changeable after the event without damage to relationships

During research additional potential misalignments were identified by research teams but were not evident in sample projects:

Cause	Unintended effect
Contingency does not truly reflect the risk involved and may be hidden elsewhere	If the risk provision in the target cost is hidden there is opportunity for the delivery partner to create turnover instead of gain-share
Exploitation by owners to get a project without paying delivery partner gain	Like ten above but wilfully deceptive on the part of the owner
Members signing onto a target value delivery/integrated project delivery project with no intentions of achieving the target cost	Like two above but wilfully deceptive on the part of the delivery partner
Firms do not send their best people to work on target value delivery/integrated project delivery projects	Logic suggests that the best people are deployed where the most gain or loss is likely. This needs to be evident to prompt deployment of the best people
There is a lack of competition since construction is not competitively bid out	This is a concern of owners and requires selection to have some form of competition

Findings from this research, in the field of private sector hospital schemes in the US, is like commercial participants behaviours when operating under Highways England's Collaborative Delivery Framework model. There are subtle differences, but identified irrational behaviour is similar. This research confirmed that to operate effectively as an integrated project delivery model (Fischer, 2017) all integrated project team members must operate in the spirit of the model and act with integrity.

The key findings were:

1. Work to build and maintain trust amongst partners.
2. Understand what is important to each other's businesses.
3. Training in lean construction, and how integrated project delivery is different, is related to gain share.
4. All parties to an agreement must invest adequate time and resource to make it work.

In Martin Fischer's book William McDonough, in a forward, described it as, "...in effect, the art of marshalling collective intelligence, creativity, and imagination and advancing that composition towards highly effective outcomes…" To combat previously experienced predictably irrational decision making, any new procurement model needs a series of nudges and incentive strategies to promote rational behaviour aligned to objectives and outcomes. Any new model must reflect the pipeline of work and expenditure of the asset enhancement programme, and the integrated team must include the owner/client. Gain or loss potential needs to be evident and obvious to suppliers.

3.1.10.3 Fresh thinking needed for mega projects [2016]

In 2016 *Fresh thinking needed for mega projects* (Madden, 2016), considered why mega projects may be less than optimal in their delivery. Madden discusses a need for major infrastructure projects to focus on serious organisation and governance in the form of a formalised temporary management structure. The paper reflects a need for decision making architectures that support the objectives of mega projects. It also discusses the impact on mega projects of political influence and stability of purpose, in this context, to achieve success. Madden describes mega projects as "…usually more than £1 billion…" with a wide range of parties brought together throughout a project's long duration.

Focused on mega projects, Madden explains how important temporary management organisational thinking is. The need to carry intent, purpose, and strategy from the beginning of a project through to its end. His proposition is that while conventional projects are focused on efficiency, schedule and risk, major infrastructure projects face large scale transient community movements throughout their duration. It is precisely because of this constant changing of people throughout a project that management organisation must be equipped to maintain focus. Madden, in part, responds to *Over-optimism in government projects.* (NAO, 2013) in which the National Audit Office paper identifies key contributors to over optimism.

Temporary management organisations are described as needing “open system” thinking, agility in transition from stage to stage, as they involve transient communities of businesses and people over a prolonged period. Findings suggest a temporary management organisation must not be fixed at the start and rigid throughout a project’s life. For success, they need to flex in size and shape. Madden advocates viewing schemes as a series of shorter delivery phases or “sprints” using parametric analysis to create productivity benchmarks against which progress, and performance can be measured.

Madden’s paper goes on to spotlight a need for effort and resource invested at the front end of project processes to properly define benefits and aligned solutions that create effective management throughout the long-term delivery of a scheme.

Madden concludes that mega projects are different, and need to be treated as different, they fail if simply managed using scaled-up project methodologies.

Madden’s thoughts around a need for open, flexible, and agile systems and properly thought through temporary management organisations resonates in the highways sector. In talking about organisation, governance, and systems however, his analysis confuses the design of an environment with potential individual influences on decision making in an ever-changing conceptual and pluralist environment. Designing the context and environment is not enough to generate success. Recognising the impact of group dynamics on behavioural decision making is needed. Any new model needs the capability to continuously measure and inform decision makers confidence derived from integrated behavioural decision-making indicators. While the strategy of short sprints to maintain focus on performance is right it requires an environment and systems to be more effective not simply assuming organisation, and governance design are key factors in achieving success. It needs changes in behaviour of the tribes engaged to do tasks that form the work.

3.1.10.4 The Oxford Handbook of Mega-project Management

In this seminal work relating to the principle behavioural theories around the success and failure of mega-projects, Flyvbjerg explores how and why schemes are started when there is so little fixed information. He goes on to ask why they so often fail against the investors ambition and hypothesises that the reasons have common themes he labels “sublimes” (Flyvbjerg, 2017a). These commonly inform the drivers that, even at the start, cause people to make decisions in mega projects that result in failure. The four ‘sublimes’ are:

1. Technological: the excitement technologists get from the project
2. Political: the associated power from political influencers being associated with the project
3. Economic: based around how much economic value both public and private is associated with the project
4. Aesthetic: the pleasure derived from being associated with something of a landmark status.

The premise of Flyvberg’s research is that these sublimes overpower the thinking of planners and investors despite evidence that there are repeating and obvious blind spots in developing and delivering mega-projects. While Highways England’s portfolio of projects in regional Investment are not considered, in the context of mega-projects, they would benefit from use of the same iron-laws around sublimes.

The blind spots noted by Flyvberg are categorised as:

Blind Spots	Highways equivalent
Large projects are inherently risky due to size, gestation, and delivery periods.	Highways projects take five to eight years from inception to completion.
Projects are often led by people with only partial competence in similar schemes.	Availability of resource has become the basis of selection.
Decision making is by groups with conflicting interests despite a desire to be aligned.	The construction process is fragmented with trading agreement fragmenting risk and causing interface issues.

Solutions are considered unique due to size and grandeur provoking uniqueness bias.	Every project is in a different location which stimulates a feeling of uniqueness.
Fail fast does not happen due to the impact of escalated commitment – too 'locked in' to fail.	Failing to meet commitments is prioritised as reputational risk.
Sums are so large that optimism bias becomes a prevalent issue	Typically schemes between £20 - £900million
Changing requirements over time disrupt or compromise the schemes objectives being achieved.	Multi-faceted stakeholder groups with key representatives and policy change contribute
Managers tend to ignore the likelihood of 'black swan' events during the development and delivery timescales.	Complex schemes take a lot of planning and management thinking and teams become insular.
Because project approvals seek to avoid including provision for 'black swan' events, there is often insufficient provision for uncertainty.	Highways projects do include 'portfolio risk' which seeks to aggregate black swan events across the portfolio, not within a project.
Because of the above, projects information and decision making is subject to strategic misrepresentation of both costs and benefits.	Additionally reporting culture tends to bury failure and lessons learnt are too infrequent across portfolios or even in programmes.

The learning that can be taken from this is that large and mega schemes will break [fail] because of a combination of; 1) the sublimes and biases present, and 2) too few competent people in control of schemes. The options are:

a) get it right from the start and be more honest about the process, or

b) become more competent at fixing schemes when they inevitably break [fail].

Many of the biases referenced in this book were those reflected from practice in highways during *Collaborative Delivery Framework*. They have resonance in this sector and so the thinking and description of the bias into discrete categories will be useful when building a prototype procurement model.

3.1.11 Applicability

What differentiates historic procurement models success or otherwise, when implemented, are:

- Choices made by individuals at key points
- Alignment of procurement model environment to goals and integrating project delivery
- Poor management of change.

To improve the chances of success in implementation of a new procurement model to the highway's community, adopting Lewin's 3-step change process could be helpful. Theories around behavioural insights and economics, why people do what they do, is commonly based on socially influenced habit, personal drivers, perceived benefit, and informed by emotional response rather than fact. Infrastructure construction is perceived as being highly engineered, with deterministic systems thinking with high volume but moderate complexity. In terms of the choices decision makers make, little work has been done to systematically nudge emotion driven irrational choices to improve productivity. The findings of this review indicate that several ideas from literature may contribute to resolving problems prevalent in construction procurement models. Rational-legal authority is a premise upon which all contracts are drafted and take effect. But to be more effective they may need to describe a story (the project in an agreement). This is turned into a common 'imagined reality' amongst all members of the extended integrated project team community. The story must be clear and relevant to influence aligned participant decisions so that a designed temporary management organisation can achieve the commonly imagined reality of the asset enhancement. To be effective the procurement model must reduce remoteness from consequence of risk and responsibility transfer. Creating a short and visible 'Golden Thread' between action and consequence.

From these underpinning theories, there emerge several guiding thoughts:

1. **Directly aligning the decision makers choice to a commercial outcome, good or bad, may be the key to sustainable productivity improvements -** Reviewing practice highlighted that

success is all about how connected to the consequence, aligned, motivated, and engaged the people involved are. And the ability of suppliers to connect people to behavioural change and innovative ways of higher productivity working that leads to improved delivery performance. Expected value theory is a tool used by people judging the value of a decision. This judgement contributes to the emotional response needed as a component of loss aversion.

2. **Therefore, loss aversion has potential to improve incentivisation modelling by connecting an individual's emotional response as well as a perceived commercial one -** Incentivisation in this regard could be focused not only on loss of cash, but also loss of trust and reputation that leads to loss of access to future work. If the power of loss aversion, found in Kahneman's social experiments, transposes to the procurement models we use in construction, it could double the effort made by decision makers to improve productivity. By connecting decisions directly to avoid losing profitability and jeopardising sustainability through accessible work pipelines. The ability, for a procurement model, to create and communicate a new way of working across a wide range of people for a sustained period will play an important part in improving sustainable productivity improvement.

3. **For successful operation of any new procurement model participants must simplistically be encouraged to focus on four key areas: efficiency, predictability, scheme outcomes, and customer value improvement -** The need for change is evident but the means of achieving it is not. Building on learning from social experimentation in the field of behavioural economics and extrapolating findings into this field has potential. The validation of someone's actions or decisions, through perceived social compliance, enables each person to be more comfortable that their choice conforms with its tribe's social beliefs, even more so if it complies with traditional or charismatic authority.

4. **To succeed tribal social norms must align with the desired outcome** - otherwise at best an asymmetric decision will occur and at worst, there will be a complete misalignment between decision taking and a project's objectives.

5. **Countering predictable irrationality by nudging, using a series of specific and disruptive nudges** - could create a sustainable productivity shift so desired by clients, commentators, and practitioners alike. However, where a nudge, created by a decision architecture, is designed to change one behaviour it may also change others. Scenario testing will be required to identify similarities and test and challenge prototype choice architectures for unintended outcomes. An intimate contextual knowledge of commercial strategy, contract documentation and operating behaviours of many "tribes" within this community will be needed to affect an efficient procurement model. Development and delivery of road enhancement schemes engages large numbers of people. There are a myriad of relationships, tribes, social norms, authorities, and rules.

6. **The model should test tribal behaviour against a system thinking strategy; how do each set of mores work within itself and with each of the other tribal mores -** There is a constant call by construction deliverers for environments that deliver self-determining early involvement to influence solutions and share in rewards from innovation and disruptive thinking. A new procurement model provides opportunity to create a group dynamic that 'raises the bar' of acceptable decision making. It must respond to existing social group ontology, client, and suppliers at every level, and

Through self-organisation, embed self-policing based on incentivised outcomes within the ecosystem - There is opportunity to selectively transpose empirical evidence from social and behavioural experimentation to focus on more consistent, and continuous improvement of productivity. Focusing on changes to decision making within the procurement model has, if used with surgical precision, potential to achieve a sustainable step change in productivity.

3.1.12 Conclusion

The opportunity to use nudge theory to set policy to change independent choices is well documented. The social science theories in this review all have proven implementation in other social settings. There is an opportunity to take these theories and apply them to a new setting of highway infrastructure construction. Effective changes to productivity related decision making may be available by exploring the symptoms of poor decision making and identifying root cause. By using thematic data analysis and auto-ethnological data from groups of practitioners a new decision architecture, that complements a standard form of construction contract, could be crafted. Careful selection and design of a complex system of choices, and the architecture to guide practitioners away from poor productivity habits, has potential. The challenge remains to take the thematic analysis of data from case study surveys and interviews and combine it with learning from the underpinning theories. This offers the opportunity to design nudges that, when acting independently or as a suit, result in nudging the community away from habits of irrational decision making and into new higher productivity. Nudges designed to achieve new levels of production output will need to be supported by new commonly understood social norms. These will, as with any induced change, be put under severe pressure by tribal pressures from the social mores of the habits and sublimes of the mean activity, observed from case study data. As changing these social habits and commercial sublimes will take time, management of the expectation of the extent of change in the short term, will be needed with the sponsors of this research.

The development of a new highway high productivity procurement prototype from this research, that will stand up the rigour and testing of independent review and then market testing, will be unique.

4 Methodology

If change to highways enhancement project culture, structure, and activity is to be successful it must result in better safety, productivity, and predictability. Therefore, any new way of working must realign micro and macro decision making of thousands of involved participants in asset design and the asset enhancement delivery processes. Previous procurement models, based on the client's view, have not resulted in the desired change to behaviour, productivity, or waste reduction.

Qualitative research highlighted the options of deductive, inductive, abductive and retroductive logic. This research concentrates on retroductive logic by abstracting the behaviours of the past to determine the structures and mechanisms capable of producing future preferred events.(Hlady-rispal and Jouison-laffitte, 2014).

Research will follow the structure methodology described by Saunders as a research onion (2020).

Saunders *et al* (2007) develop the concept of research structure to identify the onion view. They establish that there are six layers to the onion and that choices must be made in each (see fig. 9). The layers are philosophies (1), approaches (2), strategies (3), choices (4), time horizon (5) and techniques and procedures (6). In each layer, there are a range of alternatives that can be selected – sometimes as points on a continuum and others as discrete choices.

This approach to designing a methodological framework provides a systematic basis for making aligned choices. The choices made in this research are now discussed in accordance with the research onion approach.

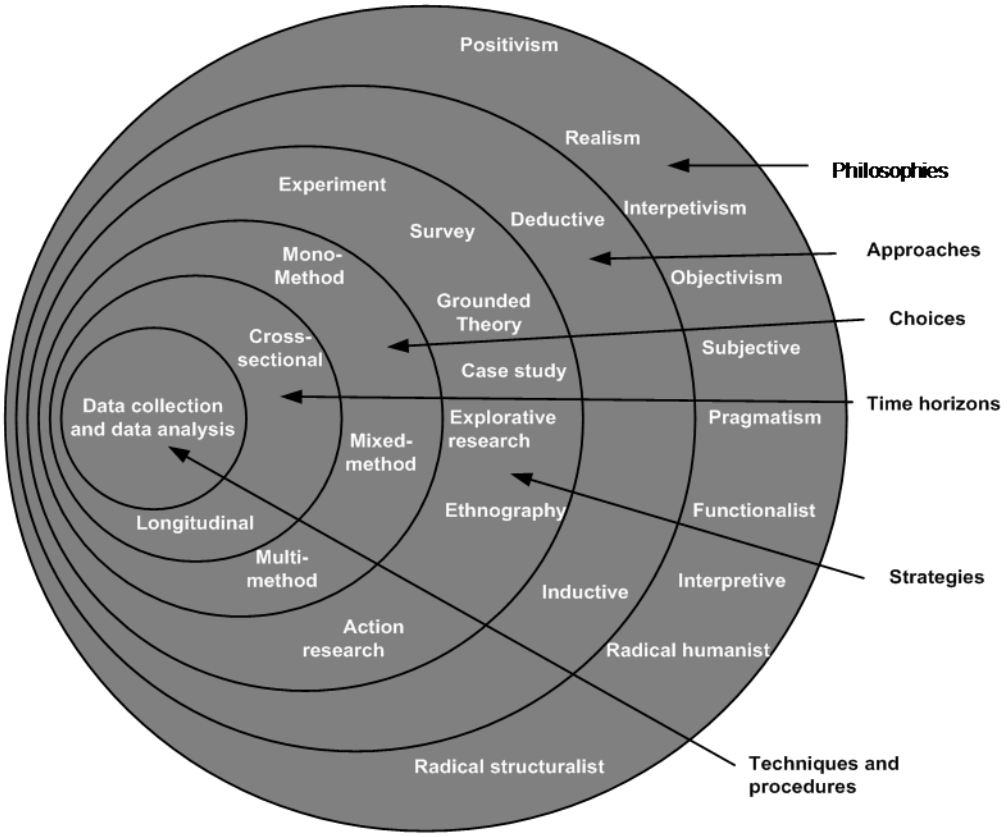


Figure 9 Research Onion (Saunders *et al* 2007)

The choices in the development of the philosophy of the research centred around the retroductive nature of the logic used to take qualitative data to abstract from historic behaviour to deduct the structures and mechanisms in a future procurement model. Historically a theoretical and functionalist approach has been taken to design procurement models but without success in changing the habitual decision making on projects.

1. The research philosophy is pragmatic and interpretive. The data needed to develop and analyse how social actors, and groups of actors, within the confined highway construction community have created, and habitually act in accordance with, social norms. It is not explicit or objective, but is, at times, vague and uncertain. It will, therefore, need interpretation to allow a proposed more rational set of social norms, that guide predictably rational decision structures, to emerge. The interpretation will inevitably reflect the perspective of the author and core team. However, to maintain objectiveness in the development of a prototype, the emerging concepts, ideas, and propositions are subject to

pragmatic simulation and thought trial using a commonly imagined actor that will provide scrutiny through exposure to the wider community.

2. The approach will principally be one of inductive reasoning. The process will involve developing concepts, ideas, and principles out of grouped analysis and subsequent interpretation of available data. These will then be organised and presented as nudges in the form of a new choice architecture for simulation and validation through pragmatic thought trial.

3. The strategy will be to develop theories based on simulated action research using survey data from a single community wide case study of Collaborative Delivery Framework. (See section 3.3)

4. The study uses mixed method of qualitative data. The methods of data collection and analysis are listed in 6 below.

5. The time horizon is cross-sectional not longitudinal. The evidence and data collected relate to engagement with the community from across the broad spectrum of disciplines in the strategic highway market at a relative single point in time . There is no attempt to observe a solitary case or group of cases over a longer period. Data relates to a particular engagement activity with multiple parties relative to a single data gathering exercise, which by necessity of its scale spanned a 6-month duration.

6. The techniques and procedures involved are (these are discussed more fully in section 3.2):

    a. Primary data collection

        i. Exploratory interviews

        ii. Validation interviews

        iii. Survey of wider practitioner groups

    b. Secondary data collection

i. Review of practice to define the problem

ii. Limited Literature review

iii. Underpinning theories

c. Data analysis techniques (prototype development)

i. Grouped analysis

ii. Wideband Delphi workshops

iii. Facilitated modelling

iv. Simulation using thought trials

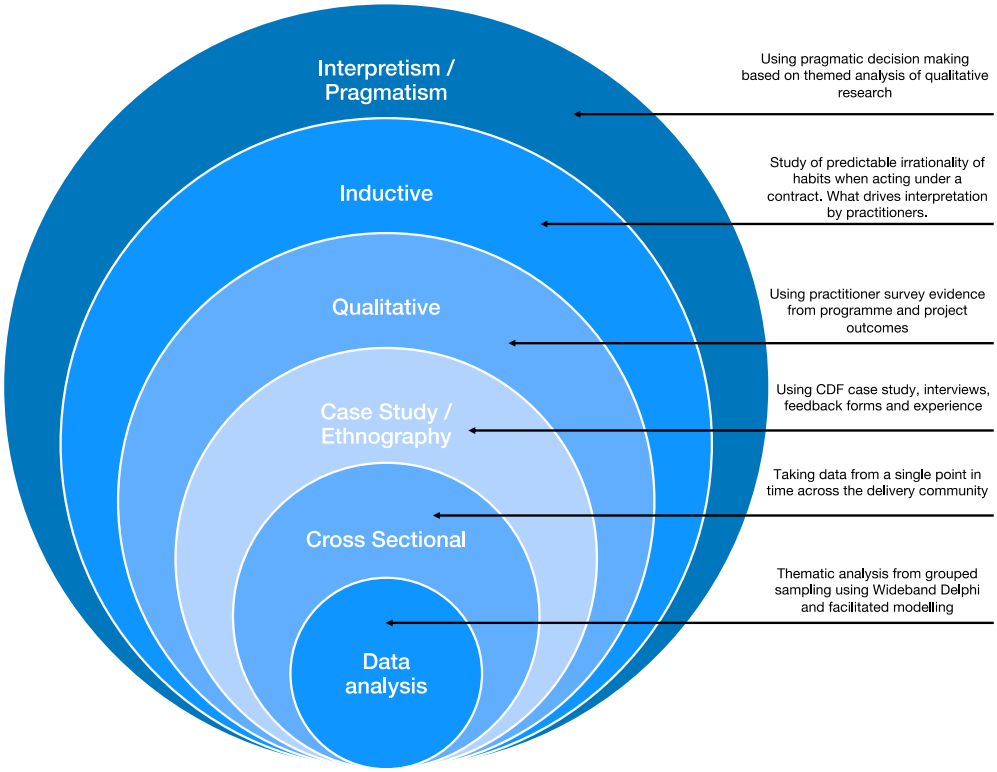


Figure 10 Research method (Saunders et al., 2016)

Building a prototype will follow this structure because it takes existing practice data from interviews and cases studies through retroduction determine a new alternative. By assessing the philosophy of

prototype design in previous procurement models as deductive or abductive where slight change has been evident this retroductive philosophy using facilitated modelling was adopted.

The flow of this process is described in figure 11:

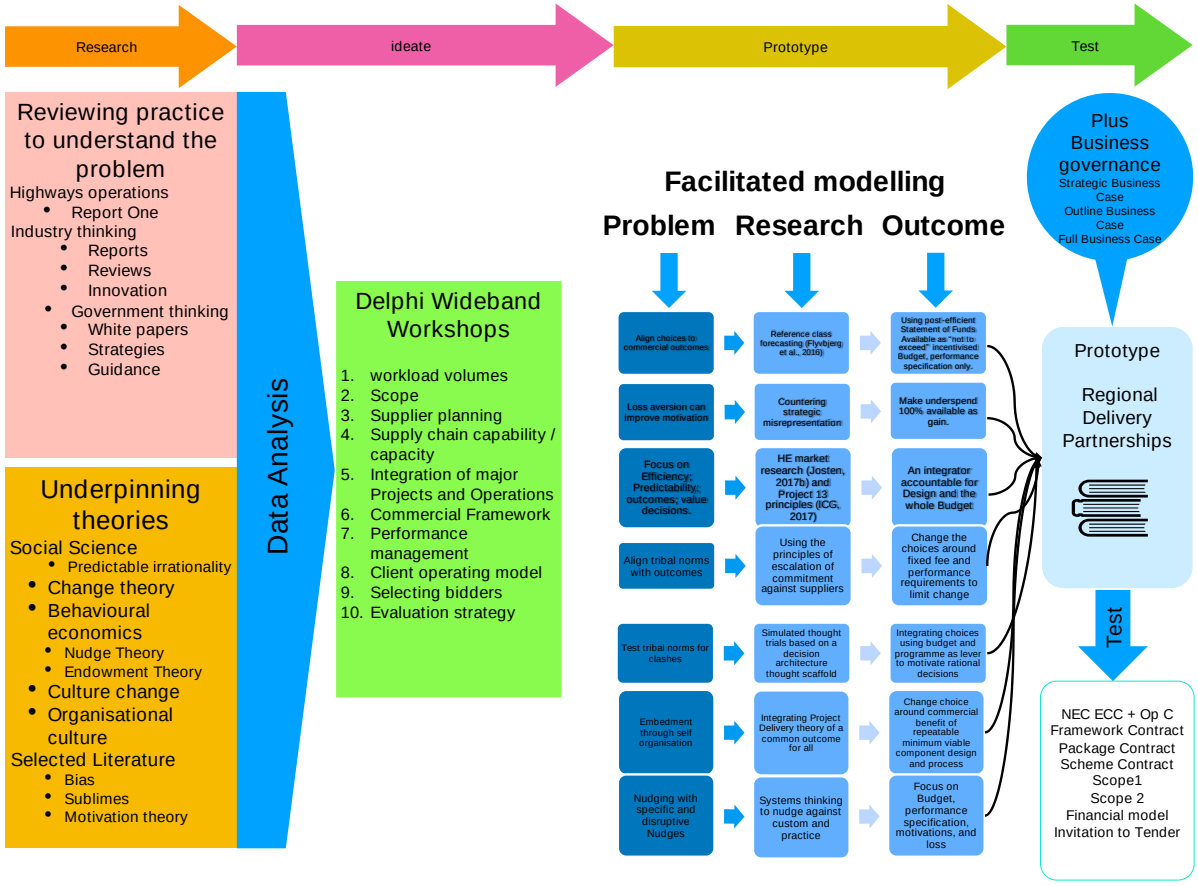


Figure 11 Research process flow.

To improve the likelihood of success in practice, wideband Delphi workshops involving experienced panellists using anecdotal cause and effect analysis across the existing hierarchy, will pragmatically determine opportunities for higher productivity choices. The primary researcher / facilitator was also a participant in the process. To counter the potential of research, bias all the decisions were considered across the core group, ratified by the design management group, and ratified by the steering group. The primary researcher / facilitator was required to substantiate any proposals throughout the process and record key decisions to be retained in the procurement model development records. This applied to the timeline shown in Fig 12.

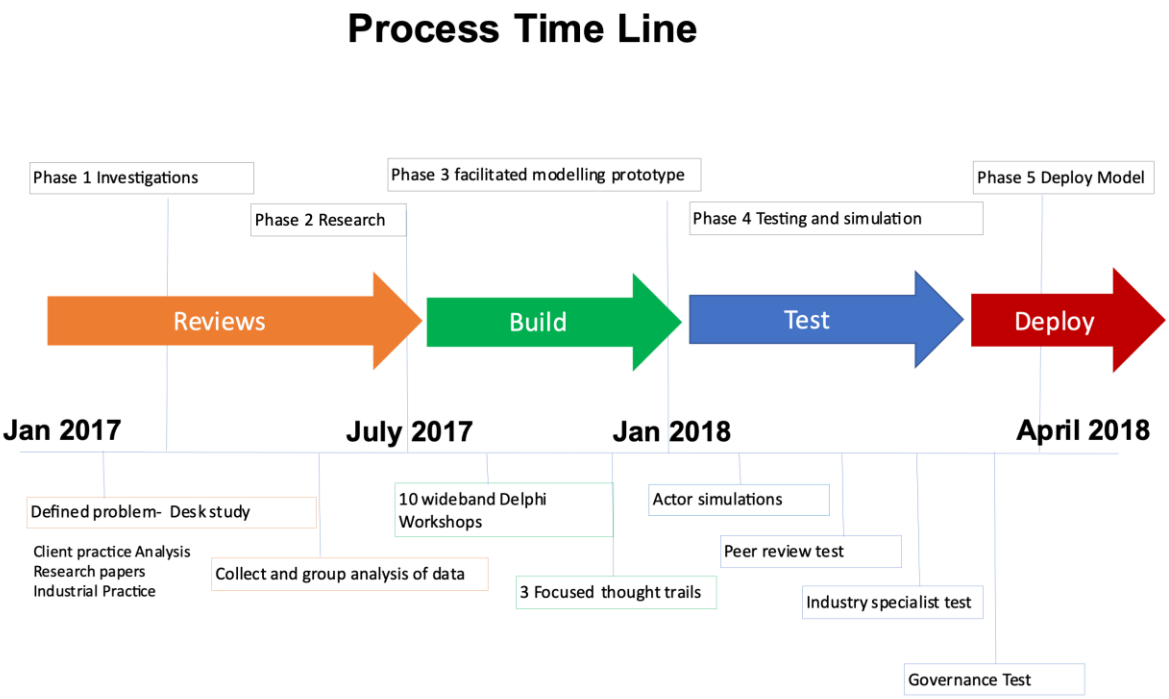


Figure 12 Process timeline

Using facilitated modelling a series of ethnological and auto-ethnological thought trials will be undertaken in Scrum sprint conditions using a theoretical agent to simulate outcomes. Predictions from this simulation will pragmatically construct and refine “choice architectures” (Thaler and Sunstein, 2008) to design a prototype capable of realising the aim. Changes in choice pathways will be used to pragmatically align decision making within existing hierarchical ontologies for designing and delivering road enhancement projects. These changed choice pathways will be intuitively designed to drive higher productivity and greater predictability.

To reinforce taking a pragmatic approach research considered the structuring of thinking which impacts on the choices people make. Establishing new choices in an existing social hierarchy will also consider aspects of Cambridge social ontology (Faulkner et al., 2017).

"These concepts form the basis for the 'morphogenetic cycle', which splits social change into three processes: [T1] conditioning → [T2-T3] interaction [T4] elaboration.

At T1, agents (as individuals and as groups) are conditioned by the social structure and cultural system. From T2 to T3, agents act, react, and interact at T4, the social structure and cultural system are changed (morphogenesis) or maintained (morpho-stasis)." (Archer, 1996)

To influence decision making research will focus on achieving a procurement model to intuitively establish aligned behaviour in ecosystems [integrated project teams] to realise the defined aim. Using information about why people make decisions, the research will first investigate how decision making is overtly influenced in social settings:

1. In a simplified post Michael Bergin helpfully describes ontological perspective (Bergin, 2017) and poses the question, "are social entities perceived as objective or subjective?" In this research they are considered subjective.
2. Qualitative research must determine realism, idealism, and materialism (Snape and Spencer, 2003) of the delivery environment.
    a) Realism is based on an external reality independent of what people may think or understand it to be, which, in this context, may be described as a contract or trading agreement.
    b) Idealism maintains reality can only be understood via the human mind and socially constructed meanings. This reflects the interpretation of a contract, or trading agreement, by an individual.
    c) Like realism, materialism also claims that there is a real world, but it is only the material or physical world that is real. In this context only a built asset, or physical design of an asset, is real. A Project Managers' key role is to create a common *imagined reality* (Rao, 1994) using clear and connected documentation to create

understanding. Other phenomena, for instance, beliefs, values, or experiences arise from the material world, but do not shape it.

d) John Dudovskiy in *Constructivism research philosophy* (Dudovskiy, 2018) describes objectivism and subjectivism as:

   i) Objectivism "portrays the position that social entities exist external to social actors concerned with their existence"(Catterall, 2000).

   ii) additionally, objectivism "is an ontological position that asserts that social phenomena and their meanings have an existence that is independent of social actors."

   iii) Subjectivism (also known as constructionism or interpretivism) on the contrary, perceives those social phenomena are created from the perceptions and consequent actions of those social actors concerned with their existence. Formally, constructionism can be defined as "an ontological position which asserts that social phenomena and their meanings are continually being accomplished by social actors." (Bryman, 2015)

This research, based on realism – the contract; and subjectivism – the way that people perceive they should act socially; will focus on the use of a structure in which the translation of choices for individuals, in groups, operating under a new realism, can positively influence a subjective outcome. The intent is that contracts define agreed real choices, by representatives of the parties to the contract, which they must intuitively be able to interpret in an aligned way. This will only be possible in an environment of analytical dualism (Archer, 1996). Separate structures and agents, assigned rights, and obligations, relative to pragmatic interpretation within a real purpose under the contract. To understand how to change poor productivity decisions, and remove multiple types of process waste, it will investigate why misaligned subjective interpretation of roles, across a hierarchical ontology using real documents, are frequently perceived differently. Understanding decision drivers

will make eradication of subjectivism more likely enabling change in the culture of productivity. Motivation is subjective so attempts at greater alignment will examine the effective use of incentives (Do et al., 2015b) to motive achievement of a common imagined reality.

It will seek to use pragmatism to link choice architecture and motivations to social norms, using loss aversion, to change the way decision makers historically favour predictably irrational decision making. Decisions that previously provided a counter-intuitive advantage to a supplier, will act against the supplier. Decisions, previously set as 'op-in' from the client, will when repositioned as 'opt-out', require a supplier to act on them to remain viable and sustainable. Integration, collaboration, and lean construction, previously set by the client as ambitions of ways of working, become essential to commercial success.

The likelihood of sustainable success from this changed choice architecture will use pragmatism to test outcomes using internal and external subject matter experts and industry renowned practitioners.

By identifying known, and unknown, social conditioning from independent reviewer's experience before deployment, the model will be tested and refined.

This research will follow a progressive but pragmatic process to reach an outcome. The procurement model will result from facilitated modelling involving a wide range of participants. The result of facilitated modelling has the potential to create a choice architecture that can be assembled around a thought scaffold. From practitioner experience an auto-ethnological simulated actor will be fashioned. Using scenario-based simulations and practitioner intuition predicted decision patterns will be created through the choice architecture to understand the potential for rational and irrational decisions within the hierarchical ontology. These simulations will be used to intuitively refine motivators and suppressants using simplified choice pathways within the architecture.

Outcomes from this simulation will provide an improved likelihood of achieving ambitions of; waste out and productivity up.

Previous research by Highways England resulted in structures derived from conditioned group think to understand the positive and negative feedback from operational procurement models. It contained strong indications of conditioned group think (Oberai and Anand, 2018). Investigating data from observations, contained in detailed feedback, as representative of culture in a social community structured for development, design, or delivery (Josten, 2017) provides insight into the habits and sublimes of current practice. Research will also look for corrosive cognitive dissonance (Syed, 2015), uniqueness bias, optimism and overconfidence bias, the planning fallacy, strategic misrepresentation, and any other themed cognitive challenges (Flyvbjerg, 2017a). This work will pragmatically analyse root cause from primary data. It will intuitively consider how representative it is of acceptable behaviour and culture. Grouping primary data into analysed behaviours will create the opportunity to plot and test new choice pathways. Pathways for individual decision makers, and groups in companies and projects, nudging integrated decisions into an unfamiliar environment of collective practices that intuitively shift the dial towards high productivity.

This research will investigate organised processes and look for highly developed examples of constructivism (Dudovskiy, 2018) where a common imagined reality is socially constructed.

By understanding perceived boundaries within a known, contained, and commercially bounded social construct a pragmatic view of the decision landscape can be assimilated. From wideband Delphi workshops and thought trials choice pathways for change agents, or groups of agents, within this defined and extremely specific hierarchical ontology will be redesigned.

To look at waste removal panellists will consider if subjectivism contributes to cognitive dissonance despite pragmatic realism. Within communities practicing in this field detailed analysis of primary data will consider the contribution of conditioning [T1 from the Cambridge social ontological (technical education)] resulting in “group think”.

Again, in his simplified post, Michael Bergin helpful describes epistemology as being

> *"…concerned with the nature of knowledge and ways of knowing and learning about social reality. Two main perspectives for knowing are positivism and interpretivism (Bergin, 2017)."*

Constructivism and naturalistic are terms commonly referred to in the literature and sometimes in an inconsistent way, for interpretivism. (Guba and Lincoln, 1994)

In this research the term constructivism refers to *why* communities behave as they do. It identifies the basic principle supporting the notion that reality is socially constructed.

> "a relativist position that holds the view that there is no external reality independent of human consciousness" (Robson, 2002)

By pragmatically applying this research to a real-world outcome it will use a theoretical framework of symbolic interactionism . To do this it will harness qualitative personal experience in facilitated modelling interventions to inform the perception of boundaries within a known, contained, contract. Then, based on a pragmatic review of subjective social interactions between agents within this structure, it will derive new decision boundaries to the desired pathways. These will be used to influence an agent's choices within a defined and specific ecosystem. Boundaries to the pathway will consider, and seek to avoid, the unintended consequences from within other parts of a construction ecosystem. This research is designed to establish a new choice architecture based on how agents or groups 'might intuitively act' within a new reality, a contract, describing the transactional social construct. It will use this information to influence and motivate actors away from "predictably irrational" decisions that lead to low productivity . To successfully improve productivity, choice architectures will focus on empowering front-line practitioners to intuitively remove process waste by changing perceived social norms using the rights and obligations of ontological agents. To test sustainability, facilitated modelling, using thought trials and scenario testing, will use Blumer's three premises of symbolic interactionism:

1. "Humans act toward things on the basis of the meanings they ascribe to those things."
2. "The meaning of such things is derived from, or arises out of, the social interaction that one has with others, and the society."

3. "The meanings are handled in, and modified through, an interpretative process used by the person in dealing with the things they encounter."

Practicing construction communities contain known, and unknown, social conditioning. To reduce constraint caused by this in the new model intuitive estimates of agent behaviour will be reviewed for indications that what currently happens reflects morphogenic critical realism (Newman, 2020). This not only erodes productivity; detrimental to the client in a contractual relationship; but also, to the supplier as it cannot perform in line with its competitive ambition. To benefit everyone, amended choice architectures will aim to influence decisions to reduce process waste from interaction between agents, or task groups, and correspondingly increase predictability and improve productivity.

The likelihood of sustainable success from this new choice architecture will be tested using internal and external subject matter experts and industry renowned practitioners.

The research will conclude with the final two phases establishing a landscape within which a new procurement model can be tested by industry experts; and deployment in which the new model is published in a real-life open market tender.

4.1 Research Phases

4.1.1 Approach

The primary data set is a contemporary record from the highway sector describing the positives and negative gaps recognised from operation of *Collaborative Delivery Framework*. Cluster group analysis was interpreted to qualitatively identify root cause and effect of current decision making. The changes contained in the prototype, and final new procurement model's choice architecture, use findings from secondary data to nudge decisions as mapped from this interpretive process as described in 9.1.1.1.

4.2 Defining the problem

Having identified a problem originating in existing practice highlighted in data analysed in reports to stakeholders, research will consider organisational construct and subsequent behaviour in construction communities in detail. Reviewing this analysed data created a better understanding of problems that need to be addressed through research.

Current literature and practice-based thinking, relevant to understanding how decision making disrupts existing productivity decisions, will be used to inform a new procurement model applied to achieve the aim.

Reviews of practice, underpinning theories, and academic thinking were desk studies.

4.2.1 Development Phase

This phase considered two main strategies.

A. Stage One – ten Wideband Delphi workshops (Wiegers, 2013) used agile scrum techniques to determine the structure of an embryonic prototype.

B. Stage Two, Three, and Four - Facilitated modelling (Franco, 2010) to determine processes and decision points. This applied a thought scaffold, built around the embryonic prototype model and a simulated key commercial agent, progressively stabilised and defined the eventual decision pathways of the prototype.

4.2.2 Why wideband Delphi workshops?

The development of a prototype would eventually require a small-scale team to progress against a defined timeline. Taking analysed data from market investigations and the underpinning theories review guiding principles of a model formed. Construction of the pathways necessitated collaboration and facilitated thinking to avoid regression to a mean of custom and practice and avoid unconscious bias. To achieve this, wideband Delphi workshops allowed for input data to stimulate a lively and diverse debate on core issues, principles, and feedback. Rather than Delphi (Rowe and Wright, 1999) workshops, where participants are asked to receive information, assimilate, and

estimate individually, wide-band Delphi is based on active diverse collaboration and dialogue during the workshop. This results in a consensus estimate of the impact of the subject under discussion. Workshop output depends on the diversity of panellists and structure, organisation, focus, and pace. Pace must be swift enough to reach conclusions to debate and avoid procrastination but provide sufficient time to deliberate enough to allow reasonable consideration of all aspects of an issue. Outcomes from wide-band Delphi are aimed at a collaborative majority decision around estimated outcomes based on scenarios given to a panel.

Both the model and choice architecture, (interactionism) simulated against integrated delivery team members, (contained societies) was trialled. This was facilitated based on group model-building (Hovmand et al., 2012) working with subject matter practitioners to collaboratively model this separately, but symbiotically. Work developed the choice architecture and agent's roles within it. Trialling tested the interactions (ways of working) between the structure and agents, and between agents within the social construction of a scheme's theoretical hierarchical ontology.

Simulations informed and shaped a new structure for this contained society while simultaneously influencing choice architectures to reduce process waste and improve productivity. Contract documentation, in this instance, described both the rights and obligations of agents and communities within the society, essential to the reality of a legal construct, enabling predictability, efficiency, timeliness, quality of outcome, and overall performance.

To create a realistic foundation, in the form of an embryonic prototype, wideband Delphi workshops harnessed critical realism relating to structure, agent behaviour, and culture from participants. This consensus based estimating methodology reflects the pragmatism required for this exercise. Participants were drawn from as many of the known scheme communities within Highways England as possible. Participant diversity was essential to recognise multiple perspectives, constructivism, and the system dynamics evident in infrastructure construction's ontological ecosystem, in reaching

consensus. Wideband Delphi harnesses group diversity of thinking with the potential for creating a formalised structure reflecting the system dynamics informing boundaries for the model's design.

4.2.3 Why Facilitated modelling?

To maximise the effect of the review of practice and underpinning theories, the use of a single intervention is not considered appropriate. The development of a new model favoured facilitated modelling (Franco, 2010) using a select group of experts from Highways England and support specialists from Erst Young for detailed financial simulations. The facilitator brought together the specialist and expert contributors and, based on theories considered to be appropriate, adopted an applied research technique to facilitate the development of a new procurement model to address the key problem statement.

The research facilitated modelling used thought trials to take an embryonic prototype through development into a prototype ready for testing, scrutiny, and deployment. Only a core team were used for these stages. This team established a 'typical' set of agents within an imagined socioeconomic ontology of a scheme. Using the embryonic prototype, comprising a soft system thinking social structure, a simulation of a new way of working with real interfaces, and probable reaction of the agents within the model was trialled. This trialling tested how to nudge choices towards the aim providing resilient interfaces and sustainable consistent rational outcomes. The core group used intelligence, gathered from the wide-band Delphi workshops, to maintain perspective during the group model-building stage. Participants from the Wideband Delphi workshops were referred to, when required, for clarification based on experience.

This stage also consists of, on completion of the prototype, a series of external assurance gates used as second, third, and fourth tier challenges consisting of selected expert focus groups. A second-tier challenge panel was drawn from Highways England subject matter experts. A third-tier challenge panel of independent experts was drawn from industry. A fourth-tier challenge panel was drawn from Highways England's investor, Department for Transport: Commercial Advisor Board.

Having used multiple layers of challenge to create sufficient confidence in the prototype being fit to be deployed in open public procurement for the expenditure of public money, it was deployed.

4.3 Design Process

This research will adopt a design thinking process (Plattner et al., 2016). The use of this model adapted to the situation will allow structure and inform the outcome in a sequential way. Design thinking process characteristics are: empathise, define, ideate, prototype, and test.

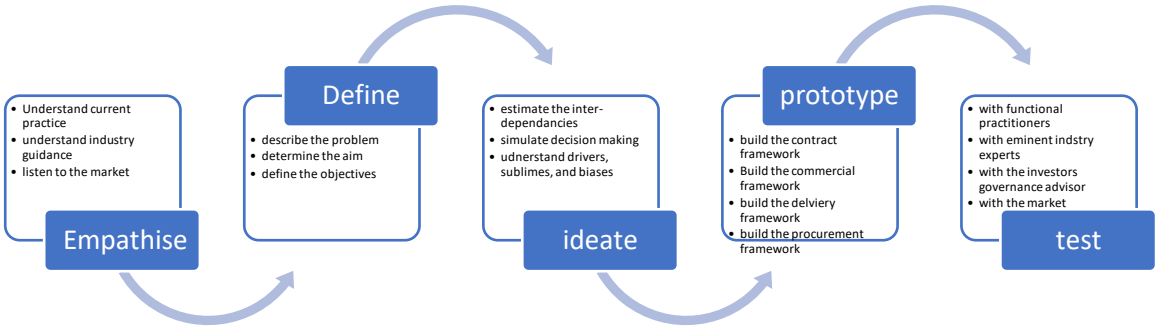


Figure 13 procurement Model Development Process

Each stage of research will identify the characteristics required to achieve the aim. Each stage will consider the aim: what requires change, and how to implement a sustainable new way of working; assuming no change to the existing hierarchical ontology of the market.

The cross-sectional data gathering, and its analysis, will be the empathise and define stage of design thinking. Ideation will be informed by the underpinning theories and review of current practice.

Research was carried out across a cross section of the market between January 2017 and April 2018 as shown in Fig 12.

4.3.1 Wideband Delphi workshops

A series of workshops were established, each focusing on a specific topic area. This focus allows effective selection of participants. Highways England's focus group included selected people to create a group with diverse backgrounds, thinking, and approaches from different functional departments.

- Procurement
- Wellbeing, health, and safety
- Project Management
- Standards Engineering and Safety
- Finance
- Cost Planning and Estimating
- Operations - regional
- Sponsorship
- Benefits realisation
- Risk Management
- Schedule Management
- Management data and reporting
- Commercial Delivery

Workshops were lively and challenging with passionate and forthright debate and discussion. The debate was richer for the diversity of participants and the outcomes considered more secure as a result. Strong but active facilitation was required to maintain focus and pace to enable the workshops to reach conclusion. This was essential to set the context of subsequent workshops. Facilitation was drafted in from an independent third-party organisation to improve balance and pace. The clear and maintained rules of a workshop were upheld throughout and rigour was applied to note taking and recording of the outcomes.

4.4 Stage 1 – Wideband Delphi Workshops

The sequence of these workshops followed a consistent pattern:

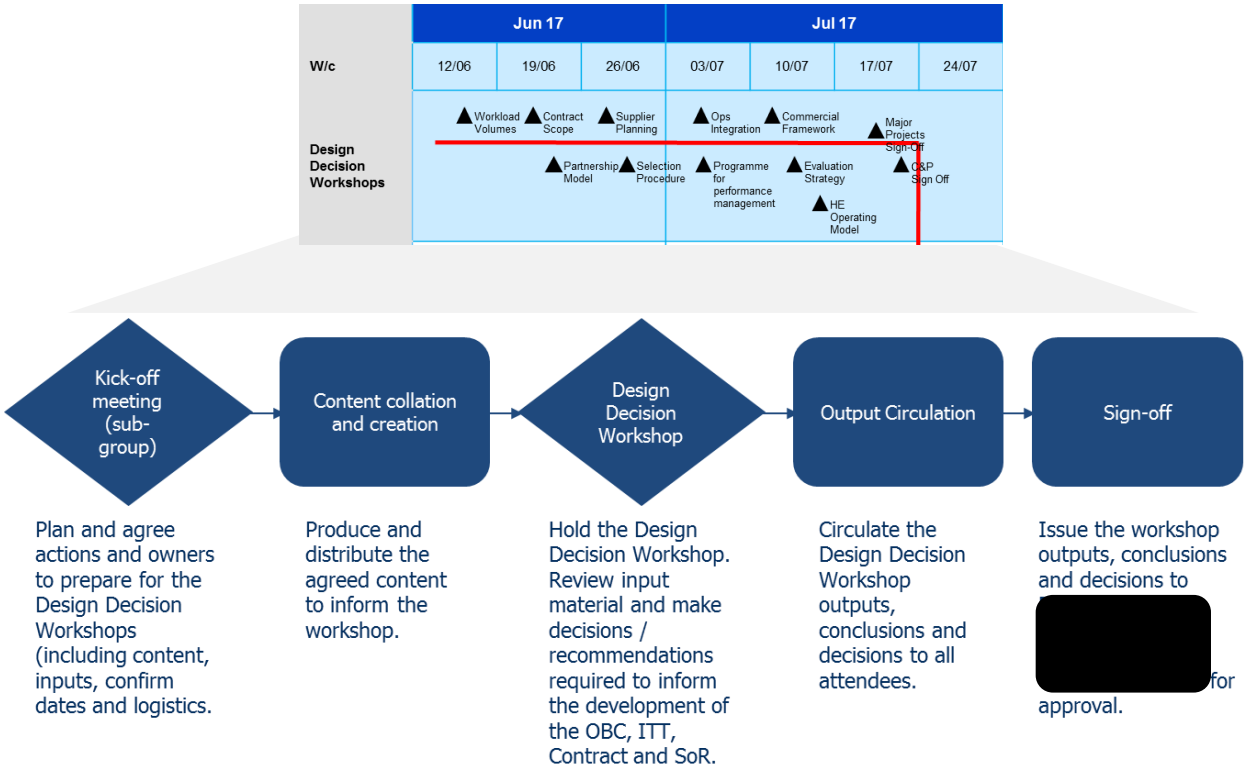


Figure 14 Workshop management plan

4.4.1 Organisation

Workshops were grouped into topic areas based on aspects of the problem. Each workshop required pre-reading which included relevant information with a specific focus on the unique Highways England *Collaborative Delivery Framework* practitioner review (Josten, 2017). This spotlighted relevant information to the aspect under discussion. Each workshop was at least six hours long and consisted of an invited panel of subject matter experts from within Highways England's community; employees and advisors. It did not include suppliers due to perceived and actual conflicts of interest in a future bidding process.

To start each workshop any information relevant to inter-related aspects already discussed, or to be discussed, was outlined to the panel. Regular re-focus breaks (every hour and a half) were taken throughout the workshops for comfort and refreshment.

Workshop rooms were well ventilated, and participants kept hydrated to promote alertness and focus. Workshops were facilitated by an independent person to achieve intensity and pace.

A facilitator was chosen for each workshop from Ernst Young (EY) as an independent organisation. EY was selected based on knowledge about the process, techniques of workshop facilitation, and desired outcome. Its team was considered to have a level of industry knowledge required to effectively facilitate and manage the pace of discussion. After each break a synopsis of discussion 'so far' was given to restart debate by the facilitator. When necessary, reiteration of workshops rules was also given to participants, as well as observations regarding focus, pace, and expected outcomes of the workshop.

4.4.2 Who

To achieve pace and continuity in every sequenced workshop a small core group consistently attended. The core group was, in most cases, no more than 25% of each wideband Delphi panel.

Core group consisted of a nominated person from: Delivery, Commercial, Procurement, Legal, and prototype management office. They were chosen based on accountability, in Highways England, for the delivery of a prototype. Each core group member had experience in the delivery of programme outcomes, professionally qualified in their specialist area, and released from their day-to-day business duties to focus on the development and deployment of the prototype. At each focused workshop, this core group supplemented a panel from relevant functional divisions of Highways England, or its support community. Panellists were selected by:

1. Knowledge of their function in Highways England,
2. Experience in the delivery of capital projects,
3. Seniority, with delegated authority to make irrevocable decisions for their business function,

4. Time release from day-to-day activity to focus on the workshop without interruption.

The workshops were sequentially numbered (W#) and required panellists from functions as noted below:

- W1 Workload and volumes – Strategy & Planning; Finance; Project Management Office; Estimating & Cost Planning
- W2 Scope – Delivery (Major Project & Operations); Safety engineering & Standards; Property
- W3 Supply chain planning; Performance management; Procurement; Delivery (Major Project & Operations)
- W4 Supply chain capability / capacity – Legal; Procurement; Delivery (Major Project & Operations); Estimating & Cost Planning; Performance management.
- W5 Major Projects / Operations integration – Operations Commercial; Delivery (Major Project & Operations); Estimating & Cost Planning; Performance management.
- W6 Commercial framework – Commercial Delivery; Strategy & Planning; Finance; Project Management Office; Estimating & Cost Planning.
- W7 Performance management – Legal; Delivery (Major Project & Operations); Estimating & Cost Planning; Commercial delivery.
- W8 Client Operating model – Project Management Office; Commercial Delivery; Programme Hub; Finance; Business services; Property.
- W9 Selecting bidders- Project Management Office; Commercial; Programme Hub; Finance; Business services; Delivery (Major Project & Operations).
- W10 Evaluation strategy – Legal; Procurement; Commercial Delivery; Delivery (Major Project & Operations).

Each panellist participating had the expected contribution explained as being representative of a function. Additionally function heads who deputised participation were advised the participants in workshop decision making was irrevocable.

4.4.3 Process

Each workshop followed a consistent pattern. The decision rules were outlined. The topic area was defined, and format of an expected outcome described. Every workshop was organised against a discussion framework, aspect of the problem, and subtopics. Each run by an independent facilitator to assist with focus and timekeeping. Each workshop had a series of scribes and administrators to capture discussion actions and results.

At the end of a workshop any residual action, estimation decisions and / or inter-dependencies on forthcoming workshops was captured and agreed by the panel. Records of these workshops were redacted to protect confidentiality (Workshop outputs records).

Each estimation decision was subsequently noted and passed to each of the relevant facilitated modelling themes. Actions were followed up within a set period with each outcome notified to panellists for reference. Inter-dependencies were passed to future workshop facilitators for inclusion along with a synopsis of discussion and expectation for the future workshop.

4.4.4 Decision making

Each workshop was empowered to reach estimated outcomes in its aspect area. Each estimated decision was subject to a set of overriding conditions.

- It must be legal.
- It must be compliant with known constraints, such as the delegated authorities under Highways England's operating licence, and relative to other existing contract conditions.
- It must be compliant with the "design principles" determined from the unique practice review of Collaborative Delivery Framework which the model was to replace.

- It must consider the action plan requirements. These were driving greater efficiency, predictability, outcome focus, and value improvement.
- Its impact on, and effectiveness in, driving behaviour change towards sustainable productivity should be understood.

Only if all these decision criteria are met was an estimated decision allowed as a prototype proposal for progression to thought trial. Discussions resulted in outcomes that migrated to a proposal if they complied with all these conditions. It was essential that the core team were alive to these decision-making conditions throughout. This minimised rework from an estimated outcome being progressed, with inter-related outcomes in other workshops, only to discover later that it did not comply with basic conditionality.

4.4.5 Building the prototype

Ways of working between elements of a social structure, and agents within it, were simulated by creating a prototype model. The aim was to inform a blueprint and create a set of guiding principles or foundations for the research. To build on the foundations of this embryonic prototype, functional aspects of the likely social structure were identified that responded to the guiding principles. Following identification of functional elements within the structure, its loose construct was drawn from inter-related wideband Delphi workshops. These workshops contributed to an embryonic prototype by confirming boundaries to decision pathways using a skeletal structure of all elements. The elemental workshops were held in sequence to build pathways in the structure using progressive layers. In this way the social construct and ways of working emerged with elements designed using the existing hierarchical ontology to the virtual ecosystem. Where subsequent workshops challenged decisions made previously, and the construct required amendment, individual participants from previous workshops were consulted. Throughout development the task core group attended all workshops to absorb intent and logic while maintaining the foundations and boundaries throughout.

To build a prototype the facilitator, and core team, engaged in facilitated modelling using compilation sprint teams in a thought trial setting. The facilitator and sprint teams trialled nudges that influenced re-modelling of pathways across all elements but focused on one operational strategy within the prototype at a time to maintain the foundation points. Development separated into three facilitated scrum sprint teams each focusing on one of three parallel strategies:

- Delivery / Commercial
- Legal / Contract
- Procurement model

Each sprint team was facilitated against a timeline, and all were run progressively over the same overall period. Each sprint was facilitated to oversee focus, boundary constraints, and timeliness. Each sprint team also contained a lead to maintain focus when not being facilitated. They met on a five-day cycle for consistent development decisions with assurance provided in a weekly leader meeting and a monthly Design Authority Group. Regular alignment to business strategy, progress, and key decisions was sought from a further bi-monthly Management Steering Group.

4.5 Stage 2 - Facilitated modelling

Sprints (Scrum.org, 2022) using facilitated modelling (Franco, 2010) were undertaken progressively over a three-month period. They developed nudges that combined into a nudging plan to influence practitioner decision making using structured thought trials. The facilitator challenged and disrupted status quo thinking with knowledge from the underpinning theories. In leading this active research, to change decision making under the procurement model, to achieve greater predictability and higher productivity. Each facilitated session considered each part, of each element, in the context of the aim. To develop a strategy towards the aim, within the context of an element, development was facilitated against an action plan and schedule. The legal contract strategy team was the most difficult to challenge. Contractual elements of the prototype perform within boundaries set by central government, based on Public Contracting Regulations, Public Procurement Notices, and

approved standard forms of contract. All other sprint teams considered outcomes recognising these boundaries. While facilitating the development of a designed element of the prototype, sprint teams, when faced with an interface point across trials, liaised with all other sprint groups. These liaisons were controlled and structured so that core facilitated sprints were not delayed. Thought trail sprints were fragmented into a series of 12 weekly sprints. At the end of each weekly sprint the team leaders shared information through a consensus meeting and resolved decisions around interfaces.

Choices, options, and gaps that require final decisions relating to the prototype were considered at each bi-weekly design steering group. These included decisions relating to commercial, procurement strategy, and contract work streams all of which required further detailed business consideration. Each weekly, and biweekly, decision point confirmed decisions within the prototype which progressively and iteratively modelled the final prototype build within its thought scaffold. Process decision points for completing the prototype were driven by inter and co-dependencies for micro decisions.

4.5.1 Participant selection – facilitated modelling

To expedite this complex process, of timely decision making, a sprint team was made up of specialist advisors allocated to each strategy. Participants were selected to meet the following criteria:

1. 5-years' experience in operation of Highways England from a recognised business function.
2. Recognised under Highways England's assurance processes as a subject expert.
3. Available to be dedicated for the entire duration of trials.
4. Holding delegated authority to make irrevocable decisions.

A dedicated location was made available for these teams to work symbiotically. No protected diversity characteristics were used however at least one participant in each workshop was representative of the Equality, diversity, and Inclusion policies of Highways England.

4.5.2 Constraints on the process

To achieve a prototype, and realise the aim, required development and drafting to be complete with sufficient time remaining to allow evaluation and governance to take place before deployment in April 2018.

Research was applied within the boundaries of:

- Defined investment was based on Road Investment Strategy 1 (RIS1) (£4.5billion) plus additional capacity for known schemes for Road Investment Strategy 2 (RIS2) (£4.2billion) based on an indicative regional split.
- Packages and schemes to reflect Highways England's regional operational structure.
- The prototype required a contingency mechanism to provide resilience against future supplier failure.
- The model will not be used to deliver Smart Motorway Programme future work.
- It included all corporate standards and policy and pan Governmental requirements.
- Business reputational risk was considered throughout.
- All existing Highways England Policies must be recognised as applicable to the delivery environment.

4.6 Stage 3 - Validation

Before any new model that defines the contractual arrangements could be deployed, for the management of public money, a series of validation tests were held. To protect Highways England's commercial interests, as a UK Government arm's length body, any new procurement vehicle must be rigorously tested. Between January and April 2018, the date of deployment, the new model was tested, and evaluated in a sequential assurance review. In a rigorous multi-layered assurance process, it underwent four tests sufficient to establish rigour but expedient enough not to delay deployment.

Test 1 – A peer review using a panel of six subject matter experts drawn from those engaged in the wideband Delphi workshops. This group tested design principles established to streamline development of the prototype.

Test 2 – The core team of sprint leaders undertook this assurance with its primary focus to resolve residual, legal, operational, commercial and governance risks. Testing included interdependency of all parts of the prototype. Financial resilience of the prototype was tested by independent financial modellers.

Test 3 –. These two external panel reviews were by five industry experts selected, at the request of Highways England, by the Institute of Civil Engineers based on experience of similar scale delivery models and procurements. This panel reviewed fitness for purpose in a "critical friend" report. Its initial recommendations considered how the market might respond to the prototype in deployment. The second part of the external test was by a technical expert from Highways England's Board.

Test 4 – DfT Procurement Advisory Board, on behalf of the Department's Business Investment and Commercial Committee, scrutinised on behalf of the shareholder group. This was a requirement of Highways England's licence.

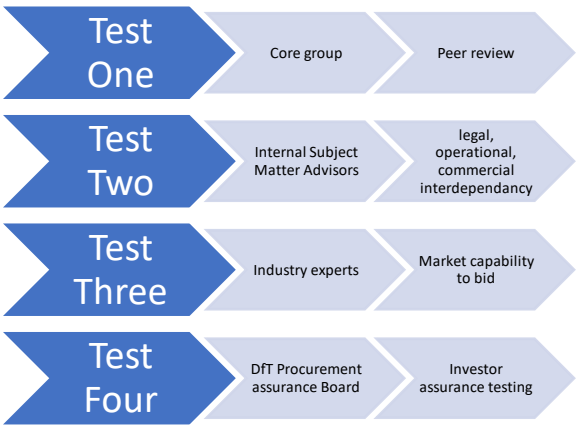


Figure 15 Testing sequence

Tests were designed as multi layered and happen in sequence with an investor assurance board set as a final approval review.

Each test panel had the following selection criteria:

4.6.1.1 Peer Review

- No previous involvement in development of the prototype.
- Recognised expert within a business function.
- Capacity to dedicate time to assurance.
- A single external ex-supplier commercial expert.

4.6.1.2 Industry Experts

- Institute of Civil Engineers commissioned to recommend 5 eminent participants.
- Senior Responsible Officer reviewed proposed candidates, to avoid conflicts of interest.
- Appointment of an evaluation panel chair.

4.6.1.3 Non-Executive Technical Expert and investor review

- A non-executive board reviewer nominated by Highways England's board
- Investor Procurement Assurance Board
    - Standing group used to assure procurement and contracting models for DfT investments.
    - Nominated officers of DfT procurement assurance group.

4.6.2 Defining evaluation limitations

Each assurance cycle was limited to constructive comments. The new model, in seeking to achieve the aim, required testing to consider how the application of this research, in a model, would impact on the decision making of bidders in the existing market. Its application, to be successful, needed to be understood and lead to a predicted change to decision making from bidders.

Participants were briefed, as a check to viability, to use experienced professional auto-ethnological data to predict model characteristics considered to have potential to:

1. Create a legal risk.

2. Generate counter-intuitive decision making from bidders.
3. Suppress or constrain bidder activity.
4. Create misunderstanding or confusion amongst bidders or result in administration.
5. Constrain the aim to remove process waste and improve productivity.
6. Avoid unreasonable liability transfer to suppliers.
7. Introduce unfair contract conditions.
8. Constrain Highways England's from delivering its investment commitments.
9. Expose DfT or Highways England to reputation damage.

4.7 Stage 4 - Deployment

This research enabled Highways England, in March 2018, to issue an open market procurement. Tender with returns targeted for June 2018.

Tender returns were evaluated through July to August 2018 with a recommendation for award at Highways England's Investment Committee, DfT, and eventually Secretary of State in November 2018.

5 Research findings

5.1 Wideband Delphi Workshops

5.1.1 W1 - Workshop one: work volumes

So that future bidders understand the extent of any bid, and to ensure the prototype model is fit for its purpose, the extent of work to be let through it needed estimation. The model duration had to be estimated as well as a forecast of the volume (monetary) of work to be let. This volume also needed to be split to represent any probable bid lotting and subsequent management of the model and contracts. This required estimation as, at the time of the workshops, only two years of funding and work was firm, but the potential model was for six-years.

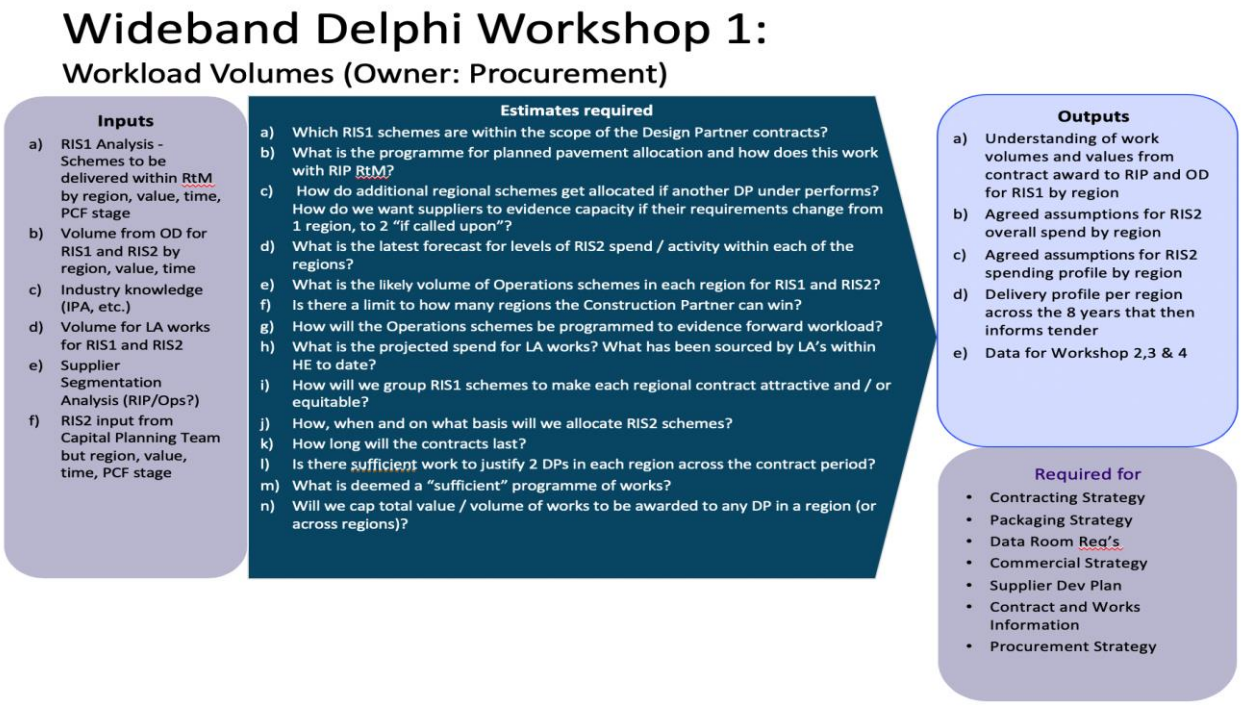


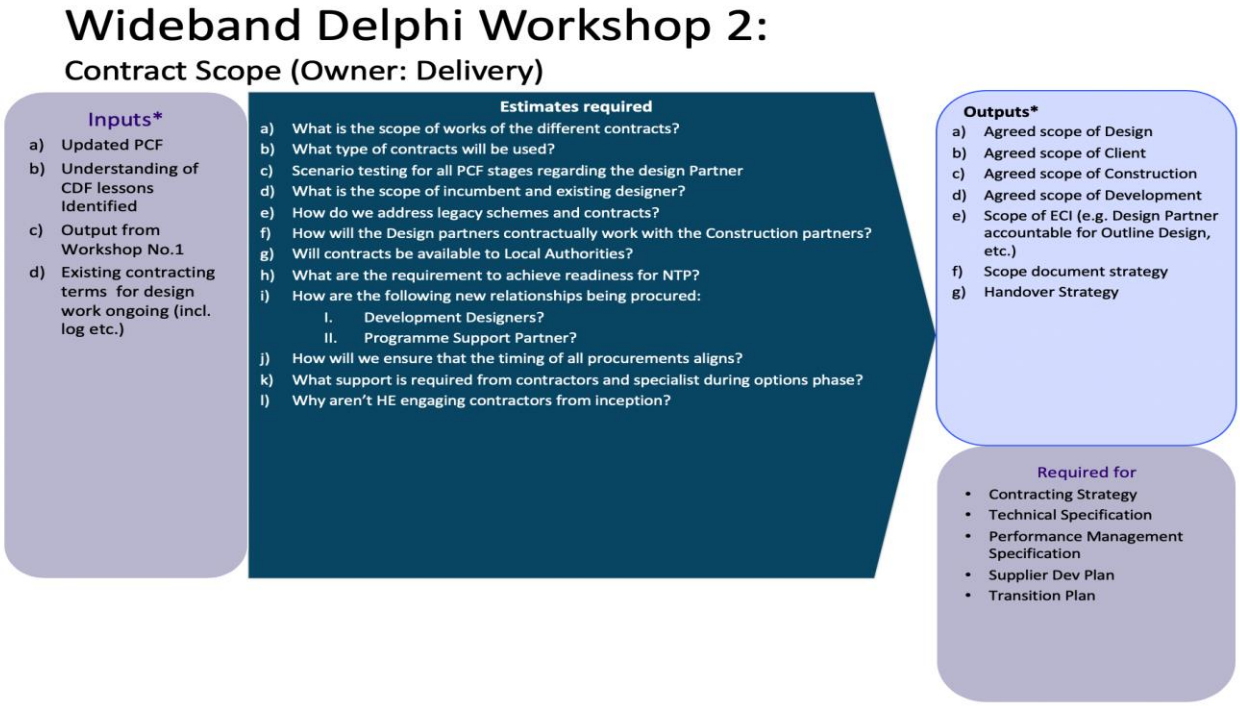
Figure 16 Workshop 1 – Workload Volumes

The six-year period covered Road Investment Strategy One (RIS1) and Road Investment Strategy Two (RIS2) with RIS2 containing unknown content or location. Volumes by location would impact scale of organisation bidding therefore impacting on W2, W3, W4, W4a, and W6. Outputs would feed into estimating for delivery but would also impact the estimating on procurement.

The outcome of this workshop was an estimated overall volume of work circa £9 billion to 2025 spread nationally. Likely volumes in the Southeast and Northeast would create asymmetric allocation of work. The extent of this asymmetry was left to facilitated delivery modelling. Type of work was debated as well as any reasonable split between supplier capability. Initial estimates were for supplier capability splits of £0 - £50m; £50m - £100m; and £100m + to 6 geographic regions split across England to reflect the Highways England Major Projects business structure.

5.1.2 W2 - Workshop two: scope model

Reliant on outputs from W1, this workshop covered model scope. It was inter-dependant on W5. Scope was predicated as replacing *Collaborative Delivery Framework* as a route to market for delivering design and build of major projects within Highways England's Regional Investment Programme and large capital replacement projects. Estimated decisions were needed on type of work; if it could include other programmes, the type of operational works, if any; any project size constraints; at what stage a supplier would be engaged; what liability transfer might look like; how to link performance to future work access; and avoidance of aspects of the problem encountered relating to scope noted in the cross sectional analysed data set. Outputs would feed into the facilitated modelling on delivery.



Outputs from the workshop concluded that scope should be exclusive to Regional Investment Programme and operational capital replacement. Smart Motorways Programme and Complex Infrastructure Programme works were at this point considered to fall outside of scope. Debate on constraining project size considered that no limit should be applied as by definition the work under a programme defined the work type and size. Liability transfer discussions resulted in the opportunity to move design liability to 'fitness for purpose' if possible. This would be tested in the facilitated modelling of commercial and contract. Linking performance to allocation of future work was also described as an ambition from this workshop and progressed to facilitated modelling for further exploration.

5.1.3 W3 - Workshop three: supplier planning

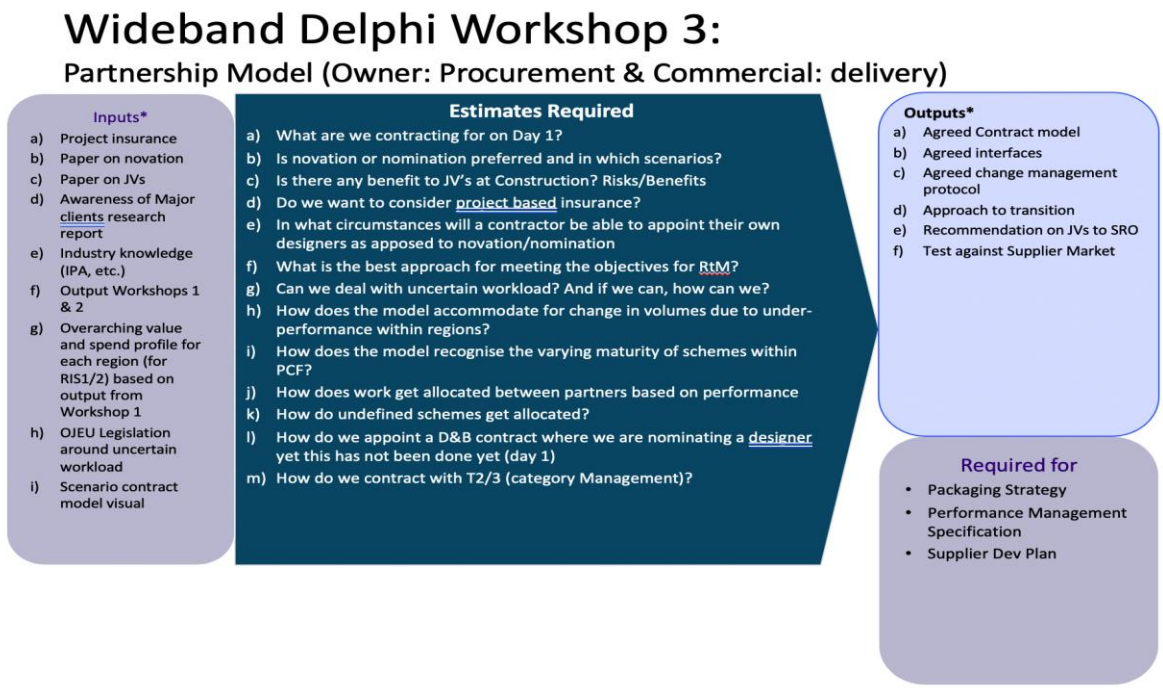


Figure 18 Partnership model

Highways major projects in the UK require financially stable suppliers with defined capability and capacity for risk transfer. Planning a prototype that would access as wide a market as possible, resisting the continual narrowing of the market, was a primary focus of this workshop. As a result of *Collaborative Delivery Framework*, Highways England saw its market, of capable and available supplier, reducing. Combined with mediocre performance, its reliance on a diminishing supply

market was escalating as a corporate risk and seen as a root cause for escalating prices and increased frequency of missed completion dates. This workshop was tasked with creating a way to disrupt the existing supplier community to increase the number of bidders for this framework. Considerations were size, capability, selection criteria, preconditions to bidding, financial capacity, and liability transfer capability. Also considered were client team competency to manage new and existing suppliers in a new model designed to deliver against ambitious objectives. Outputs would feed into the facilitated modelling of delivery.

Outcomes from the workshop determined that to access new bidders a mix of small, medium, and large bid lots would improve returns. Selection criteria, preconditions, capacity, and liability transfer were discussed, and recommendations made for later consideration. The extent of work in each of three bidding categories was taken forward for testing in modelling of delivery.

5.1.4 W4 - Workshop four: supplier capability and capacity review

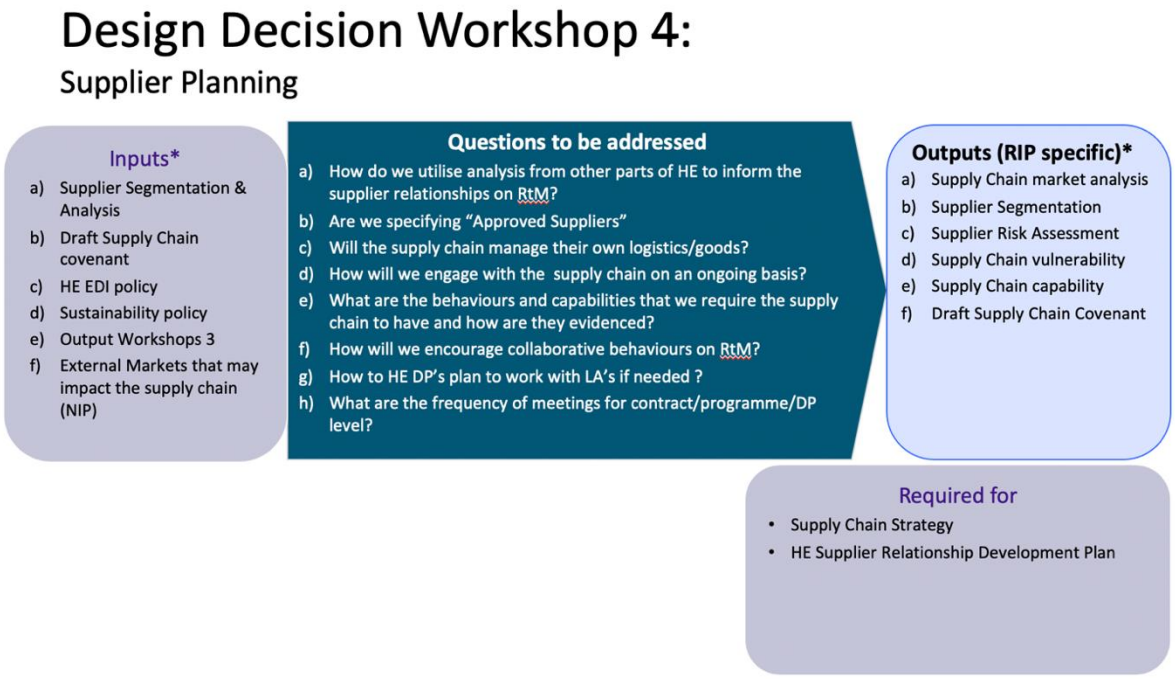


Figure 19 Supplier planning

An aspect for consideration was the point of engagement of designers and deliverers in the process. Inefficiency generated by the client employing the designer to assemble a solution based on investor requirements, determined from optioneering, and then bringing a supplier in to engineer a solution

to enable greater efficiency was a strong message from the cross-sectional data. This aspect, its practical implications and intended and unintended consequences, was the focus of this group. It involved discussion around financial capacity, intellectual capacity, design management capability, insurances, as well as more tactical design and build liability transfer. The discussions were impacted by W1, W2, and W3. The estimated decisions created inter-dependency on W5, W6, and W7. Outputs fed into modelling on delivery, commercial, and contracting.

The recommendations included establishing a means to bring a supplier in and pass ownership to it from the beginning of solution development (Project Control Framework stage 3). Two stages earlier than previous models. Opening the opportunity for extensive influence of the delivery partner over the outcome. It also created significant liability if undertaken under similar terms as historic frameworks. Intellectual property rights, intellectual capability to work earlier in the process, and fair and reasonable liability transfer levels were all discussed with recommendations made for later modelling.

5.1.5 W5 - Workshop five: Integration of Major Projects and Operations work type

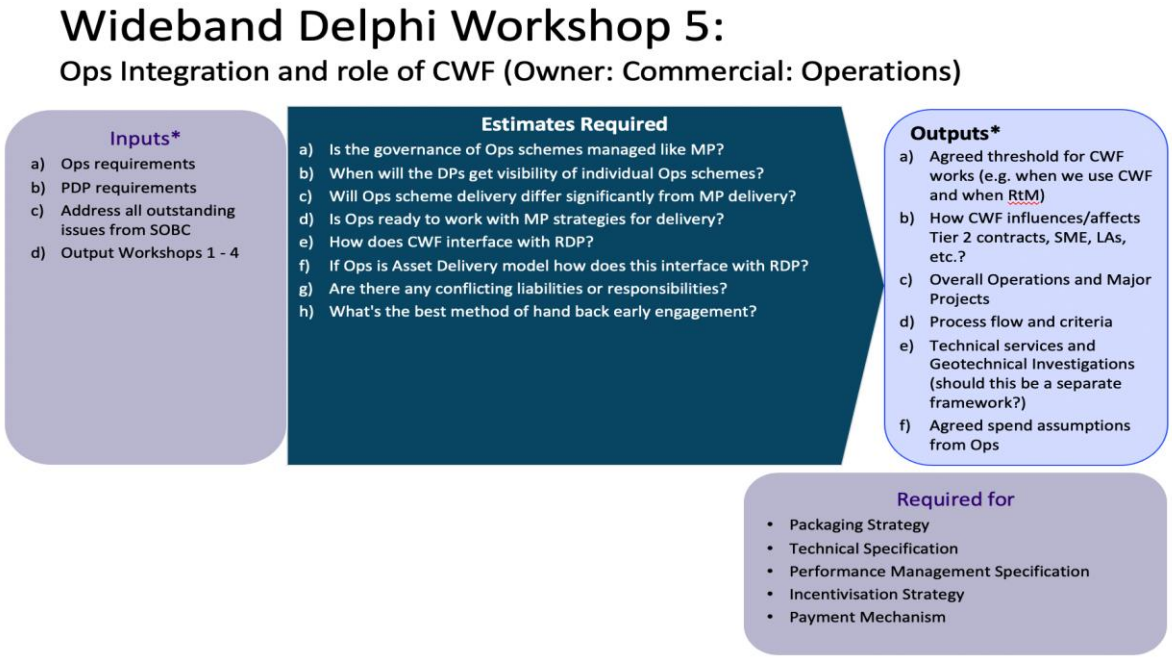


Figure 20 Integration of major projects and operations

As policy, following varied levels of success in Operations directorate undertaking large replacement schemes, Highways England wanted this new prototype to be used to deliver future replacement schemes over £15-20m. At the time of W5 Highways England was working through *Road Investment Strategy One*. *Road Investment Strategy Two* was unknown. However, the type of work being undertaken by Regional Investment Programme as well as work programmed by Operations Directorate as replacement schemes, should funding be available, was known. This workshop drew on experience of historically similar schemes to describe supplier responses needed between major projects and operations to enable it to act consistently to buy both types of work through a consistent procurement model. This workshop was dependant on information from W1, W2, and W3. Its output was inter-dependant on outputs from W6, W7, and W8. Outputs would feed into modelling of delivery and commercial.

Recommendations from this workshop included proposals to include agile wording in incentive strategies and contract drafting to allow for different work types. It also made proposals for similar work types to be coordinated to potentially become the focus of bidding lots. A lite version of the project controls mechanism for project development and delivery was suggested for consideration in later modelling. This would include the rationalisation of processes and products for smaller, less complex schemes.

5.1.6 W6 - Workshop six: Commercial framework

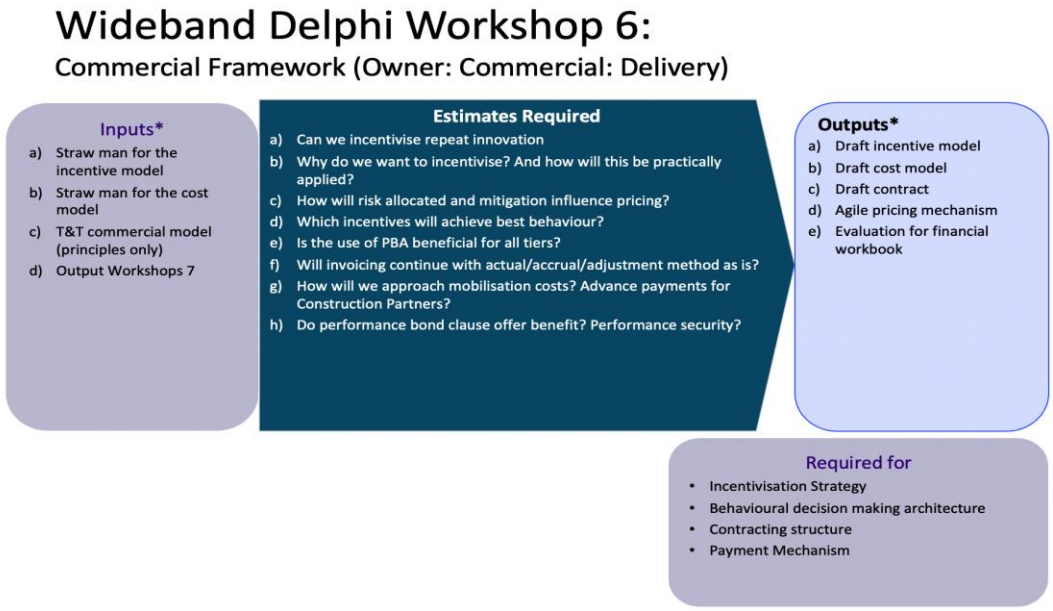


Figure 21 Commercial framework

Procurement models all rely on a commercial framework. Along with transfer of liability comes what, and how, a supplier is to be paid relative to the risk a supplier considers itself capable of managing successfully. While price can, to an extent, be competed for a single scheme, long term frameworks are harder to compete on price due to their diversity and duration. Conditionality of payment and risk definition, as well as access to future work and incentives used to enhance outcomes, all need careful consideration. To gauge estimated market reaction this workshop established potential commercial conditions. Then, based on the auto-ethnological data of participants, estimated the impact of potential supplier decisions and resultant rational, and irrational, responses. The workshop depended on the outcome of W1, W2, W3, W4, and W5. The estimated outputs would impact W7, and W8. Information from this workshop would feed into modelling of contract and commercial.

Recommendations from the workshop articulated the need for a combination of incentives. It recommended that in considering the commercial strategy known internal business monitoring and controls (governance) from within suppliers be anticipated when designing controls. These focused on ‘Self-Regulation’ (Millward et al., 2010) resulting from the right incentives using loss aversion as a

stimulus. A further recommendation was to simplify any incentives to enable workforce visibility of the 'golden thread' to allow connected motivation (Smith, 2009) in personal decision. This workshop also outlined some principles for the simplification of a performance measurement tool used under *Collaborative Delivery Framework*. It recommended that performance of suppliers should more closely align to how Highways England was measured by its investor. This workshop also proposed that any incentive from loss must be visible to a whole supply community and not simply the prime supplier. Transparency and cascading terms and conditions was proposed for consideration in thought trials on delivery and contract.

5.1.7 W7 - Workshop seven: Performance management

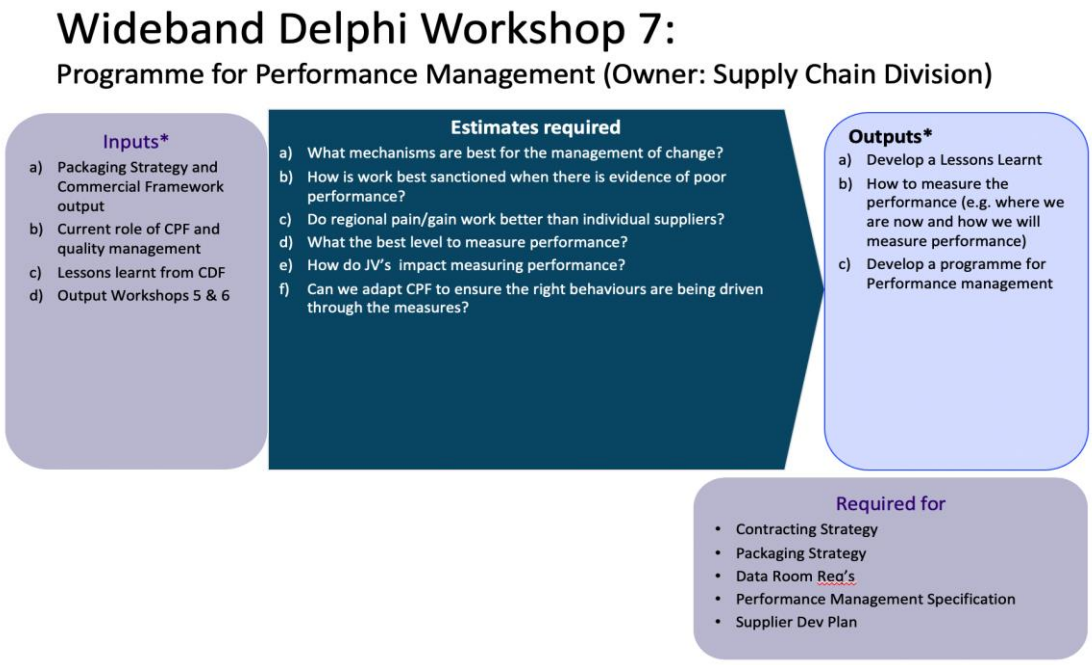


Figure 22 Program and performance

Experience from the *Collaborative Delivery Framework* showed that without visible consequence mediocre performance, in a limited supplier market, becomes corrosive. Feedback from the cross sectional analysed data indicated that previous performance models were too cumbersome, too subjective, without direct consequence, and ineffective. This workshop was tasked with estimating the impact of simpler, more challenging, more connected (supplier and Highways England's)

performance metrics with clear outcomes. The workshop depended on the outcome of W1 to W6. The estimated outputs would impact W8. Information from this workshop fed into thought trial on contract and commercial.

Recommendations from the workshop were to use a balanced score card with no more than 10-15 metrics. Metrics should reflect the three business imperatives of Highways England namely, safety; customer service; and delivery. The workshop recommended that performance may be capable of being used to limit access to future work under the framework. This question was trialled in thought trials on procurement and contract.

5.1.8 W8 - Workshop eight: Client operating model

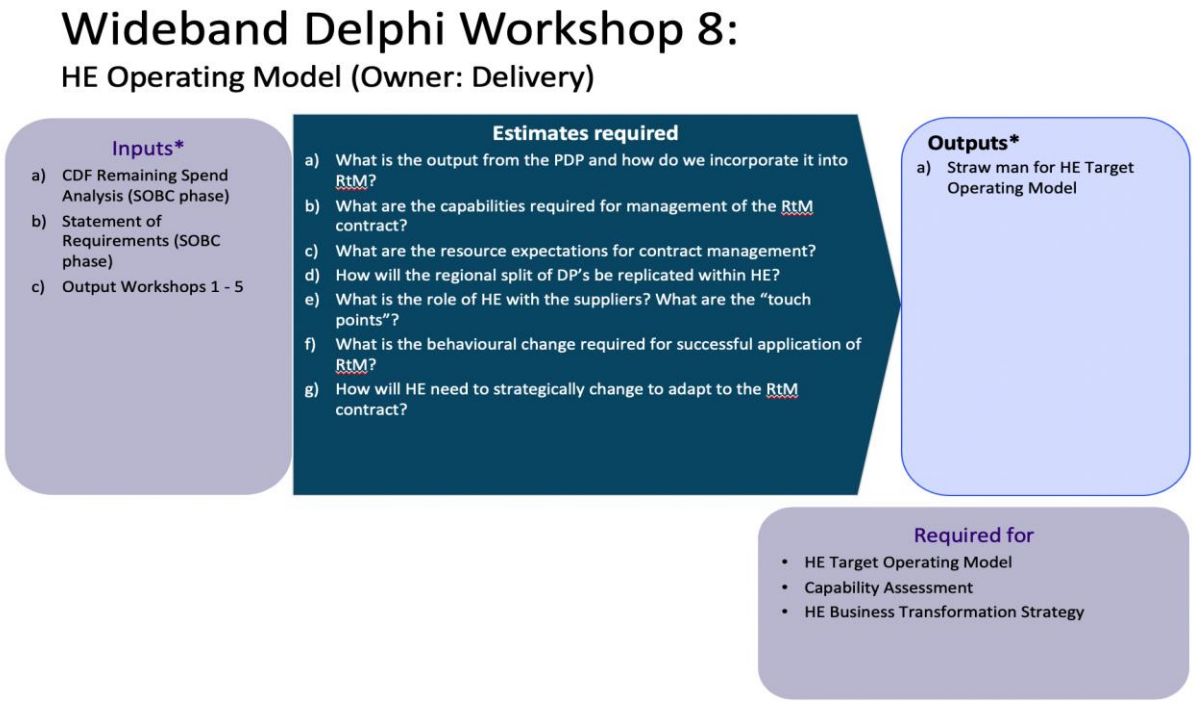


Figure 23 Highways England's operating model

To enable the delivery and commercial strategy to function a procuring authority (the client) needs to perform as an enabler. So, this workshop focused on results and proposals from W1- W7 and how elements of the prototype would impact on the clients operating model. Discussions revolved around the client's ability to work to, or flex, its project control framework, financial planning and

accounting, legal boundaries, functional alignment (current and future), governance and oversight, compliance with asset standards, and procurement processes within Framework management. The outcomes from this workshop did have implications in thought trial for the procurement model but primary focus was on contract and commercial. Wider implications to changes in operating model also fed into the business case forming part of the internal governance process applied to the prototype. How the client operating model constrained, or enabled, framework performance would, it was considered, play out over the framework's life.

Recommendations from the workshop included use of central government's thought leading guidance on portfolio, programme, and project management. This was a valuable tool by which to both set the operating model for the client body and seek alignment when evaluating supplier capability. This was further considered in the thought trail on procurement. No proposals were made to alter the client governance model, asset standards, or legal boundaries. However, this workshop did support the recommendation to move access to future work towards allocation and away from secondary competition as an efficiency to both client and supplier.

5.1.9 W9 - Workshop nine: Selecting bidders

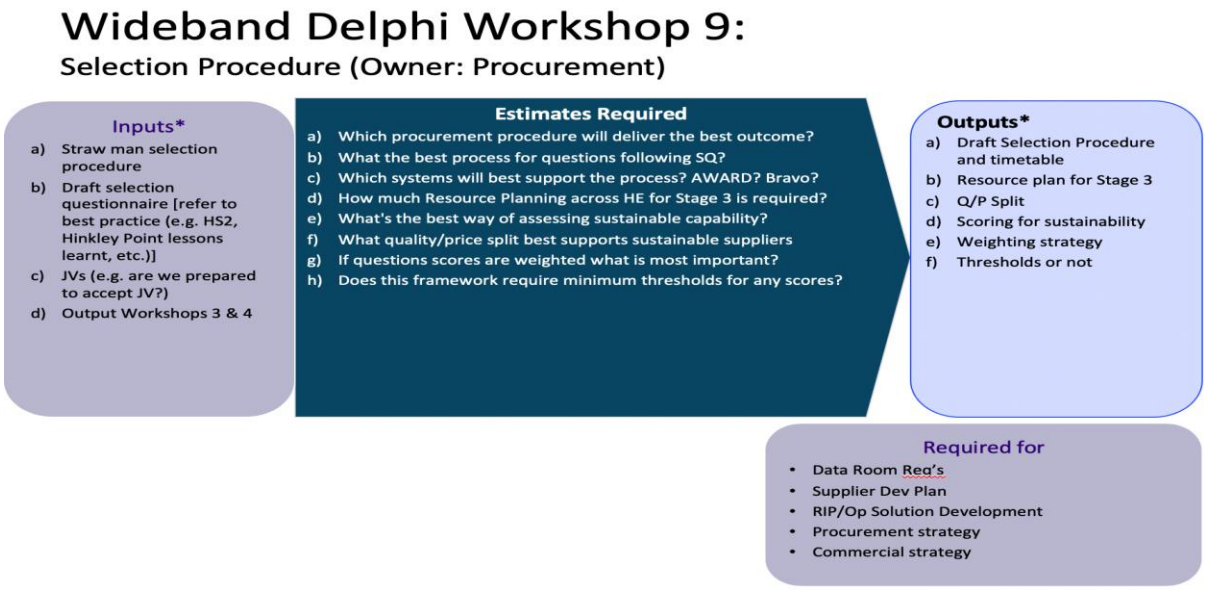


Figure 24 Selecting bidders

Bidder selection in public procurement is a binary process governed by the public contracting regulations and in Highways England's case, its investors protocols. Within the then Official Journal of the European Union regulations (OJEU, 2001) there were three sections of a major bid. Selection questionnaire, quality response, financial response. This workshop was designed to estimate how to beneficially shape the selection questionnaire which, while highly controlled, does allow for procuring authority particularisation. Highways England had to this point a standard selection questionnaire. This workshop recommended its adoption, amendment, or change. It was influenced by the outcome of W3, W4 and W6. It had a future interdependency on W10. Outcomes from the workshop fed into the thought trial on procurement. Recommendations supported the use of the existing selection questionnaire. It also supported a move to allocation of future work. Proposals from the workshop included making this framework exclusive to Highways England and not enabled. It also recommended an open market tender and not selective process. It also discounted the use of competitive dialogue. The workshop additionally recommended its estimated split of quality and financial weighting as 75 quality and 25 financial.

5.1.10 W10 - Workshop ten: Bid evaluation strategy

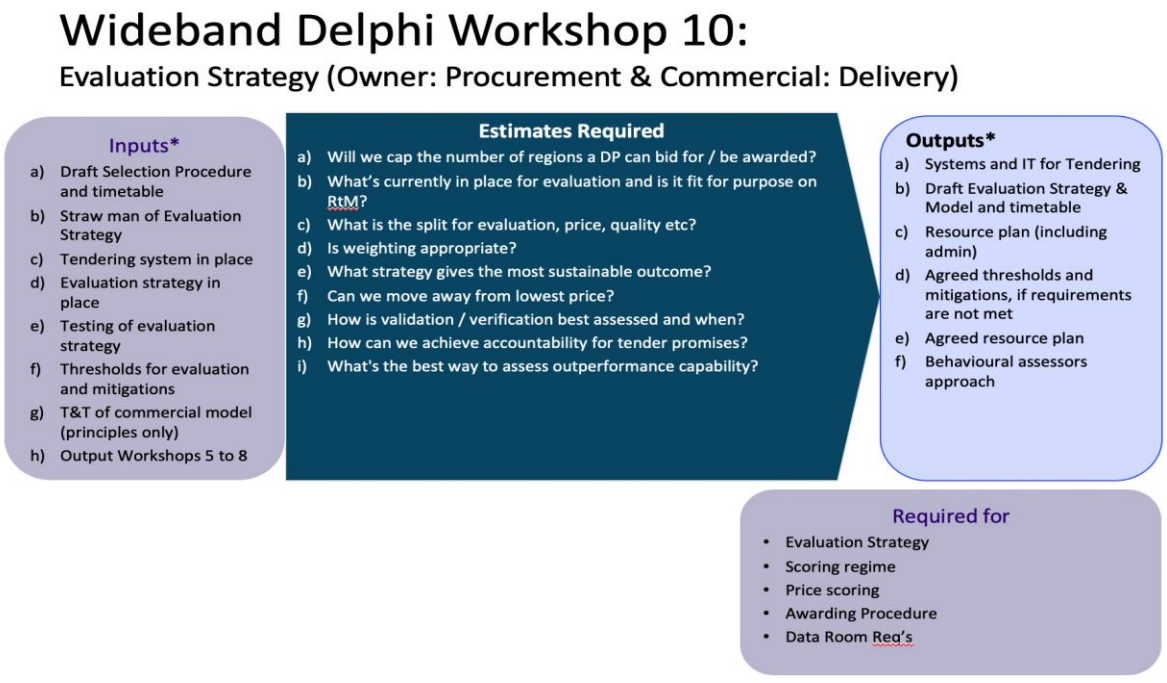


Figure 25 Bid evaluation

Under OJEU open tender rules, used at the time for UK public contracts procurement, evaluation was split between quality and financial response. The weighting of these elements could be determined by a procuring authority along with the scoring and subsequent evaluation of each element. This workshop focused on the strategy for this evaluation. It estimated the impact of the quality / finance split on the outcome of the tender process, supplier sustainability and behavioural assessment, supplier reliability, transferability of tender information throughout the administration of a potentially six-year framework, scoring, and the impact on aggregation of points over the whole bid. Differentiation mechanisms in scoring by weighting applied to quality and financial elements were also influenced. In all these it considered rational and predictably irrational strategies by bidders. Inputs were dependant on W3, W4, W6, W7, and W9. The output from the workshop would influence thought trial on procurement.

Recommendations from the workshop shifted the quality / finance balance closer to 80/20 due to the importance of quality on the sustainability throughout the framework duration. The workshop suggested an asymmetrical scoring pattern to increase separation of scores and that no more than 25 quality questions should be used in total. The workshop recommended not including behavioural questions or a test in the tender but creating a 100-day mobilisation challenge for all awarded bidders that impacted future allocation. This was to build upon a cultural and behavioural maturity question strategy in the bid. A further recommendation was the use of validation post-evaluation to check on evidence and commercial understanding. It also made recommendations on thresholds for key areas of evaluation.

5.2 Facilitated Modelling

Issues of duplication avoidance from challenging timescales involved in running parallel workstream activities meant the core team acted as a collaboration spine to each stream. The core team met outside of normal hours to correlate daily developments.

5.2.1 Work Stream 1 – Delivery / Commercial

5.2.1.1 Who

Modelling, facilitated to maintain focus on the potential offered in the underpinning theories, was undertaken in parallel over an eight-week period. Each stream was facilitated by the prototype development management office and led by a subject matter expert acting as participant and facilitator. This subject matter expert was proficient in contract and procurement and experienced in operating as part of the delivery senior leadership team. They were also instrumental in assembling the analysis from the underpinning theories and practice literature. As such, they were the lynch pin of the research, design, and build of the prototype. The core group from the workshop stage made up the core team of all facilitated modelling. Delivery trials did not include contributors from legal. The core team was supplemented by participants from Regional Investment Programme delivery and operational delivery.

5.2.1.2 Format

Building the prototype by facilitated modelling was systematic and done over the six-week period during which thought trials occurred daily. Prior to the trials the core team assembled a thought scaffold within the preliminary prototype. This was a virtual sketch of the prototype provisionally assembled to form the basis of the trials in collaboration. The build process identified the next piece of model to be formed and, while assembling it within the thought scaffold, used the thought trial team to challenge and adapt it.

Elements were adopted or rejected using a similar decision architecture to that used in the wide band Delphi workshops. In build stage however, trials additionally considered the sociological effect of nudging suppliers and project teams. Trial panellists considered how social norms might cause/trigger regression or adoption by practitioners. Where an element of build, in a thought trial, was considered to create the opportunity for misinterpretation based on custom and practice, or from auto-ethnological data, counter intuitive or predictably irrational behavioural responses from potential suppliers, it was challenged. This challenge resulted in either:

- a wider understanding of where other areas of the prototype would act to hierarchically remove/mitigate the risk,
- Rejection of the element for re-consideration and re-design
- Adoption with an understanding or its impact across the prototype.

In every case each element's performance, as an integral part of the prototype and its inter-action with all other elements, was constantly reviewed. This inter-play across the prototype was three-dimensional, first dimension being in the specific trial, second the other work streams, and third the emotional response expected from participants.

5.2.1.3 Inputs

Each trail considered outputs from relevant workshops against a backdrop of prototype requirements and objectives. Using auto-ethnological data from trial participants each element of the delivery model was built using information from the practice reviews and underpinning theories to shape its contribution to an eventual prototype choice architecture. W1 volume workshop informed the probable pipeline of work for suppliers on the framework. Access to future work through performance was a core element of the emergent incentivisation strategy. It also provided principal information in the procurement process. During each trial, all workshop outputs were considered when thinking through how to combine nudges into a mechanism for nudging behavioural change.

From Highways England's grouped analysed cross sectional data (Young, 2017), it was evident that counter intuitive behaviour impacted outcomes under the *Collaborative Delivery Framework*. To address this the contract and procurement thought trials explored root causes of behaviour (see 9.1.1.1). They examined what caused those choices, and what might be changed through nudge interventions in the prototype. Causes took account of the tribal influence, perception of commercial benefit to the individual and tribe, and the emotional response to the choice. Nudging created a different choice architecture and pathway for decision makers by conveying different

rights and obligations, threats, and opportunities. It also had to confidently change the emotional response of the decision maker to be considered effective.

5.2.2 Work stream 2 – Legal / Contract

5.2.2.1 Who

As with modelling stream one, facilitated sessions were undertaken in parallel and over a six-week period. This stream was facilitated by the prototype development management office and led by both a subject matter expert in contract drafting and commercial management acting as participant and facilitator dependant on the topic of discussion. The core team from the workshops made up the core team of all the thought trials. Contract and commercial model trials included contributors from all core areas. The core team was supplemented by participants from specialist areas such as performance management, cost planning, conflict resolution, estimating, and commercial data analysis, as appropriate.

5.2.2.2 Format

Building a commercial strategy and translating it into contract drafting was undertaken systematic and done over the six-week period. Thought trials occurred daily throughout. The build process identified the next piece of the commercial model or contract suite to be formed and, while assembling it within a thought scaffold, used thought trials to challenge and adapt it. Elements were adopted or rejected using a decision architecture format like that used in the wideband Delphi workshops. In build stage however, trials additionally considered the commercial and risk-based decision-making effect of nudges and how social norms, and availability heuristic might cause regression from practitioners. Where an element of build, in a thought trial, was considered to create the opportunity for misinterpretation, based on custom and practice, or counter intuitive, or predictably irrational behaviour, it was challenged. This challenge resulted in either:

- a wider understanding of where other areas of the prototype would act to hierarchically remove or mitigate the risk.

- Rejection of the element leading to a need to reconsider or redesign it.
- Adoption with an understanding of its impact across the prototype.

In every case, each element was assumed to perform within the system and as a part of a whole prototype and its inter-action with all other areas was constantly reviewed. This interplay throughout the prototype was multi-dimensional, first being in the workstream and second the other two thought trial streams developing iteratively in parallel.

Contract design particularly generated a great deal of trial activity with expert drafters translating thought trial ambitions into the most efficient drafting available. In several areas, the inter-related activity of what would be a suite of seven documents working together and independently, caused prolonged trial discussions. Contract documents that reflected the ambition of the trials were being adapted from standard forms of NEC contract. This required an intimate knowledge of not only the contract forms, but legal precedent, operational mechanics, and intent to limit duplication and potential cross document contradictions. The intent of drafting a suit of documents was to minimise duplication and limit the potential for misinterpretation, or gaming. The process of refining the contract documentation took many iterations and a great deal of refinement to optimise the suit.

5.2.3 Work Stream 3 – Procurement

5.2.3.1 Who

As with other modelling, this was in parallel and over a six-week period. This stream was facilitated by the prototype development management office and led by both a subject matter expert in procurement management and procurement lawyers acting as participant and facilitator dependant on the topic of discussion. The core team from the workshops made up the rest of all the thought trails. Procurement practice and market engagement trails included contributors from all core areas. Participants included specialists from strategy and planning, framework management, communications, contract drafting, and business governance supplementing the core team as appropriate.

5.2.3.2 Format

Building a procurement plan and translating it to support market engagement and business governance was systematic and over six-weeks. Thought trials occurred daily throughout. Procurement worked closely with the commercial and contracting trails process assembling the procurement strategy within a similar thought scaffold to the commercial strategy. The team used thought trials to challenge and adapt its approach. These trials used the same decision architecture as wideband Delphi workshops to adopt, or rejected, ideas for an effective procurement strategy. During build stage however, trials additionally considered legal risks that ranged from bidder challenge to insufficient competition. Trials considered the outcome of decision making caused by nudges and how social norms might trigger regression from practitioners creating the perception of departure from prescribed processes under procurement regulations. Where a built element, in a trial, created an opportunity for misinterpretation, counter intuitive or predictably irrational decision, it was challenged and then assured. Challenges resulted in either:

- a wider understanding of other areas of the prototype that would act to hierarchically mitigate a risk.
- Rejection of an idea leading to redesign and rebuild.
- Adoption with an understanding of its impact across the prototype.

In every case, each part of the procurement strategy performed as part of a whole prototype and its inter-action with all other areas was constantly reviewed. Procurement planning included elevated levels of coordination with other trials so that outcomes from procurement resulted in an operable model.

Procurement processes focused trial activity on 1) legal compliance 2) probity, and 3) equality, in bidder information and activity. Procurement at the build stage was focused on making sure that in open market competition all bidders were treated fairly, openly, and in accordance with procurement legislation. The volume modelling done in the delivery strategy workshops resulted in

an estimated six-year volume of £8.7 billion, the largest single construction framework procurement overseen by Department for Transport to that point. External scrutiny was acute. Throughout procurement thought trials the Department for Transport procurement advisory board representatives where regularly updated on trial outcomes and briefed on processes and protocols being built into the prototype.

This oversight was later extended to the procurement process, evaluation, and deployment of the procurement model.

5.2.3.3 Inputs

Procurement planning and modelling took information from the delivery, commercial and contract trials to help refine the invitation for tender. It also took contributions from strategy and planning's work in preparing to establish the details of *Road Investment Strategy Two* which would contain investment funding commitment to support volume ambitions in the prototype procurement model.

Procurement trials also referenced cross sectional ethnological data from the unique practitioner review undertaken by Highways England (Josten, 2017). In assembling the trial team careful consideration was given to experience of team members. This ensured that a dynamic and effective procurement plan would be devised as close to right first time within a six-week timeline as possible. Compliance with the timeline of its programmes was essential to be able to meet Highways England's public commitments to its investor.

5.3 Conclusion

Development, building, and deployment of a new prototype procurement model for *Regional Delivery Partnerships* was done between summer 2017 and November 2018. As applied research, building the model followed an interactive process based on design principles derived from underpinning theories to identify nudges to solve a defined problem. The research identified ways to improve productivity based on redefining success from outputs to outcomes, and realigning effort into value generation. The main findings were:

1) Incentive models should closely reflect a visible decision link between risk and reward.
2) Incentives work in integrated project delivery ONLY when the client is engaged.
3) Integrated project delivery can, if done properly, be more efficient than transactional trading.
4) Performance must play a major part in incentivisation. Linking performance to future opportunity is a powerful incentive in a limited market where business sustainability is driven by work acquisition.
5) Opt-in procurement models do not work.
6) Simplicity of delivery structure, rule change, and outcome connectivity assists the people engaged in delivery to understand how to enact change.
7) Contracts are not read by the majority, so strong messaging needs to reinforce key themes on the intent.
8) Incentivisation must release opportunity for innovation to remove people from processes to:
    a. Avoid compromise in sustainability due to a demographic time-bomb
    b. Increase productivity.
    c. Increase predictability.
9) Change will only happen because of education and in a commercial environment this must be led by clients. Expecting project-based investment as the crucible of change, while persistently maintaining demand, does not work.

There are several factors that were found in underpinning theories to inform these changes:

1) The need to transition from opt-in to opt-out psychology.
2) Use of loss aversion rather than gain ambition as the basis for incentivisation.
3) Means of countering predictable irrationality.
4) Harnessing the power of self-organisation and how to encourage and support it.
5) Understanding and influencing social norms and tribal behaviour to create sustainability.
6) Understanding bias and sublimes and their influence on decision making.

Between Summer 2017 and late Autumn 2017 subject matter advisors were engaged in wideband Delphi workshops (Wiegers, 2013). These were used to estimate changes based on findings applied to observations from analysis and reviews. These estimated changes were then, from Autumn 2017

to early spring 2018, subject to thought trials (Dietrich and Haider, 2015) using facilitated modelling based on three streams of activity. From this modelling a new prototype was built and, following extensive testing, eventually deployed through an open market public sector tender (Government, 2015) between late spring 2018 and Autumn 2018. Suppliers, called Delivery Integration Partners, bid for a place on this framework which was awarded in November 2018 (Smale, 2018). This research was applied to develop and build the model, assure it, and eventually deploy it. At the end of the build stage the prototype consisted of seven key documents (Delivery Integration Partnerships Contracts 9.5.1):

- Frameworks Contract,
- Framework Information,
- Package Contract, Scheme Contract,
- Scope One,
- Scope Two,
- Quotation Information,
- Invitation for Tender.

Highways England faced report after report citing declining capability and productivity, demographic time-bomb issues, high and repeated levels of failure generating waste, and entrenched transactional behaviour caused by regressive terms and conditions of trading. Some of the papers published identified potential, with the correct procurement model, for significant productivity improvements. Realising such potential is dependent on a procurement model to counter the known biases causing repeated failure it commissioned this research. Change was designed to embrace nudging the necessary changes in practitioner behaviour. These were designed to release potential in sub-tiers of supplier through cascaded alignment of risk and reward. During the review of practice, it became obvious that since the 1980's, reinforced by observational papers from across

the international and UK infrastructure construction market, productivity stagnation is endemic. Highways England took the opportunity, presented by a new procurement model for 75% of its enhancement schemes, to transition to achieve a step change in productivity.

The main aim was:

> Develop and deploy a new procurement model with unique choice architecture to motivate a change in decision making in the existing market hierarchical ontology to achieve tangibly higher productivity.

Using two-stage live practice research and facilitated modelling (Franco, 2010) this aim has been pursued and realised. The procurement model needed to implement a sustainable new way of working to achieve this aim, in the existing hierarchical ontology of the industry, was developed, built, and deployed.

Changing highways enhancement project structure, and activity, has been achieved by using behavioural insights to realise the opportunity to change culture. *Regional Delivery Partnerships* (see 9.5) has been built using a thorough analysis of behavioural cause and effect across the existing ontology. A series of facilitated modelling thought trials, based on socioeconomic and behavioural economic theory, were used to create a choice architecture capable of motivating the eradication of waste. Predictions from simulations informed the design of this new choice architecture. This research resulted in a series of inter-connected nudges that, when combined into a new model, have the potential of nudging significantly different decisions and higher productivity outcomes.

The outcome uses a 'morphogenetic cycle', that splits social change into three processes: [T1] conditioning → [T2-T3] interaction → [T4] elaboration.

The *Regional Delivery Partnership* model has created: T1 conditioning. It defines a new way of working through morphogenesis. It is a procurement model that establishes aligned social and commercial rights and obligations within a confined road building ecosystem [integrated project

team]. This realises the defined goals of efficiency, predictability, outcome focus, and value improvement.

T2-T3 Interaction - It establishes a structure in which the translation of roles for individuals in groups, operating under a new high productivity environment, can sustainably achieve the model's intent. The intent and structure are described in a contract that motivates all parties towards an agreed way of working, within a choice architecture, making a significant productivity shift possible.

T4 Elaboration – The new model describes agents that are assigned rights and obligations relative to a contract scope. *Regional Delivery Partnerships* identifies decision pathways to counteract poor productivity and high process waste. It changes roles and responsibilities to better align risk and rewards across a hierarchical ontology described by participants in the community.

Such change relies on a community desiring to change. It needs training to understand, act, and integrate its actions against a common imagined reality. This must be based on the same documents understood, perceived, and translated or interpreted consistently despite involving many thousands of participants. To generate the investment needed within the community to achieve this the procurement model needs to recognise it is designed to improve this subjectivism in the medium to long term. It sets out to radically improve culture over time by effectively aligning risks and rewards. It creates focus on a common imagined reality within which roles, when adopted and performed effectively, lead to tangible success though higher productivity and improved value.

This research used personal experience, combined with cross sectional grouped data, a review of practice, and underpinning theories to develop a new structure, agents, and decision labyrinth.

It highlighted how changes in decision pathways, available to agents within a defined and contained community, can be nudged to achieve better outcomes from greater productivity.

Previous research by Highways England exposed the existence of conditioned group think. In trying to understand the positive and negative feedback from operational procurement models' analysis was constrained by this conditioned group think. The resultant designs were hampered by

widespread and corrosive cognitive dissonance. Investigation considered observations, contained in detailed feedback, as representative of culture in a social community structured for development, design, or delivery (Josten, 2017). Analysis of the data shows widespread and corrosive cognitive dissonance, uniqueness bias, optimism and overconfidence bias, the planning fallacy, strategic misrepresentation, and many other cognitive challenges (Flyvbjerg, 2017b). Investigation forming part of this research considered the root cause of observations contained in cross sectional ethnological data. It considered how representative it was of what is, and leads to, acceptable behaviour and culture in a well-established tribal highways community. By interpreting group analysis of this data into behaviours this research created the opportunity for new choice pathways to be built to counter these outcomes. It focused on individual and groups of decision makers, in companies and projects, and the necessary nudges needed to move behaviour into an unfamiliar environment of collective deployment of capability, more likely to shift the dial towards high productivity.

This research identified extremely well organised processes which are highly developed examples of constructivism (Dudovskiy, 2018) where a common imagined reality is socially constructed.

Extensive numbers of perceived boundaries, limiting beliefs, were found within a known, contained, and commercially bounded social construct. From wideband Delphi workshops and facilitated modelling new boundaries and pathways for change agents, or groups of agents, were identified. They provide fresh choices within this defined and extremely specific hierarchical ontology.

Regional Delivery Partnerships contains a choice architecture specifically tailored to a highway's enhancement or capital replacement contract motivating, using specific combinations of nudges, a supplier to reduce the cost of unnecessary process waste and poor productivity as the consequence of opting out of effective delivery. To make this new way of working sustainable the model nudges adoption of a new set of ecosystem social norms.

It uses choice architecture and motivation linked to these social norms, primarily loss aversion, to change the way decision makers regard rationality around decision making. Decisions that previously provided a counter-intuitive advantage, now act against the supplier. Decisions, previously requiring op-in by a supplier, are now fundamental and critical to enable a supplier to remain viable and sustainable. Integrating the project delivery team and collaboration, previously requested as ways of working, are under this model essential to success.

The likelihood of sustainable success from this changed choice architecture were tested using internal and external subject matter experts and industry renowned practitioners.

By identifying known, and unknown, social conditioning from independent reviewer's auto-ethnological data before deployment, the model was refined and validated.

This research followed a progressive and logical process to reach an outcome. *Regional Delivery Partnerships* has been the result of facilitated intense workshops involving a wide range of participants. It took the estimates from these workshops and subjected them to facilitated thought trial modelling using smaller groups of highly experienced practitioners. The result of facilitated thought trial modelling created a decision architecture and choice pathways that were assembled around a thought scaffold. From practitioner experience a simulated actor was fashioned. Using case study simulations, the team then predicted decision patterns through the choice architecture to understand the potential for predictably irrational choices from within the known hierarchical ontology. These case-study based simulations were used to refine motivators and suppressants using simplified choices within the architecture.

Outcomes were predicted using a simulated decision-making agent acting in the new structure and decision labyrinth to emulate an optimised pathway. Predictions from this simulation forecast a significantly improved likelihood of achieving; waste out and productivity up.

5.4 Theories that worked

5.4.1 What positively influenced the prototype?

Workshops were designed to promote active diverse discussion and gather, from experience, several influencing factors. How nudges were positioned within the model would influence a project outcome. Workshops also considered the power of language differentiating the new model from established custom and practice. This language issue was particularly important where innovative ideas needed explaining or clarifying, to avoid regression to the mean of learnt behaviour or interpretation. A great deal of focus was applied in workshops to determine if philosophical ideas would translate to the workforce and therefore change decision making behaviour at grass roots. Several ideas were discarded in the workshop stage when, in the panel's estimation, although philosophically strong the idea would not translate to the workforce and so was unlikely to change decision making behaviour. Diversity of thought, derived from the wide band Delphi workshop participants, positively impacted design, and assembly of a prototype. The rigour and focus of workshops being done with intensity and pace over three weeks, with diverse but informed input, was highly effective. Setting the rules to be irrevocable decision-making forums was essential.

5.5 Theories that did not work

5.5.1 What negatively influenced the prototype?

Complexity, or the need for simplicity, was repeatedly the subject of great debate throughout the workshops. With panellist's experience indicating, that despite great intent, previous models had failed to achieve traction through overly complex terms. The topic of complexity consistently cropped up when discussing incentives. While incentives where specifically the focus of W6 contract and commercial, every workshop sought to find a way of capturing an incentive for suppliers to perform better in its focus area. At the same time little time and focus was applied to client performance in enabling or constraining suppliers to achieve the aim of the model. Absence of this

negatively impacted development of the prototype. Its absence also led to challenge in the market engagement and bidding later in the process.

5.6 What changed

As a result of applying attributes from the underpinning theories to aspects of the procurement model, the principal changes were:

1. The ethos moved from opt-in to opt-out. This allows a client to realise its targeted efficiency in setting an incentivised budget and creates the motivation to realise all other savings as additional benefit to the supplier.
2. The motivation strategy adopted loss aversion as the primary theme in both loss of cash and loss of opportunity.
3. Motivation included removal of acquisition costs around future opportunity by introducing work allocation based on performance.
4. Incentives are sequentially linked to customer values releasing an additional share of savings against economic and social value metrics using an investment baseline marginal gains mechanism.
5. Motivation theory was used to style the fixed margin characteristics using loss aversion as a self-governing strategy to reverse engineer turnover growth, a known issue, to dilute margin because of poor decisions making.
6. The model is overtly designed to harness integrating project delivery and eco system collaboration. This creates capability using a temporary but focussed social norm to enable permission to change custom and practice.
7. The use of single point design and build responsibility aims to engage all tiers in attaining predictably good outcomes based on equity in success. Single data, collaborative planning,

and choosing by advantages are all embedded into the operating mechanisms outlined in the scope and contract.

5.6.1 Facilitated Modelling

Review of practice in *Road Investment Strategy One* and how projects performed under *Collaborative Delivery Framework* revealed a consistent pattern of activity. Suppliers, consistently forced to acquire work through secondary competition, deploy a win strategy and then set about identifying opportunity for change based on design flaws or document errors. After award supplier behaviour focused on price escalation legitimised under the contract. This strategy allowed suppliers to change the price never having to deliver against the price submitted at tender. Change was seen to occur through to final account increasing the tender winning price sometimes by as much as 80-100%. Construction contracts are designed to work in competition but need the client's design to be correct at time of tender. However, the skill with which suppliers operated this mechanism of change acted detrimentally in two regards:

- Under bidding to win with efficient internal mechanisms to exaggerate pricing of change to cover poor management or construction planning and undelivered productivity. Clients' culpability in change being used to resist being held to account.
- Change used to frustrate and distract decision making processes transferring the costs associated with disrupted, and therefore sub-optimal productivity, away from the supplier and back to the client.

Prototype development for a new procurement model required these two fundamental flaws in the existing model to be corrected. To enable this each designed contractual nodal decision point was analysed and considered as an opportunity for a decision nudge but retained a choice creating 'free will' as a form of empowerment. To achieve this, using experience from the model development team, delivery decision-making data was analysed for its potential to inform a designed nudge. Appendix **Error! Reference source not found.** contains known delivery decision-making points, e

xisting counter-intuitive decisions, and the likely nudge required to change the decision-making outcomes. Combining these nudges creates the unique decision architecture and choice pathway of this procurement model.

5.6.1.1 Protecting a prototype from regressive thinking

Highways England, its staff, and its existing supplier community had been operating under a series of progressively more collaborative procurement models for 20-years. The resulting long-term relationships built up over a prolonged engagement created a series of deficient performance habits. Supplier businesses, in construction delivery and knowledge services, are recorded as operating within a conservative and un-diverse talent pool (Farmer, 2016) This is reinforced by four key findings:

- Recognising, accentuating, and exaggerating the price of change is considered advantageous, sometimes essential, to recover from underbidding by the supplier after being appointed following competition.
- When an asset enhancement is designed, without the builder's involvement, constructability is always sub-optimal presenting opportunity for skilled suppliers to challenge and cause design change to its commercial advantage.
- Pragmatic change is inevitable; therefore, supplier planning is more effective on a short-term basis while retaining experts in agile management capable of exploiting the consequences but coercively convincing a client to accept liability.
- Professionals in all aspects of construction capability delineate towards either supplier or client. This creates, reinforces, and embeds social norms of two tribes, client side and supplier side.

To protect any new model from regressive thinking these four elements of delivery habit must be addressed by integrating project delivery (Fischer, 2017). To reset social norms around decision making required close alignment between delivery modelling, incentivisation, and procurement

modelling. Changes in model structure and commercial risk transfer had to reflect a detrimental outcome for the decision maker if no change to behaviour occurred irrespective of the cause. Aspects of tribal behaviour were considered and described prior to modelling so that a labyrinth of potential damaging decision making, including emotional drivers, across this closed society could be simulated. To define a different choice architecture, the capacity and triggers for change were evaluated. When procuring, focus needs to be on a supplier's ability to understand and plan to progressively change responses relative to rewards. In organising to manage a contracted risk, suppliers must be able to understand the risk and its implications to delivery to effect the change needed to secure an economically successful outcome in context of the risk.

5.6.1.2 Outputs

The procurement model thought trials involved facilitated modelling to dissect analysed data relating to decisions taken during previous delivery processes and associated social norms. For this the team used Highways England's pre-existing *Project Control Framework* (Highways_England, 2017) as a guiding structure. It contains seven key stages of a project and circa 180 pre-defined products. These are selected on a project-by-project basis as required to successfully achieve permissions to, and deliver, enhancement projects. Established in 2013, and undated in 2017, it is well understood by both Highways England staff and suppliers. It describes components required for a scheme to successfully achieve permissions from authorising bodies, and to meet internal governance requirements. Each scheme particularises its route through the framework and identifies relevant products. Using this guide, the thought trial modelling panel tested which party might best control the effective outcome of each process and product. The panel also looked at where best to allocate responsibility, and accountability, and how to structure a choice architecture to optimise a scheme's outcome. This focused on how ownership of different risks might result in an optimal outcome for a scheme. These decision points, the associated choice architecture, and changes to choices for client and supplier, required an appreciation of what influences decision in the common hierarchical ontology as well as pre-existing social norms. These influences change

through the life of a live project where pressure shifts from investor to stakeholders, then to customers, and project benefit delivery. Thought trial outcomes changed the scope of the procurement model from “design and build” to “develop, design, and build.” It triggered a fundamental shift in the prototype from project control framework stage five and six, to stages three to seven.

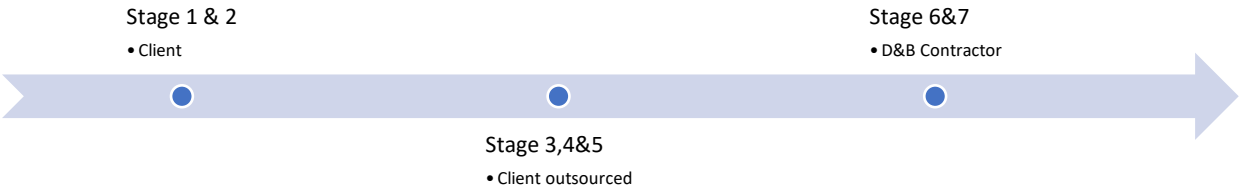


Figure 26 Stages under Collaborative Delivery Framework

Figure 27 Stages under the new procurement model

It also affected the incentivisation strategy to include performance using an eligibility criterion for future work and how the model should commercially deal with the distinction between development and delivery phases. This set of trial outcomes informed lot packaging and procurement structuring. The main challenges posed at trials were:

Challenge	**Trial outcome**
Could a noticeable change in productivity be achieved through minor improvement based on *Collaborative Delivery Framework*?	Trial outcome was no. More radical change was required in a new procurement model that drove significant and a generational shift in productivity.
To drive a generational shift in productivity what incentives would work?	Trial outcome was to seek greater leverage on loss aversion. To build a commercial strategy around post efficient target pricing, access to future work and release of cash incentives

	against key performance indicators based on customer service and generation of value improvement.
Could productivity improvement be achieved without the ability for suppliers to inwardly invest from incentivised gains?	Trail outcome was no. This created a link between exceptional gains being available for high performing and continuously improving suppliers. However, poor performing, and stagnating suppliers should be subject to the results of 'opting out' by paying for overspend themselves. This resulted in a recommendation that 'opting out' should be linked to disallowed costs passed to the trial on contract drafting. These were linked; nudging to create a golden thread between decisions gains and inward investment capacity. Recommendation was to make super gain (100% of savings) overtly visible and therefore attractive enough to change behaviour.
Should the prototype be limited in scope of work from the portfolio of Highways England's major projects?	Yes, Trial outcome was scope limited to regional investment programme and operational capital renewals. Smart motorway programme works, and complex infrastructure work was specifically excluded.
What was the best geographic organisation to address potential workloads and map onto Highways England's delivery structure?	Trial outcome was to structure supply aligned to Highways England's major project's organisational structure resulting in a division of work into lots by six regions: Yorkshire Northeast, Northwest, Midlands, East, Southwest, and Southeast
What was appropriate banding for work type and volumes?	Following on from the market capability workshops and considering the procurement balance sheet requirements of likely suppliers compared to the budget split of projects the Trial outcome was banding of suppliers up to £100m and over £100m sized schemes irrespective of engineering type.
How could company standard scope and policy be differentiated from project specific scope?	Trial outcome was to establish two scopes: scope one general and scope two project specific. This went forward to trial two contract drafting. Using a scope document to contain a lot of information previously included as client contract amendments was designed to make future change easier. Nudging the community away from transactional

	management of change towards integrated decision making.
Could change in decision making be overtly influenced by changes in choice architecture related to scope details and framework instructions. Would the social norms be too strong meaning availability heuristic would prevail?	Trial outcome was yes. Scope wording structure and outcomes were refined to respond to a changed decision architecture. This was passed to procurement drafting of the contract. The nudges included shifting from a descriptive specification to a performance specification outcome wording rather than input wording and a consistent mechanism for measuring performance and value improvement.
Which incentives might work in implementation of a changed delivery model?	Trial outcome was to focus incentives on budget, customer service, and access to future work and value improvement. All incentives were organised to drive a loss aversion from suppliers. As many incentives as possible were made objective decisions rather than subjective decisions. Performance based incentives focused on metrics that were translated from highways England's performance metrics with its investor to align performance objectives.
Equality, Diversity, and Inclusion were thought to improve productivity how could they be made more prominent in an industry with a notoriously poor record especially for equality and diversity?	Trial outcome was to write a series of challenging requirements in scope one relating to employment and skills planning. This was accompanied by an employment and skills maturity matrix. Additionally technical procurement questions and performance measures relating to employment and skills were included through coordination across all trials. This trial also resulted in a drive to remove gender bias from documents and use plain English an input to the procurement trail.

5.6.1.3 Scope One and Scope Two.

During the operation of *Collaborative Delivery Framework*, several changes to policy, standards, and controls had been implemented. As the main contract terms and conditions had been drafted to contain all these requirements within them any change required a deed of variation (Adriaanse, 2016) to alter the framework under which each scheme contract was awarded. This is a very time consuming, cumbersome, and legally heavy mechanism considered inefficient for the scale of this

procurement model. (One deed of variation under *Collaborative Delivery Framework* took three years to implement) As a result of the delivery thought trials, in collaboration with the contract and commercial trials, the team determined that establishing two scope documents would provide much greater flexibility for such changes in the future.

Scope One was designed to contain all standard and centrally controlled information, policy, standards, finance controls, processes, and procedures, etc., Scope Two was to contain all scheme specific information, high-level requirements, site information, timescales, target prices, dates, and particularisation of scope One, etc.

Future changes to requirements under either scope could be managed naturally, swiftly, and effectively under the standard form of contract change controls mechanisms.

6 Discussion

6.1 Changing behaviours by nudging choices.

6.1.1 Programmatic thinking

To change delivery decisions from those based on the pros and cons of a particular scheme to consider the opportunity offered by a programme, the choice architecture had to recognise a benefit to the decision maker. Delivery practitioners applied the analysed market data and auto-ethnological data to identify opportunities. Practitioners regaled the lost potential of dealing with schemes in a progressive rolling programme. Lost opportunity included failing to exchange materials between projects in a quasi-circular economy, economy of scale buying, knowledge transfer, workforce continuity, sub-supplier continuity, and many more. This productivity constraint was attributed to secondary competition and fragmentation of programmes in pursuance of demonstrable value for money from lowest price.

The delivery thought trials challenged the notion of improved value from competition within a limited and contained framework market. The outcome was to influence the contract trials to arrive at a three-tier contract model: framework, package, and scheme. This allowed a supplier to be engaged in multiple schemes of a similar nature, or similar geographic location. All these situations, although not solving the issue entirely, created a framework environment where suppliers are empowered to consider all these issues on contracted schemes in a more productive programmatic way.

From the delivery trials the prototype included two further productivity enhancing initiatives.

1) that a region could assemble a centre of excellence. This emerged as a model requirement, the collaboration of delivery integration suppliers principally to determine what excellent is. It is designed to explore the benefits of diverse thinking unconstrained by competition. This uses the

notion that no one supplier is good in everything, and each can learn from others across a programme.

2) a requirement for all suppliers to contribute to a sustainable improvement hub. The format of this hub is for the community to determine. But, in theory it provides a place to hold and share information within a region and across the programme relating to how to sustainably implement what good productivity is, determined by each centre of excellence.

The model empowers suppliers to collaborate and share information to continuously improve productivity. This is counter-intuitive to suppliers more used to competing but enabled a programmatic mindset and a decision pathway to enable it.

6.1.2 Incentivisation; what and why

Delivery trials highlighted a need for incentivisation to be simple and direct enough for a 'golden thread' to be seen from the model to the workforce of a scheme, in both development and delivery phase. Incentivisation of productivity is only considered to be effective if people undertaking an incentivised task can see a direct link between outcome and the incentive. In previous model's productivity incentives proved too remote from the workforce, or too complicated to understand. (Project Level Incentive Funds [PLIF] being a prime example.) The delivery thought trials continuously assessed the relatedness of productivity incentives, being considered under the commercial trials, to an imagined workforce of future schemes. Was it too remote; was it too complicated?

6.1.3 Choices in practical application

Procurement model trials considered the application of a new choice pathway in delivery of schemes of all types. These scheme types were anticipated to be undertaken as part of both regional investment programme and capital asset replacement. Distinct types of schemes, while similar in nature, have particularities based on the nature and complexity of their context. This has the potential to exacerbate uniqueness bias, one of the causes of scheme productivity failure. The

thought trials considered the nuances of applying these aspects of a prototype and advised any generalisations for nudging productivity based on a type of scheme. This focused on the repeatability and minimised the uniqueness of the schemes.

Amongst issues considered by these trials were a series of complications arising from the adoption of a new productivity model across a portfolio of projects all at different starting points. Also considered was the application of the model on schemes not yet started. This resulted in a series of implementation options mapped onto the procurement thought trial and included in the invitation to tender (41)a)(1) page 78). The impact of this was to consider every scheme to be transferring to the supplier as if it were not started. For those schemes progressed by Highways England, in advance of this transfer, adoption by the supplier would follow due diligence at Highways England's costs of work done to the date of handover. This required a series of handover protocols including the adoption of design liability and transfer of rights and obligations connected with existing data. Unpicking all scenarios into a series of generic starting points and then providing information to the contract, commercial, and procurement thought trails required careful consideration as well as effective project management.

6.1.4 Nudging: efficient, predictable, outcomes, and value-based decisions.

Facilitated modelling resulted in a series of nudges. These were based on several theories; loss aversion, prospect theory, expectancy value theory, rational choice theory, and the notion of 'opt-out' as a premise to macro and micro decision taking. By working the commercial and procurement thought trials together efficiency was driven as a condition precedent to setting the Budget. With the possibility of setting a post-efficient budget and offering a supplier all the gains from out-performing it, delivery could be incentivised to implement all changes that it recognised as doable. By offering bidders an opportunity to convert tender quality promises into contract commitments, used to differentiate scoring (see work stream three), delivery incentives could be linked to outcomes. Again, with this possibility, by working with the commercial thought trails, performance

measuring of predictability, linked to allocation of future work, created a ‘golden thread’ between performance decision taking and access to more work. Finally, the thought trial for delivery focused on wording of the scope, creating High-level requirements (Scope Two (A)) describing asset performance as an output specification (Lam-Frendo, 2019). This condition allowed for the contract to connect commercial risk to the ability to influence the solution early by creating a ‘single point design responsibility.’ Consequently, the delivery integrator would take control of design transferred from client to supplier but also the responsibility of it being fit for purpose. This translated into ‘you said, we did,’ listening to market feedback data, the supplier would now be involved even earlier than early contractor involvement. By reflecting feedback this empowering change was designed to achieve buy-in from suppliers. It gave an integration partner opportunity to optimise the effectiveness of a designed solution as well as the efficiency of design. Finally, by linking a measure of value derived from a scheme as an incentive, the delivery thought trial connected the purpose of a scheme to the community and customer benefits derived from it. This final connectivity allowed for justification of decision making to both a workforce and investor. This empowers the supplier and its eco-system to control what was, and was not, necessary in the design to meet high-level requirements, within budget, and on time.

6.1.5 Scenario testing: rational and irrational outcomes.

During facilitated modelling the core team created a verbalised virtual actor as a quasi-decision maker. Using auto-ethnological data to compile the characteristics and agenda for the actor, (an imagined delivery commercial director) each aspect of the delivery model was case study tested. When working with thought trial two and three the core team shared its virtual actor traits with the other thought trial teams. In all thought trials the characteristics, drivers, and agenda of the simulated actor were reached by consensus. In the event of a new aspect under consideration needing the simulated actor to be refined, the core group first discussed the characteristics that were intact, and then refined those that needed to be reconsidered. Using the core group’s experience each team member substantiated their opinion of any changed or maintained

characteristics and a majority-based decision was made about the simulated actors characteristics going forward. Decisions to continuously build the simulated actor's characteristics and likely decisions was as time consuming in the trials as reaching a conclusion on an issue. However, the ability for the trial team to assimilate the outcome of a choice architecture would be later rewarded in the testing stage. Throughout the assimilation stage of trials, decisions reflected the predictably irrational decision making of the simulated actor. The multi-faceted agenda, likely to be in operation because of the decision makers tribally base social norms, was extremely challenging. However, using this technique allowed the core team and trial panellists to synthesise decisions made in a new choice architecture and plot the outcome of predictably rational and irrational decisions. Most notable in this process was the potential for mis-aligned agenda and decision drivers. Where this became apparent the thought scaffolding was redesigned to create nudges to the choice architecture that addressed a route cause for a decision, and not simply attempt to deal with a symptom. In this way the design choice architecture was more sustainable than one that ignored the root cause and invited counter intuitive, predictably irrational outcomes. Many iterations of these redesigns resulted in discarded choice architecture branches as in simulation they either failed to achieve a desired outcome or were more likely than not to drive irrational decisions.

6.1.6 Stream two – Contract and commercial documents.

6.1.6.1 Inputs

The underpinning theories, practice review, and wide band Delphi workshops indicated that to change anything in the delivery of schemes a radical change to Highways England's commercial strategy was required. It was also clear in the analysis of data from *Collaborative Delivery Framework* practitioners that a simpler, plain English, and more direct set of contract documents were required. In all, the commercial strategy and contract documents needed to be clear, concise, and convey a direction of travel away from transaction towards integration, to radically improve productivity. Thought trial members were encouraged to read three key practice papers prior to trials starting, as well as the *Collaborative Delivery Framework* analysed practice data, to enhance alignment of

thinking. These were, The *Nichols review 2017 (Nichols, 2017)*, IPA's *Project Initiation route map (IPA, 2014)*, and IPA's *Transforming infrastructure performance (IPA, 2017)*.

6.1.6.2 Influencing the prototype with new thinking

Assembling a commercial strategy involved translating and conveying key structure, rights, and obligations through rational behaviours described in a set of contract documents. This requirement within the context of a standard form of contract and known legal precedence, made document design, and understanding, complicated. So, it was essential to be clear and concise. Clarity would rely on consistent language and style, as well as consistent logic to mechanisms within the contract. A series of challenges faced the trial teams:

Challenge	Trial Outcome
Could a commercial structure be used to change behaviour?	Trial outcome was yes. This informed choice architecture offered to the party, now forming as a delivery integration partner, to lead transformation in productivity through integrated project delivery (Marco and Karzouna, 2018). The nudge interventions included holding the primary contracting body responsible for the overall design performance, defining its role as that of an integrator not a constructor, and removing options to change the budget except in the case of a change to performance requirements.
Could a commercial approach be devised that opened inward investment to change productivity but guarded against unintended windfall gains?	Trial outcome was yes. Using 100% gainshare but against a fixed post-efficient budget established the basis for this. Shifting to a post-efficient budget creates tension where changing ways of working becomes an immediate sustainability issue. In setting a post efficient budget the ambition is not to target all inefficiency but only some. The remainder is available for re-investment by the supplier in improving performance. This nudge also informed the inclusion in procurement requirements of a "commitments register" describing the efficiency commitments made at tender that contractually linked to the ability for associated inefficiency to be disallowed from the defined costs of the project.

Was cash the best incentive or would access to future work be more effective?	Trial outcome was a combination of both cash and access to future work based on performance. This information was adopted in trial two for translation into a commercial strategy and drafting into the contract. Experience from trial members determined that access to pipeline of allocated work had been seen before in collaborative delivery framework but with insufficiently robust mechanisms to be implemented. In drafting the eligibility to future work mechanism careful consideration was given to using it as an incentive needing to be evidential and objective. Cash incentives work in some instances for a company but rarely for the workforce as the benefit from a decision to the individual is too remote to be effective.
Would bidders from design or integrator businesses respond to this model differently to constructors?	Trial outcome was no. This allowed generic and open wording to be used to attract all types of bidders. Considering bidders from all three categories of business did not materially change how a delivery integration partner should be procured or the expectation created by the documented model. The main impact of a prime supplier not being a constructor was the construct of the integrators supply chain. This was considered appropriate to become part of the quality assessment of bidders and not significant in the drafting of the contract or the commercial strategy.
Would a changed commercial model attract inexperienced suppliers?	Trial outcome was yes. Information from this trial was passed to the procurement trial to inform market capability assessment and engagement. Banding within the contract was also informed by Highways England's ambition to access new medium sized delivery integration partners to build its core strategic supply chain over time. Consideration was also given to the potential of new entrants without knowledge of the mean working practices in two regards. 1) scope one described a way of working with Highways England that may put a new entrant at a disadvantage if quality assessment contained unconscious bias to existing suppliers, and 2) quality

	assessment in procurement requiring evidence should promote transferable skills from other construction sectors.
Could Highways England respond to its role in a changed commercial strategy?	Trial outcome was potentially yes. This information was passed to the delivery trial to build capability internally, and to contract drafting to inform client commitments contained in the contract. Guidance from the contracting trail was also passed internally to inform pre-award training for major projects and operational staff in preparation for deployment.
How much commercial model change did the market have capacity for?	Trail outcome was to advise moderate to stretch change but to moderate expectation against a medium to long-term transitional horizon. Building on advances under collaborative delivery framework focus was on behavioural change of agents under revised rights and obligations. The structure of the new model and how parties' function under it was the most meaningful change. To register this as a unique way of working, on a journey to enterprise working over 10-15 years of transition, regional delivery partnerships required some headline changes. However, it also needed to be familiar enough to the development and construction market to allow companies to understand and evaluate risk transfer characteristics so they could bid.
Could a new model be robust enough to continuously improve suppliers' performance?	Trial outcome was yes. The means of holding suppliers to account were outlined and passed to the contract drafting trail and the procurement trial for translation into documentation. This commercial trial also informed some of the early thinking around the development of a balance score card for performance. It also devised a means of connecting performance measurement to allocation of future work. This trial specifically sought to really push into areas of procurement law not considered before. The result was not only a balanced scorecard but characterisation of some metrics being objective and some subjective. Legal advice was that only objective measures should be used for allocation. This required a new alignment of performance measurement of,

	and by, Highways England. The exercise also significantly reduced the number of metrics measured as well as introducing more sophistication into how data was to be collected.

From thought trials there were four distinctly new things:

- Financial performance was to be measured against an all-project-costs post-efficient budget; including client costs as well as supplier costs. This determined supplier performance against budget under or overspend not simply their price. Financial incentives reflected a simpler model of 100% retained underspend and 100% overspend, but overspend capped within a project, package, budget to a sum equivalent to the fee made up of overhead and profit.
- The use of performance as the basis for eligibility to future work and the introduction of work allocation based on performance, embedding a move away from secondary competition. As reward for reliable performance work could be allocated, but for deficient performance a supplier becomes ineligible for new work until its performance improves.
- Risk management is a team activity. Projects will be delivered as an integrated team with client and second tier suppliers being active members of the team. To encourage this programmatic sub-contracting is designed to become far simpler than other framework models with designers especially being treated as an associated company to the delivery integration partner.
- Despite financial incentives being 100% retained underspend, 50% of this relates to value improvement based on a package of works. The 50% related to value improvement is, if earned, to be released at the end of a package and could, during package delivery, be used to off-set overspend on other schemes if required. This provides the supplier with a safety net using programmatic thinking and the client with customer and community value improvement as the basis for enhancing the supplier's share.

6.1.6.3 Protecting the prototype from regressive thinking.

Highways construction company decision makers trade on knowing the commercial structure of contracts and understanding how to manage corporate and commercial risks within them. To develop a new procurement model in a newly formatted contract, the core thought trials team where conscious of building it simply and clearly. This was considered necessary to prevent practitioners regressing based on the availability heuristic. The risk was suppliers not spending time or effort to understand and interpret complex contractual documentation against their business operating models. Contextually, a suite of documentation is complex, so simplifications and clarity were additionally relevant to understanding. To enable bidders, and internal delivery teams, to understand changes and differences in commercial strategy, alongside contract drafting a guidance document and tutorials was planned. Designed to raise awareness and supplement training sessions during the market engagement stage of deployment, this was considered essential to the model's adoption. To coordinate output, this activity was done collaboratively with the delivery and procurement thought trial workstreams. During prototype build the coordination of this strategy, and contract drafting to recognise nudges, nuances developed in other thought trials and the team worked diligently to incorporate them into contract drafting. This required extensive cooperation between contributors and subject matter experts. It was essential contract drafting not only carried the intent of a nudge but complied with the key choice architecture and decision ontology. It was also essential to eradicate conflicting instruction in other parts of the model. Cooperation and coordination were extraordinarily complex and required intensive sessions of cross-workstream iterative working. The hierarchical decision architecture adopted in the workshops was used to prioritise decision making. Additionally, drafting was constantly monitored against neutral gender and plain English drafting.

6.1.6.4 Outputs

A series of outputs were produced during this set of thought trials:

- Business case contributions for internal governance; commercial case, strategic case, and financial case. This included principles and strategy of the incentivisation model.
- Contract documents; framework, package, and scheme contracts, including the mechanics of incentivisation. (See 41)a)(4))
- Scope documents; scope one and scope two (See 41)a)(2))
- An invitation for tender based on the commercial case and contracting structure. This included information around how to price the financial section relative to the procurement model's commercial strategy. (See 41)a)(1))
- The quotation information for post award scheme budget setting. (See 41)a)(3))
- Framework information, partly instructional and partly to inform interpretation of the framework's operational structure and processes. This included guidance on incentivisation principles and operation as well as future work allocation and qualification requirements. (See 41)a)(5))

These documents were all built, and peer reviewed, within the core team alongside thought trials being carried out relating to individual issues, cross referring issues, and defining interpretation and operational guidance.

6.1.6.5 Incentivisation; loss aversion and endowment effect.

Previous frameworks and associated procurement models assume that a competitive market, forced to secondary compete for future work, would be incentivised to continually improve performance to achieve sustainable workloads. These models are based on an 'op-in' philosophy – if opportunity for improvement is set at a suitable level, corporate desire to change, and 'op-in' to a client ambition, will increase. This has not resulted in transformation of productivity during the previous ten-years of procurement models. In macro terms it demonstrated the endowment effect.

Regional Delivery Partnerships prototype procurement model is designed differently. It assumes that to be awarded a place on the framework a supplier must have created confidence in the evaluator that it understands how to implement efficient working and integrate project delivery. In effect it establishes a supplier's understanding of the client core requirements; efficient, predictable, outcome focused, and value driven. This visible commitment to improved productivity allows the client to establish target budgets that anticipate the effect of these commitments. A supplier states a level of efficient operational understanding. If the supplier subsequently does not do what it has committed to do i.e., 'opts-out,' any resulting inefficiency cost is not paid as part of the price, i.e., uneconomic working is a supplier liability.

Establishing an 'opt-out' model creates tension within an integrated project team. The Integrated Project Team needs to engage the delivery partner's post-efficient methodology to achieve a post-efficient budget. This tension is designed to positively influence decision making to improve productivity as the probability and visibility of loss rises. Under the principles of loss-aversion the effort likely to be deployed by a supplier to avoid such a loss (avoiding 'opt-out') is more than twice as powerful as a supplier's effort to 'opt-in.'

Loss aversion has not been used for public sector construction contracts in the UK before. All referenced contracts have been based on 'opt-in.' While the principle of 'opt-out' is strong, the prototype employs it in two distinct areas. The first in setting a post-efficient budget against which a supplier's financial performance in design, and delivery is pivoted. The second in creating the potential to lose access to future work for failures in overall performance. This establishes deficient performance as a loss of market share criterion in a market where acquisition of work involves a process that can sometimes take 2-3 years.

An additional incentive, built into this procurement model, engages a secondary means of mitigating loss even in an overspend situation. This is based on customer value. It centres on achieving key performance indicators based on stakeholder commitments. If a supplier meets these additional

indicators, it will both increase its share of underspend, and reduce the level of its capped liability of overspend. This incentivises improving customer value even when overspending the budget. By doing this, even in a situation where a supplier has not employed its post efficient decision strategy effectively, the model creates the ability to mitigate loss by meeting customer commitments. It is using loss aversion to drive value improvements.

6.1.6.6 Framework, Package, and Scheme contracts

During the commercial and contracting thought trial the structure of contracts across the framework was discussed in depth. Initial thoughts were to engage a framework contract, and then a package contract, using multiple connected schemes operating under a sectional completion agreement for each package scheme. This was rejected following a three-day trial including a scenario test and simulation of a series of schemes being undertaken. The trial concluded that the framework should be established as the head contract with package and scheme contracts enacted as a form of works orders. Neither framework or package contract would create the ability to commit to expenditure but simply create the intent of placing works orders for packages and schemes, respectively. The contracting model, following investor instruction (UK Government) used a *New Engineering Contract* (NEC) *Engineering Construction Contract* (ECC). To allow flexibility to undertake paid work in packages, in preparation for schemes, the package works order included the ability for a client to issue an “Early Work Order” under an NEC ECC short-form contract. This created the ability to undertake advanced works necessary to determine site and/or asset condition data, advanced design to inform surveys, and most importantly for the initial packages, mobilisation of the Framework. This facility, created in cooperation with the procurement trials, would mean suppliers could be paid to undertake due diligence on initial package(s). It also allowed collaborative compilation of a framework, package, and scheme delivery plan before issuing a scheme works order and entering a scheme contract.

6.1.6.7 Financial workbook

Part of each tender is a financial workbook. The procurement thought trial established the format and proportionality of finance compared to quality. The commercial trial worked through how elements of the financial workbook would be used in post-award to maintain the integrity of bidding differentiation. The principle commercial strategy options tested at trial were:

- Fee (business overhead & profit) would be fixed at the earliest point to nudge suppliers to recognise 'price pumping' (using change to increase turnover) would be counterproductive when compared to business contribution. It builds on expected value theory (Kahneman, 1979) to increase the importance of the money forming the fixed sum compared to the prospect of increasing it through change generated "pumping".
- At the start of a scheme contract the client issues a 'statement of funds available'. This cannot be exceeded when designing a solution and/or setting a budget. This reflected an ambition to more strongly motivate budget led design. It nudges designers away from "gold plated" and over engineered design as the delivery integration partner is incentivised to outperform the whole budget. This requires the client to be robust in maintaining the "statement of funds available" in the face of a delivery partner over designing to minimise design liability.
- Bid data used to award a framework contract should remain contemporary throughout the framework and be translatable to any work within scope. Use index linked pricing (inflationary and location based) for the duration of the framework.
- Unforeseeable legislative change would not be a transferred liability.
- Inflation risk would transfer to the supplier at the point of Budget setting.
- A supplier's maximum contracted overspend risk (pain) is a sum equivalent to fee.
- NEC: ECC: Option C: *Activity Schedule and Target Cost*, would be used for all scheme contracts.

In this trial three main financial workbook formats were discussed:

- Sample scheme, full quantification, for comparative pricing. To be used as the basis for pricing future schemes.
- Schedule of cost components. All indirect costs for integration and management to be used post-award relative to defined actual costs.
- 'Basket of goods' to create a supplier specific all-risks schedule of rates to be used post-award.

Option One, using a fully quantified scheme and full pricing, was discarded on several factors. First, a sample scheme would not be capable of being comparatively used in the future due to the variety of schemes covered in regional investment programme and operational capital projects. Second, experience of using this format under the *Collaborative Delivery Framework* had not been satisfactory. Its' use resulted in several contractual disputes where the extent of change had not only increased/decreased scope, the price of individual elements, but additionally substantively and materially changed scheme economics. The inability to maintain any correlation to bid financial information in post-award was used in gamification by suppliers. This thought trial therefore considered this a sub-optimal solution to represent the prototype's commercial strategy.

Option Two, a schedule of cost components for use with defined actual costs was discarded because it represented too great a prospect for increasing scope to be used to increase turnover. It was considered likely to increase gamification and may be used to enhance business contribution. Consequently, it did not provide a commercial nudge to change behaviour. It was considered to create the perception of cost reimbursement, NEC Option E, and did not represent the client's objective to predictably achieve a 'not to be exceeded' budget. This format was considered to technically work and was recognised to reduce the workload on bidders. However, the risk of regression, to an availability heuristic of emergent cost, was considered too great and likely to compromise the clients and investors objectives.

Option Three, was taken forward. It represented the best means of holding a supplier to the ambition of 'opt-out' efficiency. By committing to a capped schedule of rates, index linked, it could be used to price each solution inside a capped statement of funds available for a scheme. Using a supplier schedule of rates may have increased the burden in bidding with 1,000's of rates required to cover highways work. As a compromise the thought trial led to a condensed schedule, called – 'a basket of goods.' Highways England analysed historic priced measured work rates. It also analysed its historic spend and selected rates from each measurement category representing 60% plus of spend in that category. This totalled 58 indicative measured work rates. Each of these rates was stated in tender information. Bidders were asked to price their all-in risk adjustment to each client issued rate. The aggregate of these discounts was then used to indicatively adjust all other client historic measured rates. This strategy allowed Highways England to assemble a supplier specific schedule of rate to use post-award when assuring the proposed budget. This effectively allowed Highways England to hold a supplier to its financial tender position throughout the framework duration when setting the budget of any scheme, in any location in a region, under any circumstances. Tenderers were also given a location adjustment factor to be used if post-award it undertook work in a different region. This in effect created, in parity for the tender, the ability for each framework supplier to have a bespoke schedule of rates capable of being used nationally. While the outcome of this trial appears straight forward the degree of scenario assimilation engaged in through this trial was significant and difficult to capture in this description. The "what if" discussions in this modelling session were in the hundreds. The core team relied heavily on not only its imagined agent but simulated an imagined bid strategy for its imagined delivery partner to be able to assimilate outcomes from each option.

6.1.6.8 Quotation process and information.

Because a schedule of rates, based on a basket of goods, was selected as the financial workbook format, contract documents included a defined quotation process for each future scheme. This contained a contractual mechanism in the form of a step-by-step guide to inform a supplier of the

process to be followed to compile a scheme budget quotation. This new process was different to that followed under *Collaborative Delivery Framework*. Therefore, not only the supplier community but Highways England's staff needed guidance in its use. To ensure this process could be applied to any type of work the trial included simulation of three different scheme types. These simulations predicted a level of rate adjustment and worked with a group of specialist financial modellers. The simulations showed potential outcomes when the strategy was applied to larger, medium, and smaller schemes. It also simulated incentivisation impact with poor, moderate, and reliable performance. Modelling also considered application across a package with one larger scheme and another with three smaller schemes. The outcome of these simulations was translated to refine guidance and inform bidders, Highways England staff, and awarded suppliers. While supplemental to a standard form of contract this information was essential to convey differences from Highways England's historic practices in setting 'Total of Prices' under *Collaborative Delivery Framework* contracts and those needed for setting 'budgets' under *Regional Delivery Partnership* schemes.

6.1.7 Scenario testing; rational and irrational outcomes

During scenario testing, as part of trials relating to contract and commercial, the trial team imagined a virtual supplier commercial director. This imagined actor was constantly referenced to substantiate potential rational and irrational decision making. Simulated outcomes were based on data from the unique practice review and experience from core trial panel members. Thought trials referenced rational and irrational behaviour because of contract drafting, commercial nudges, financial modelling and incentivisation. Throughout this process ideas were accepted and discarded. Discarded ideas included:

- **No obligation to use sector wide category management frameworks.** Category management frameworks were procured and established by Highways England to work under *Collaborative Delivery Framework*. Removing an obligation to use these frameworks was discarded as in all instances Highways England considered that by using its sector wide economies of scale it achieves better commercial conditions than

individual suppliers. Combined with this was an understanding that future category management frameworks would be established in line with the requirements of *Regional Delivery Partnerships.*

- **Excluding client's costs from the budget**. This was discarded as whole budget incentivisation was thought to promote integrating the client into an integrated project team. This necessitates consideration of the whole project cost and time management by a delivery integration partner. This also requires an integrated project team to stop using fragmented liability as the basis of cognitive dissonance. Only "everyone winning" is an option with whole project costs being the basis of an incentivised budget.
- **Describing gainshare as proportionate to underspend or overspend**. This was discarded in favour of describing a 100% gain /pain share incentive strategy. Proportionality was insufficiently different to existing models to indicate a change to proper integration. Data from the practice review cited insufficient investment to enable significant changes to productivity. Proportionate gain share was a continuation of this constraint when compared to potential investment from a 100% gainshare incentive. The ambition to promote unconstrained self-investment, to change practice driving up productivity, would circuitously increase productivity and the probability of outperforming a budget.
- **Allowing Fee (business overhead & profit) to float** and be determined as a percentage of defined cost at contract completion within the incentivised budget. This was discarded as it was considered to perpetuate predictably irrational behaviour, namely pumping turnover to increase contribution, acting against productivity improvement. A fixed fee was considered more likely to lead to changed behaviour. Fixing fee was thought to nudge using anticipated internal pressure (within a supplier's business management cycle) to improve productivity performance as the primary choice to improve business returns. Increasing scheme costs by pumping turnover would become

counter-productive to a supplier as, with no corresponding change in the fee, it results in fee dilution.

- **100% pain share with no opportunity for mitigation**. This was trialled against incentivising with a potential to avert loss by continuing to meet client objectives despite a scheme potentially overspending a budget. While 100% pain resulting from a failure to maintain or improve productivity, and corresponding expenditure on design and build, by the supplier was attractive, supporting the loss aversion strategy, mitigating pain, was preferable. This trial outcome led directly to the inclusion in drafting of 'additional incentives' as key performance indicators for meeting customer commitments agreed in the contract.

6.1.8 Stream three - Procurement

6.1.8.1 Influencing prototype procurement with new thinking.

The prototype was, because of trial one and two, forming into a significantly different model to those known to exist in either highways or infrastructure at large. For the procurement trial team this posed a series of challenges.

Challenge	Trial Outcome
Would the market understand the ask?	Trial outcome was yes but significant engagement was likely to be required.
Who in the market would be interested in bidding?	Trial outcome was to broaden wording of market notices and use language that did not create an unconscious bias toward the existing market supplier group.
What type of bidder would emerge from the market: designers, integrators, or constructors?	Trial outcome informed an attempt to use open language and plain English to attract all categories of supplier.
Was it legally possible to move the framework to future work allocation	Trial outcome was yes. This informed the invitation for tender, framework information, scopes, and all forms of contract. It also

based on performance and not secondary competition?	informed the supplier performance metrics and operational protocols.
Could future workload be split to inform market decision making relating to lot selection?	Trial outcome was yes. This informed the bidding lot structure and rules relating to caps on framework share and hierarchy of allocation.
Which quality / commercial split properly inform sustainability of bidder for 6 years?	Trial outcome was 80% quality 20% financial with a split of the quality score into 25% strategic alignment, 50% technical capability, 25% regional alignment and capability.
Should suppliers be capped on individual volume?	Trial outcome was yes, max of 30% of framework to a single supplier.
What risk mitigation needed to be included to avoid failures in allocation?	Trial outcome was the design of a contingency procurement strategy incorporating secondary competition on quality only if allocation was not available. It also included a process for national competition. Followed by escalation out of the framework to open competition if no supplier was prepared to undertake works based on the model.
Would the market be strong enough (new bidders) to change existing dynamics?	Trial outcome was yes. Market engagement and expressions of interest suggested that there was significant interest from outside the existing collaborative delivery framework supplier community.

Each of these questions was the subject of a thought trial, either individually or combined with other relevant questions.

6.1.8.2 Protecting a prototype from regressive thinking.

Existing supplier recruitment practices commonly cited experience and knowledge of the sector's working practices as core candidate requirements. Highways England had been guilty of selecting bidders based on quality evaluation that commonly required knowledge and understanding of current practices to be explained and evidenced.

Development of a new procurement model required these two historic fundamental flaws, seen as regressive practices, to stop. To enable this procurement selection protocols were examined and

considered as an opportunity for a nudge in decision making. The development team considered all evaluation decision-making information for its nudge potential. The Invitation for Tender (41)a)(1) page 78) contains the evaluation decision-making points and nudges as ‘aspects’ required to change outcomes.

Historically, Highways England segregated solution development from detailed design and construction. Taking direction from its practitioner review and contributions from experienced trial team members the emerging prototype transferred responsibility for all these stages of a project to the delivery integration partner. A major risk in this strategy was continuation of transactional behaviour between solution developers and delivery integration partners meaning that historic issues would simply be shifted from client to supplier. As a result of a series of trials this rationale was assured and passed to the trial team for contract drafting. The team considered that in procurement it could ask quality questions that engaged a delivery integration partner in providing evidence of its ability to engage, partner, and manage solution designers and detail designers. This focused-on integration with a client team, delivery team and all appropriate stakeholders. With additional boundaries of; the capped statement of funds available, a performance specification and sing point design liability as well as the overspend risk incentivisation strategy, this was considered a viable risk transfer. It created the environment for effective integrated project delivery. A series of commercial issues needed resolving in the construct of documentation to reflect this decision. These were coordinated in cross trial working groups.

6.1.8.3 Outputs

Thought trials in procurement resulted in a procurement plan, invitation for tender, market engagement strategy, market engagement material, and governance documentation in response to the identified legal procurement risks.

6.1.8.4 Invitation for Tender

This document contained all the requirements for a compliant tender to be submitted. (See 41)a)(1)) It contains commercial, volumetric, locational data, and framework scope. It also contains the

process and components for compilation of a compliant tender, how non-compliant tenders would be treated, a process for raising questions and observations, an evaluation process, scoring mechanism, and the process for award. Trials continually challenged coordination and compliance of these elements within UK public procurement legislation, and investment governance, which in turn achieved compliance with all relevant European legislation.

6.1.8.5 Information to allow fair competition.

A key component of open market public sector procurement is to establish that all bidders have an equal opportunity to win. This requires consistent information to be received at the same time, and for the same period of consideration by all bidders. To achieve this a careful plan and rigid protocols are required. Thought trial three created this plan and protocols. Protocols were translated by a drafting team to form part of the invitation for tender. They explained time bound processes for communication between bidder and Highways England. Alongside the invitation for tender was an internal management plan and equal set of protocols and processes. These were assured independently as robust and compliant with internal governance.

6.1.8.6 Legal compliance

Throughout trials relating to procurement a heavy focus was placed on legal compliance with public sector procurement legislation. A significant corporate procurement risk is failure to comply with legislation. A constant monitor was maintained, in the form of a full legal review of decisions, throughout the trials six-week duration. Legislation is complex and subject to precedent-based interpretation. As such in this trial detailed interpretive debates persisted throughout the six-weeks with the trial team seeking clear interpretation of legislation to allow the procurement model's intent to be carried through to deployment and later operation.

6.1.8.7 The tender process

In concluding a procurement plan a nine-week tender period (April to June 2018) was considered to achieve a balance between adequate time to understand the bid requirements and sufficient time to compile a response. It also needed to be sufficient to allowed bidders to prepare, present, and

achieve internal governance to submit. It had to also contain time that allowed for a short due diligence period for questions and several bidder engagement sessions to help explain how the tender was designed to operate. The plan was presented in a series of pre-tender briefing sessions to explain the prototype's intent, construct, and macro commercial strategy.

The tender process in total was designed to extend over eight-months. The first six-weeks of which were market engagement in advance of invitation for tender documentation release. The remaining time was used for evaluation, verification, and award including internal and external governance of 12 weeks. This planning required meticulous care as activity involved governance cycles and the national political calendar to achieve success.

6.1.8.8 Quality vs financial split

UK procurement regulations allow for a bid response in this financial category to be split between quality (explanation of capability and capacity) and Finance (commercial and economic) responses. A series of thought trials were held to determine the appropriate split for the prototype. Main considerations put on trial were:

Challenge	Trial Outcome
As a six-year framework the perception of bidders should be quality is more important than lowest price?	Trial outcome determined 80% quality 20% finance with the split of quality positioned as 25% strategic alignment to highways England, 50% technical capability, 25% regional focus.
How relevant was lowest price in application to future and unknown schemes?	Trial outcome was that lowest bid price was not helpful throughout the framework. It determined use of a 'basket of goods' and contributed to the quotation information and framework information documentation under trial two. (See Appendix 9.5)
How can quality submissions be shaped to assess a bidder's capability in continuous improvement over a six-year framework?	Trial outcome determined a requirement for bidders to show in responses how it controls change to achieve its current state. And then how it will apply that control to reach its future framework ambition state.

Could responses be focused on 'opt-out' where efficiency, predictability, outcomes, and value improvement take centre stage?	Trial outcome was yes, and designed quality questions formatted to state ambition, question, and the aspects of a question to be addressed by bidders. It also contributed to the scoring structure and score boundary descriptions in the invitation for tender 9.5.
How could successful bidders be held to account against anticipated bid promises?	Trial outcome resulted in a tender commitment register. Commitments were then drafted as a condition for disallowed costs within the contract under trial two.
Could financial models be evaluated based on sustainability instead of lowest price?	Trial outcome was no. Legal precedent related to lowest price precluded the adoption of a different mechanism as the level of re-interpretation needed to sustain such a change as reasonable, legally, was considered too great a programme risk.
How could sustainability of both quality and finance be assessed in tender evaluation?	Trial outcome was to design a sustainability test, as a verification stage, relating to financial submissions. It also included a test of quality vs financial to assess a bidder's ability to deliver quality within the financial commitments. This included assessment of an ability to meet tender commitments and the level of reliance financial submissions had on those commitments.

6.1.8.9 Quality competition: structure, context, challenge, and relevance to operating this framework.

The trials leading to development of quality requirements was intense. The ambition of the trials to change quality from a simple set of responses to questions with evidence created a challenge. Trial outcomes lead the format of quality requirements to contain the following:

- Quality responses featured three key elements. **First,** and forming 25% of the marks, strategic alignment with highways England. This element would reflect three areas, Safety, customer service, and delivery. Macro productivity. **Second**, and forming 50% of the marks, technical competence reflecting 14 technical skills areas. Technical productivity. **Third**, and forming 25% of the marks, regional competence requiring responses that explained a bidder's ability to focus resource, and sourcing regional capability. Actual productivity.

- Each response was limited in length with constraints on format and structure. In addition, each supplier was asked to extract generic information into a single submission overview.
- Additionally, each supplier was asked to extract a minimum of three promises from each response and convert them into a tender commitment which reflected the ambitions of efficiency, predictability, outcome focus, and delivering value. These would later be converted into contractual commitments.
- A statement relating to contextualisation of responses. This required each response to consider a past state of the bidder's capability relative to the quality question. The current state of the bidder's capability relative to the question. How the bidder had controlled change from past to current state. The response requirement then asked bidders to explain how they could meet Highways England's ambition and required aspects of a technical question by the application of historic control processes to move from current state to future ambition.

6.1.8.10 Financial competition; risk structure, components, futurism, consistency, and simplicity

Trials to develop the financial requirements established several things:

- Responses should be capable of deployment in operation post-award.
- Responses should be clear and capable of minimal misinterpretation.
- Any element requiring calculation should have components of the calculation explained in full.
- Any use of discounts in the submission should be clear on how these discounts would be used throughout the framework.
- A set of location factors should be included in client's information to provide a single point of regional location factoring to all bidders.
- Any future indexation must be based on a named independent published index used by all parties.

- How solution providers (Designers) overhead and profit compared to delivery overhead and profit (Constructors) are to be treated, should be clear.
- Verification processes should be explained.
- Financial evaluation processes should be explained.
- How incentivisation / motivation worked post award should be explained.
- All explanation should use plain English and be gender neutral.
- All financial information could rely on terms and mechanisms from standard contract documentation without the need for repetition, thereby avoiding the risk of contradiction.

6.1.8.11 How to evaluate and score

Trials relating to how to score quality and financial responses accounted for several challenges.

Challenge	Response
Graduated scores should be capable of providing strong delineation in final comparisons.	This resulted in scores being either one, three, five, seven, and nine in both quality and financial evaluation. With the derivations of scoring from 24 questions some weighted and the option of 5 different marks per question even with this strategy the potential for end marking to be only separated by tenths of a point was high. With this scoring strategy the likelihood of competing bids being within a single percentage point between success and failure to the framework was considered low.
Scores in quality were weighted towards more important questions as determined by the trial group.	Strategic alignment was more important than routine technical quality. Regional focus was more important than routine technical quality. In finance, major percentage derived indirect

	cost additions were weighted more heavily than rates.
Score boundaries were defined and described in the invitation for tender document.	One of the clear explanations in the invitation for tender was the process of scoring It included a description of confidence required by the evaluator and the process of moderation of evaluator scores. Evaluators were briefed to mark down from a perfect answer and not from no-answer up. This created a positive bias on scoring to recognise the effort by all bidders to respond.
Evaluation protocols were determined such that:	Individual evaluators scored a single question from all bidders. Either quality or financial. Groups of three evaluators were assigned each question. Individual scoring was then brought to consensus across the group with substantiation required for consensus scoring which formed the feedback to bidders.
	A moderation panel then reviewed consensus marking for consistency and potential bias. Quality and finance scores were kept separate until all scoring, consensus and moderation was complete.

	A tender panel then brought quality and financial scores together and articulated any necessity for verification with individual bidders. Verification was done at bidder's offices combining both quality and financial verification.
	Verification could not enhance evaluation scores but could remove up to three points for an unverified response.
	Final scores were determined by combining evaluation, moderation, and verification process outcomes. Feedback information for each bidder was compiled from consensus, moderation, and verification outcomes.

In trials an idea that was tested, but failed, was to change financial evaluation away from scoring the lowest price with highest points. The proposed change was to use the score closest to the median of bids as the best score. Other scores would then be relative to their standard deviation from the median as it, being the best representation of quality and prices, was considered to represent the most sustainable bid.

In the thought trial this was modelled and substantiated. It was also subject to legal review. Legal review determined that there was no or little legal precedent for this method of scoring and while

theoretically it represented a considered evaluation process, any challenge could be subject to full judicial review. This may in time establish a new legal precedent. However, that time could not be accommodated in Highways England's delivery programme making it too significant a risk. For this reason, it was not adopted. The evaluation of financial responses had to model a simulated scheme to be priced by bidders. From this simulation the lowest price was used as a benchmark for best score, all other bids being scored relative to the best (lowest).

6.1.8.12 Case study testing rational and irrational outcomes

During development of a commercial and procurement strategy and plan, eventually forming parts of the procurement model, a series of case study testing took place. For this, a virtual actor was co-imagined by the core team. This actor was the delivery integration partner lead for bidding, commercial, and delivery, respectively. In the procurement trials a virtual bid director was used as a benchmark of decision making. Each trial decision was tested against the potential for rational, and irrational decision by this actor. From simulations, using experience, the core team recommended adjustments to improve rational, and reduce irrational, decision making. Examples of these adjustments were to simplify wording or shift syntax to positive outcomes relating to integration action and away from regression to a mean of existing custom and practice. These simulations also lead to the use of an ambition in quality questions supplemented by aspects on the ambition that needed to form the substance of a response and the associated confidence needed for achieving a score. (See 41)a)(1))

6.1.9 Stage 3 – Building a procurement model

6.1.9.1 Compiling a suite of documents.

From trials, a suite of documentation to represent the procurement model emerged. Documents, working as a suite, require careful integration, simplification, and minimal repetition or inadvertent contradiction. As a result of trials in stream two, drafters had been able to streamline the structure of documentation. The result of this was to compile the first draft suite (See 9.5.1). This was subject to a peer review engaging all the extended core group and other key stakeholders. The first stage of

this review was to explain the procurement model's principles to everyone. This established, across the whole group, boundaries resulting from trials using expertise and considered scenario testing. The second stage was to undertake a page turn of all documentation (all 1,500+) with a consensus on the status of content reached on each page [draft, final draft, fit to publish]. Any amendments were allocated to the drafting and trial teams responsible for originating them to maintain consistency of thinking. The third and last stage was for the core group only to review the amended documentation for consistency in tone, intent, and style. In all this process took an additional four weeks.

6.1.10 Testing stages, review panels, process, and sequence.

6.1.10.1 Who

Once built, and following the stage one review, the procurement model was ready for testing.

Testing was done in three further review stages.

1) **Stage Two review**: An independent review group from workshop participants was tasked with reviewing the prototype. This group was briefed on delivery, commercial, and procurement strategies. Given limited time the test group was asked to identify inconsistency, style, tone, or technical observations. These observations were used to inform refinement of the documentation prior to stage three review.

2) **Stage Three review**: Commissioned through the Institute of Civil Engineers, an independent group of industry experts was engaged. Five eminent practitioners representing expertise in delivery, construction methodology, procurement, commercial management, and law were asked to review the suite of documents. Observations and recommendations were acted upon in further refinement of the procurement model. 9.6 contains recommendations, observations, and actions from this review.

3) **Stage Four review**: Department for Transport's commercial advisory group undertook a review of the final documentation, prior to it being submitted for approval under its governance protocols.

6.1.10.2 Strategy

These reviews were focused on achieving an outcome procurement model that had been exposed to sufficient independent scrutiny that chances of its success in deployment were enhanced. Internal reviews were undertaken first to reduce the likelihood of minor observations by external review groups. External scrutiny was used to enhance confidence levels with and from investor governance processes. All reviews were used to enhance the probability of avoiding challenge during, or following, tendering and award.

By planning progressively rigorous reviews under graduated levels of external scrutiny a diverse and targeted group of experts could, using experience, simulate actual behaviour as well as acknowledge predictable and rational decision making. These reviews allowed the core team to determine if the nudges built into the prototype were likely to be effective or not. If not, adjustments were made to the model. These were focused on simplification and anticipation of rogue behaviours in bidding related the interpretation of operation risk.

6.1.10.3 Inputs

Based on all three thought trials a briefing pack was produced to explain the principles of this procurement model. Reviews were all designed to improve the translation of the intent and ambition derived from trials into a comprehensive and complete set of documents. These were to be used by Highways England to tender and then let contracts to deliver enhancement and capital replacement schemes for six years, up to a value of £8.7 billion with integral continuous improvement in productivity (Smale, 2018).

6.1.10.4 Outputs

The output of trials, build, tests, and reviews of the prototype procurement model was a robust suite of documents representing the ambition to improve productivity through enhanced efficiency, predictability, outcome focus and value-based decision making. These four requirement pillars had remained steadfast throughout. The procurement model was considered by the core team, sponsors, as well as internal and external scrutiny teams to be fit for its purpose.

6.1.10.5 Blending the outputs from three trails into a suite of docs

Blending of workshops, into thought trials and eventually through build into a suite of documents took a little over ten months. Some of the trials logically lead directly to a single document. Others affected multiple documents. A small number affected all documents in the suite. Working across trials, the core team coordinated and synchronised information to either be in a single, multiple, or all documents. Coordination of the underlying strategy was to limit repetition but retain clarity of purpose. Making sure the right information was in the right place and not repeated or found to be contradictory in other parts of the suite. Facilitating and guiding the core team through this required focus, simplicity, and continuity of thought.

Preparation for deployment formed part of the later stages of this. How to convey to bidders what the prototype was, its principles, structure, and scope required several iterative engagement sessions. In preparing for these a market engagement pack was compiled with slides and presentations including worked examples from earlier simulations. Market engagement started in November of 2017 and finished in March 2018 immediately prior to deployment. Some focused bid engagement sessions were run during initial stages of the tender period with independent focus being on quality and financial.

Making information consistently available throughout this period, with no information going to either a single or discrete group of potential or actual bidders, was required to comply with legislation. Documented records were kept rigorously throughout this period.

6.1.10.6 Look and feel of the prototype.

The procurement model as a set of documents is included at 9.5. While documents followed a traditional A4 format with standard type face, look the feel once opened was different.

Historically writing had suffered from being overly legalistic. Language and syntax created an 'us v's them' transactional approach. Language was gender bias. And there had been a tendency to repeat mechanisms in multiple places through documents and very often create conflicting interpretations.

In *Regional Delivery Partnerships* language and syntax was aligned between documents. All writing was gender neutral. Documents reflected plain English. Cross referencing was minimised. Simple instruction was created once in the appropriate place. Framework, package, and scheme contracts modelled the same syntax, defined terms, and style. Whilst still circa 1,500 pages over seven documents were required to define client particularisation and supplementary requirements to the standard forms of contract (another 3 documents), this is a complicated suite of documents to understand. Focus of the team was maintained to improve its simplicity and flow.

6.1.11 Corporate governance: business cases and challenges.

6.1.11.1 Explaining the outcomes

The development of the procurement model, destined for use to set the trading environment for £8.7 billion of expenditure, required rigorous testing and assurance as well as approval through corporate and investor governance. *Regional Delivery Partnerships* procurement model was built as a live practice project. The project followed an assurance gateway process, used to check, and challenge progress. To do this there was a design management group, made up of senior function heads from Highways England accountable to the business for the outcome. This group was presented with progress reports, threats and opportunities, and resource issues every 2 weeks throughout the build. For assurance a wider group, the management steering group, was used for progressive assurance through the build. This group included the design review group leader, workstream leaders, and executive directors for capital projects, finance, legal, and commercial and

procurement. This management steering group received reports every four to six weeks dependant on progress and other business cycle commitments.

The evolving procurement model was additionally subject to internal Highways England investment and Department for Transport governance. To gain approval through governance required a strong business case. The business case followed H.M. Treasury's protocol moving from strategic outline, to outline, to final business case (HMTreasury, 2018b). These iterative cases explained how the procurement model was designed to change Highways England's ability to meet its ambition to radically improve productivity when delivering elevated levels of infrastructure investment. This was done in parallel with workshops and trials that formed the build process.

Independent thought trials were held in parallel to formulate each business case stage and additionally reviewed for alignment to Highways England's business plan for major capital projects investment. Any comments or observations from this process were also absorbed into the procurement model's development and built into the final suit of documents that comprise *Regional Delivery Partnerships*.

6.1.12 Stage 4 – Deployment

6.1.12.1 Introduction

As the development of this procurement model was conducted as live research the culmination of building it was to actively deploy it in a live procurement. This was done under the governance protocols delegated from Department of Transport to Highways England and in accordance with its governance processes.

The deployment comprised a series of activities namely:

- Market engagement
- Formal invitation for Tender
- Tender briefings
- Technical query responses
- Maintaining the protocol through bidding

- Evaluation
- Award

6.1.12.2 Market engagement

Market engagement was undertaken in five key stages:

- ✓ Initial market wide engagement – Key Message: "*There is going to be a tender to do Regional Investment Programme and Operational capital renewals work following a defined process with expected timescales*."
- ✓ Receiving expressions of interest – correspondence following a Procurement Information Notice through OJEU (OJEU, 2001).
- ✓ Briefing of interested parties – Key Message: "*you said - we've listened and changed*."
    - This event attracted 180 people (two per company) from a wide market group.
- ✓ Explaining tender documentation – Key Message: "*key attributes of a compliant bid*."
    - This event attracted 200 people (no more than five per bidder)
- ✓ Explaining quality ambitions – Key Message: "*linking the documentation to a narrative of a change journey towards high productivity enterprise working*." This included worked examples. This event attracted 50 people (two per bidder)
- ✓ Explaining commercial ambition – Key Message: "*linking incentivisation and performance to the ability to re-invest in change and gain access to future work through allocation*." This included worked examples. This event attracted 50 people (two per bidder)
- ✓ Feedback on questions raised in the tender period – Webinar attracting 75 people.

6.1.12.3 Formal process

At every stage of the process rigorous controls were applied to engagement with the market. No individual organisation was given information without it being made available to all other prospective or actual interested parties.

Records, discoverable through freedom of information, of every event were held. Only evaluation was undertaken behind closed doors.

6.1.12.4 Release

In April 2018, the model was released to interested bidders. This release marked the end of the develop, build, deploy cycle and established *Regional Delivery Partnerships* as a new, high productivity, integrated working model for Highways England.

6.1.12.5 Technical query responses

As part of a formal tender process a period is allowed for bidders to raise questions and observations to clarify observations around tender documentation. This is routine practice. For *Regional Delivery Partnerships* across all 19 bidders a total of 470 technical queries were raised throughout the tender period. None of these resulted in changes to the procurement model, most were interpretation and clarification. Some were typographic corrections and some correction of data links that failed.

As a comparator *Collaborative Delivery Framework*, although for half the size of *Regional Delivery Partnerships*, generated circa 900 queries prior to submission of final tenders and several of these resulted in amendments to the model during the tender period and consequently led to tender period extensions.

6.1.12.6 Maintaining the prototype through bidding.

To enable fast responses to bidders throughout the tender query stage, a query response group was established. It consisted of procurement officers administering responses, the core group, and legal advisors. Convened every three days it was important to maintain tone and style of the procurement model in responses. When dealing with questions from 19 bidders a substantial number of the questions were similar. Approximately 30% of questions were unique. Observations were acknowledged and advice issued to all bidders. Challenges to interpretation or integrity of the procurement model were responded to clearly, using plain English, and maintaining the tone of the

model. A cut off for responses was implemented 5 weeks prior to the submission date. This allowed bidders to ensure bids could be approved through internal governance, some of which required international parent company approval and were not at risk of further clarification.

Evaluation of a significant procurement, such as this, requires many evaluators to counter the potential for conscious and unconscious bias. A threat to the adoption of any procurement outcome is that the people eventually, after being tasked with management of similar contracts, are not involved in the evaluation. To mitigate this threat major capital projects and commercial delivery teams provided 100 people, with relief from their day-to-day duties, for a period of 15 working days to be involved in the evaluation of tenders. Very few of these people, selected on seniority and technical specialism, had experience of evaluating bids. During the tender period, all evaluators being engaged across delivery, commercial, and procurement departments inside Highways England were trained on how to evaluate. This included briefing on the legal issues surrounding the process and on the procurement model itself. Specific training was also given on the construct of the invitation to tender requirements including the structure and ambition of questions, and how to evaluate based on confidence, to achieve consistency. This included being briefed in either quality or financial pre-tender workshops to cover all questions from, and answers provided to, bidders to ensure evaluators were as informed as bidders. Briefing also included training to raise awareness of the impact of failing to follow legislative rules.

6.1.12.7 Evaluation

Evaluation and scoring followed the process and timescales laid down in the invitation for tender. It was achieved by engaging in the order of 120 people from the highways England business in scoring. Three evaluators were asked to score a single response from every bidder (19). After scoring each questions single evaluation was reached by consensus using an independent consensus chair. Based on the consensus scores all responses were moderated by a moderation panel who interviewed all consensus chairs. Using independent evaluators and a mirrored scoring and moderation process the financial and quality scoring was undertaken independently. Following moderation, the scores were

brought together by a Tender panel who assured the individual processes and compared the financial and quality bids together. The tender panel could not increase scores but were empowered to reduce scores through a verification process that assessed the sustainability of price in the context of a quality submission. Once complete the combined scores were compared in a table to determine the preferred bidders. A final stage in the evaluation process was to review the supplier questionnaires which determined, in a binary format against a series of checks and challenges related to the underlying bidder suitability, if the bids were acceptable. Information about the success or failure of each bid was released to individual bidding parties as feedback following a ten-day standstill period after announcement of results in accordance with OJEU rules. Bidding feedback showed each bid response in comparison to the best scoring response from all bidders. The best response to a question may not have been the response from the best overall scored bidders.

6.1.13 Summary

To develop a procurement model, providing a platform to change productivity levels positively whilst increasing the volume of work undertaken, required a controlled and structured approach. Building from the review of practice and focusing consensus thinking, through wideband Delphi workshops, allowed for a democratic and inclusive outcome. Building at pace, recognising new thinking from the practice literary review and underpinning theories, required strong facilitator skills of control, leadership, ‘choosing by advantage’ decision making at pace, and collaboration between those made accountable for outcomes.

Focusing activity through a limited number of build stage work streams using thought trials was successful. Facilitated modelling against a thought scaffold based on the known factors of a standard form of contract was used effectively to iteratively build a robust procurement model. By engaging a core team, a wide body of diverse participants, and a democratised body of contributors the outcome was acknowledged as one owned by the whole business. This ownership, through involvement, was acknowledged as the acceptable social norm of major capital project behaviour in

trading as Highways England. Operations were changing for a reason, with the reason being owned in principle by all participants of the project delivery community.

Constant guidance from a design authority group, and assurance from the management steering group, effectively enabled progressive assurance throughout the development and build period. Progressive assurance enabled the procurement model to achieve approval at its governance stages first time. This in turn allowed Highways England to meet its programme targets. The outcome of the process was the publications and deployment of a new, challenging, and progressive procurement model that aligned the rewards for higher productivity with risk attached to not changing waste habits. Integrating project delivery, while reported as mature in the USA (Marco and Karzouna, 2018), is a new and novel way of delivering projects in the UK. *Regional Delivery Partnerships* sets out a progressive procurement model, built on integrating project delivery, with sufficient rewards to allow for investment by suppliers. This is designed to enact a meaningful change, and at the same time motivate suppliers to achieve Highways England's social, environmental, and economic value-based goals. This procurement model changes the basis of success from a historic view of "on time, to budget, for the contracted quality" to one of "exceeding the investors' expectations." These expectations are based on the investor's decision model of a prescribed ratio of cost [including time and disruption] to benefit [based on five-capitals economics (Le Fevre, 2018)].

7 Conclusion of the research

7.1 Delivering the aim.

7.1.1 The process

Throughout development of the prototype and then final model the constant themes derived from underpinning theories were maintained. Loss aversion combined with opt-out choice pathways were predominant in the designer's minds.

The use of grouped data from analysed cross sectional data was used to effectively facilitate the wideband Delphi workshops. The outcome from the workshops along with underpinning theories was used to guide the facilitated modelling and thought trials. This led to the assembly of a suite of documentation that form the procurement model. These then combined individual architectures using case study-based prediction frameworks and simulations of decision making. When combined the finished procurement model structure focuses decision making differently to motivate different behaviour, through designed choice architectures, integrating outcomes through opting-in to the philosophy of the model to facilitate higher productivity.

7.1.2 Did the workshop methodology work?

Using selected participants from Highways England focus groups including people from functional groups delivered a coordinated outcome. The diversity of the groupings in workshops was effective. The workshops were facilitated for focus and pace. This strategy effectively maintained the pace of discussion and estimation from the group. It concluded significant numbers of advisory discussions enabling the sequence of events to become meaningful. Using the first part of each workshop to brief the panel on the outcome of findings so far, within the sequence, was an effective way of progressive assurance around the constructed boundaries within which to hold thought trials.

7.1.3 Facilitated modelling as a method and its impact

Modelling was conducted as sprints (Scrum.org, 2022) and were undertaken over a three-month period in parallel. Development was facilitated through three separate scrum sprint teams each focusing one strategy:

1. Delivery Model / Commercial Strategy
2. Legal / Contract strategy
3. Procurement strategy

Each sprint team was run in parallel with a lead overseeing focus, boundary constraints, and timeliness. Regular alignment to business strategy, progress, and key decisions were sought from a Management Steering Group.

At points during the development of a strategic response to the workshop boundaries sprint teams were regularly faced with an interface point across boundaries. As all thought trials were happening in parallel, using the same core team, each was able to collaborate with all other sprint groups. This collaboration ensured core sprints were not disrupted. 3-month strategy sprints were fragmented into a series of 12-weekly sprints. All sprints, facilitated by the same facilitator, maintained focus and pace by retaining the principal that the facilitator was the guiding mind of the trials. Each thought trial team leader collaborated regularly and through consensus meetings resolved interfaces issues.

Choices, options, and gaps were considered at each bi-weekly design steering group. These included decisions relating to commercial strategy, procurement strategy, and legal contract issues requiring further detailed technical and business consideration. Process decision points to complete the model were pinpointed by work stream sprint teams and drove resolution of any dependencies for micro decisions.

The construction of virtual and imagined decision makers for each of the trials themes was highly empowering and enabled a common imagined reality of the impact of a choice pathway feature. It enabled each sprint team to simulate the potential quickly and effectively and to predict irrational decision making. Each sprint team described a decision maker to understand the potential agenda of

that decision maker from a unique perspective. The common facilitation of the sprint teams enabled a degree of commonality across of imagined decision makers agenda.

7.1.4 Theoretical Prototyping into a prototype model

A prototype procurement model was built by compiling features from the sprint teams. The sprint teams were required to consider each feature's implications across all elements but focused on a single operational strategy to shape the prototype model maintaining its foundation points. Using the concept of a thought scaffold or predicting framework (Dietrich and Haider, 2015), enabled the overall model to be virtually sketched and then cemented in place as the features were considered, subject to a prediction, and finally constructed. This method of creative thinking, used to bring the sprint teams to a common imagined outcome that could be communicated to the contract drafting team, was powerful. It allowed simulation which informed trial and error in a safe environment. The sprint and scrum mentality underpinned the fail-fast / learn-fast approach which supported not only the individual sprint but the other parallel sprints. This strategy also informed the progressive assurance of the procurement model and allowed it to succeed through governance right first time.

7.1.5 Building Regional Delivery Partnerships

From a prototype model for procurement, including its delivery and commercial principles, a set of refined and streamlined documents were compiled. These described the structure of the model's ecosystem, its agents, their rights and obligations, and the control mechanisms of its operation. It set the landscape for a change of culture in the way enhancement projects are delivered.

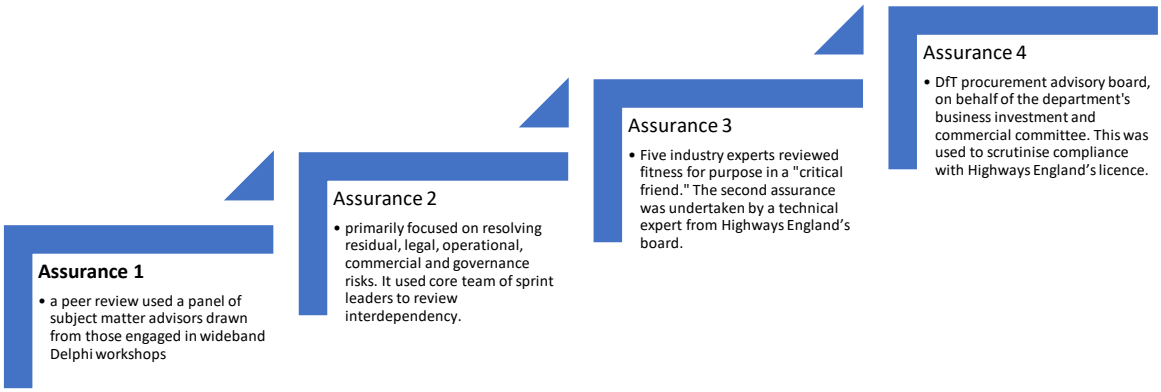
Woven into this was a choice architecture that describes commercial decision points that are designed to motivate an integrated project team to focus on: efficiency, predictability, outcomes, and customer value. Specifically, efficiency and predictability are designed to focus decision making around protecting and outperforming the planned levels of productivity.

The procurement model represents the rational activity needed to delivery highways enhancement schemes that "exceed the expectations of the investor." It reflects transfer of rights and obligations

described as required to improve productivity by practitioners and missing from previous models. It represented a shift from opt-in, to op-out. Motivation to outperform uses the potential pipeline of Highways England work to focus decisions on delivery against its ambitions. It changes the role of a supplier from deliverer of a client's design to originator of a solution and integrator of the outcome. It shifts decision making around the mitigation of threats and realisation of opportunity to the party most likely to get the best scheme outcome. And it creates the leverage for promises made prior to becoming a supplier to be integral to the choices made in development and delivery and a critical part of commercial success.

7.1.6 Assurance and review

When built, this new procurement model was tested in sequential assurance reviews to provide confidence to investors that despite being new it had a high likelihood of success. In a rigorous multi-layered assurance process, it underwent four assurance stages.



This level of external assurance was important to the follow-on stage of deployment. It was essential to succeed through business and investor governance. Building time for this assurance into the project's timeline was essential for quality management and to reduce any consequential re-work time during the tender period.

7.2 Deployment

7.2.1 Tendering and Award

In April 2018, the procurement model had undergone its final reviews, refinement and was ready for deployment. It was published and an open market procurement was run. Tender returns were August 2018.

During the first 4 weeks of the tender period several engagement and training sessions were run to condition the market and evaluators. Throughout the 21-week procurement period similar practitioner training was undertaken with people responsible for acting as client project managers following award.

Following a rigorous evaluation of all the bids submitted. 18 packages of work were awarded to 13 individual bidders (Smale, 2018). No legal or process-based challenges were successfully raised by any bidder. All bidders were given detailed feedback of their bid response relative to the most successful bidder response to each question.

All successful financial bids were verified as sustainable. All bidders completed a tender commitment register; post-award this formed a contractual requirement. In total across 18 packages of work, 1,075 commitments around safety, efficiency, quality, predictability, localised sourcing, talent, outcome focus, and value-based decision making were enacted into contracts.

7.2.2 Limitations of the research

This research was specific to design a procurement model for the enhancement and renewal of major network assets forming part of the strategic road network of England. Focused on achieving an outcome to meet a defined and prescribed timescale driven by business need. Additional time and research resource may have provided a more exhaustive data analysis that may have led to a greater level of simplification in the delivery and commercial model.

Specific limitations were:

- The delivery model was not to be enabled for use outside of Highways England.

- Highways England is licenced under the 2015 *Infrastructure Act* and granted defined five-year investment strategies putting it in a unique position to know its forward five-year capital investment.
- During development Highways England experienced and was forecasting stable fiscal policies, inflation, and labour availability.
- Scheme value under the model had no top end limit but a minimum scheme size of £20million.
- The model recognised a geographic spread across England which, while significant, is contained within travel distances capable of being achieve within one day's surface travel.
- Strategic Road Network is recognised, and highway construction in it, as a mature UK market sector.
- Central UK government mandated the use of NEC 4 suit of contracts as the basis for trading, so no other standard forms of contract were considered.
- The model is subject to English law pertinent to public sector procurement and expenditure.
- Value under the model is measured in accordance with HM Treasury Green Book (HMTreasury, 2018a), value for money terms.
- Financial returns from the tender process relied on Highways England's historic cost record and analysis. This is unique to its scope of operation and would not be relevant to other clients.
- Feedback from practitioners undertaken by Highways England and used in the development of the model was based on experiences under *Collaborative Delivery Framework*, it being the predominant procurement model prior to *Reginal Delivery Partnerships*.
- Behaviour economic theory was used in to construct a prediction framework to emulate future decisions of imagined actors in the UK Highways construction supply market. Those predictions were used to design a network of nudges aimed at nudging predicted practitioner behaviour.

7.2.3 Implications for Practice

Regional Delivery Partnerships was deployed by Highways England in 2018 as its chosen procurement model for regional capital enhancement and replacement works. Consequently, this research resulted in the model being used to deliver £9.0billion of enhancement and replacement

work between 2019 and 2026. Highways England's Regional Investment Programme equates to circa 12% of UK infrastructure spend outside of the London area. As such it is a strategic change in procurement and delivery methodology. Based on a pre-tender estimate of delivery costs for the schemes included in the framework, an overall efficiency of circa £1.692billion will have been achieved (18.8%) by the time the framework is exhausted. This compares to the productivity improvement plan of £1.235billion made in 2018 to map the potential of the new procurement model to enhance value through the Region Investment Programme.

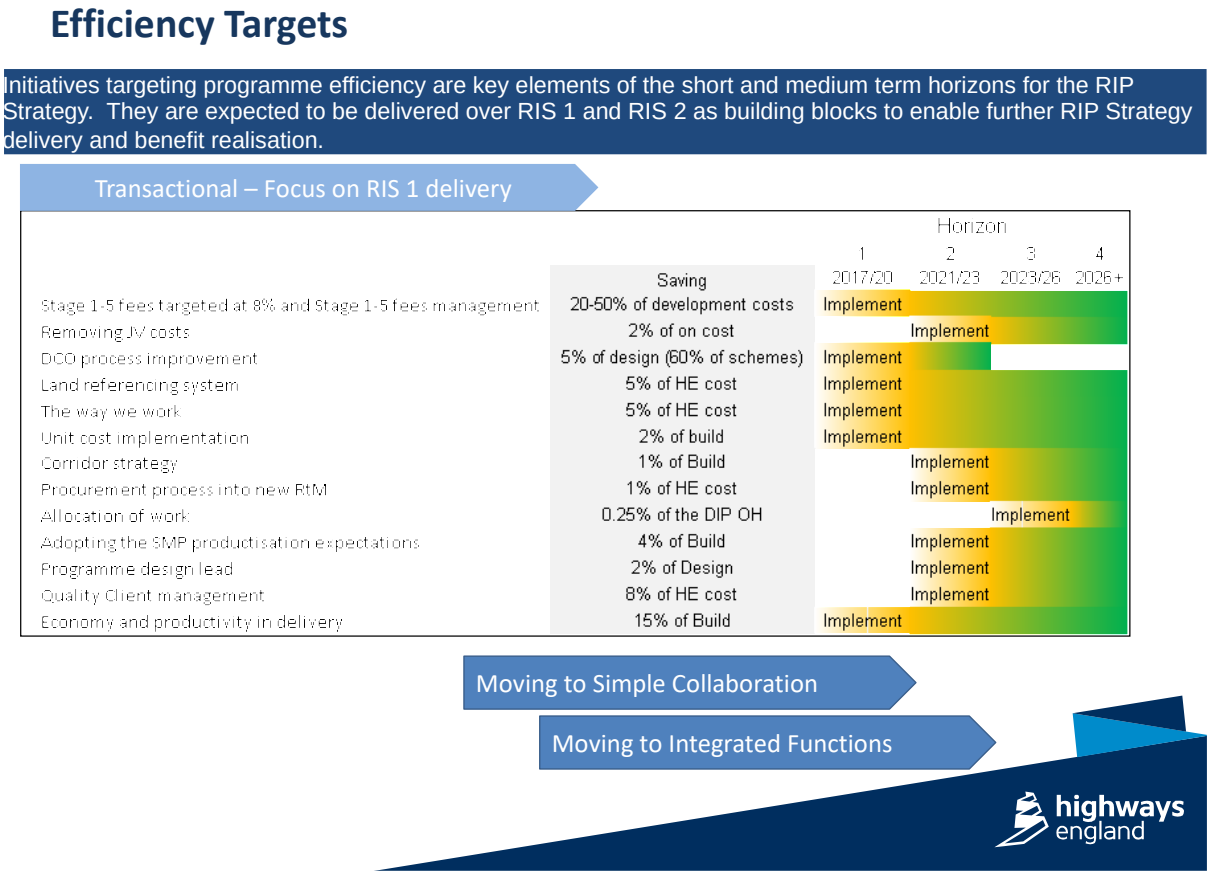


Figure 28 Predicted heads of efficiency and implementation timeline 2018 (Highways England Ltd)

The UK Government's direction of travel is to implement a value toolkit across government client bodies through the constructing excellence group of Infrastructure Projects Authority. *Regional Delivery Partnerships* adopted this strategy prior to these initiatives becoming government policy. *Regional Delivery Partnerships* also piloted many aspects of UK Government Infrastructure

Construction Playbook (Chrisholm, 2021) and *Constructing the Gold Standard for Frameworks* (Mossey, 2021) three to four years before this guidance was published as best practice.

Key aspects of *Regional Delivery Partnerships* that will have a wider impact are:

- Designing a procurement model based on “opt-out” psychology. This establishes the total post-efficient budget available to the supplier community to deliver a scheme. Outperforming the budget is motivated by access to 100% of budget savings.
- Basing a motivational model on loss aversion. By presenting the budget total and making savings available from the start of a contract the motivation is visualised to the supplier. Acting against the incentive model results in loss of opportunity. This model does not attempt to motivate suppliers to opt-in to a delivery philosophy but lays out the loss if a supplier chooses to opt-out.
- Using customer and economic value within a motivational strategy. *Regional Delivery Partnerships* motivates based on outperforming the expectation of an investor. This is based on investment decisions comparing benefits to costs. To exceed the expectation of an investor a supplier must use smart decisions to improve the ratio between cost and benefit.
- Using access to future work, based on performance only, within a motivational strategy. All suppliers in the construction market seek sustainability for their business through predictable returns from a visible pipeline of work. Highways England was, under the infrastructure Act, granted a licence with five-year investment strategies. This unique Investment horizon in public sector funding allows access to future work to be used as part of its strategy to motivate suppliers to invest in capability to change productivity. The mechanics of this can be used in any client situation, however without visibility of construction work this may lose its motivational ability.
- Transferring tender promises into contractual commitments linked to disallowed cost. As a direct result of historic tender promises not being carried through into delivery, *Regional*

Delivery Partnership requires bidders to convert a select number of promises into commitments. Failure to meet these commitments provides Highways England the ability to disallow resulting costs from the defined costs paid to the supplier.

- Contracting major infrastructure delivery based on an asset performance specification and 'fitness for purpose' liability transfer. Under *Regional Delivery Partnerships* the integration supplier is engaged to deliver a scheme to satisfy a set of asset performance criteria only. Single point design responsibility is transferred with a 'not to be exceeded' targeted outturn cost set by the client. This model relies on Highways England's *Design manual for Roads and Bridges* (England, 2020) and a detailed scope describing policy, procedural, and methodological constraints. Holding the supplier to a single point design liability, changes the culture to one where the whole eco-system can outperform, bring innovation, and contribute to platform design for manufacture thinking, collaborative design, pricing, and planning as well as sharing in the rewards for outperformance.
- Contracting with an integrator to integrate project delivery. It requires the integrator to create an eco-system environment that allows all participants, including the client, and sub-suppliers to act effectively and efficiently when designing, planning, pricing, and delivering to meet asset performance requirements described in the contract.
- Focusing delivery performance on predictability of achieving a contracted outcome. Amongst metrics to measure a supplier's performance Highways England measures how predictable a supplier is in terms of time and value generation when compared to cost incurred. This metric is designed to measure variance from planned productivity. Its ambition is to support delivery of an integrators obligations to meet a client's expectation while realising more sustainable rewards than under transactional trading agreements.

7.2.4 Recommendations for future research

This research focused on a new procurement model for large UK infrastructure highways project work on the strategic highway network in England. Further research might usefully determine a recommended lower size limit of projects where *Regional Delivery Partnerships* becomes inappropriate, uneconomic, or unpredictable. The design boundaries for the research set £20million as a practical lower limit but this may, in future, be considered too low, or not low enough.

Analysis of post implementation outcomes were not part of this research. However, the deployment of this model on 38 schemes within the Highways England major projects portfolio will generate a significant amount of data. This could be used in a post operational review of this procurement model's effectiveness in operation. Understanding how and what behavioural changes contribute to the £1.69billion of projected savings would benefit future models.

This model was designed for a specific point in time, delivery of a partially known set of schemes within a defined part of the UK Infrastructure market. In the US healthcare market *Target, Value, Delivery* has been trialled as a means of improving focus on value and thus productivity. Comparisons between the operational effectiveness of both it and *Regional Delivery Partnerships* could be used to identify common gaps, or successes.

Regional Delivery Partnerships is time bound as a procurement model. What succeeds it would be appropriate research, building on operational feedback to refine future mechanism to establish a means of continuously improving productivity in the highways sector.

*Regional Delivery Partnership*s is a new procurement model, based on a choice architecture that nudges a reset in trading behaviour for major project delivery, how it works is unknown. There is little or no organised evidence in UK construction to support this direction of travel. Anecdotal experiences were used to establish *Regional Delivery Partnership*, interpreting feedback from a discrete community. The model assimilates a need to set different choice boundaries in place to align risk and reward.

Regional Investment Programme has a series of 50 projects to be delivered under *Regional Delivery Partnerships* over a five-to-ten-year period. This provides a unique opportunity to measure comparative performance of schemes under a similar delivery methodology both behaviourally and objectively. Using Highways England's *Behavioural Management Framework* (BMF), and behavioural change route map as a consistent starting point, measurement of behavioural impact on portfolio performance could be constructively and comparatively measured.

Regional Delivery Partnerships' is designed to set in place a behavioural evaluation model to determine 'confidence in integration.' This would benefit from a factual data analysis. Comparing evidential data with confidence in integration decision making has the potential to create a quasi-optimism bias against which to evaluate trends in performance. Understanding the link between team climate, established by integrating behaviour leadership and predictability / efficiency, and value improvement, would be enormously powerful in supporting future productivity transformation.

Data is only half the information needed to determine outcome. If there is no integrated decision making, then tribal agendas will, as in the past, derail performance.

Integrated behaviour relies on characteristics of a high performing integrated teams. Characteristics that generate psychological safety as well as accountability and integrity are fundamental to high performance. These characteristics can often be easier to achieve in teams working for a single organisation as its ambition and intent is clear and consistent. Constructing high performance team characteristics in temporary management organisation made up of multiple organisations is distinctly more complex. Discovering what supports or erodes this performance would also provide a powerful insight into future increases in productivity.

Being able to evaluate comparative integrated project team performance against both performance metrics and behavioural observational indicators is a unique opportunity. Success may be more easily achieved when both indicate high performance. Valuable learning can be taken from other

sectors of industry where integrated project team mindset is more mature. Identifying other areas of construction where integrated project team success has been recognised may also inform expectations of performance under future procurement models designed to drive improvements in productivity.

Comparing performance of highways schemes with other industry sector's use of integrating project delivery could inform continuous improvement. This data, providing the environment for failure based learning and iterative development of this procurement model, could inform sustainable improvement across its communities.

Introducing challenging fresh thinking in a traditional and consistently resistant industry sector carries with it risks. Construction may be amongst the slowest of sector mindsets to adopt initiatives that generate transformational changes to productivity (MGI, 2017). There is a reason for this sluggishness observed over 40-50 years. The linchpin to change has remained undiscovered despite repeated industry review. Thus far every new initiative in contract form, change to procurement model, delivery ontology, and education has failed to shift productivity. Does this mean change agents have been looking at the wrong thing? Recognising that despite the uniqueness of projects the service processes are the same. Modern Methods of Construction thinking may contribute to changing mindsets.

Harnessing improvement by recognising failure as an opportunity is not common in construction performance. Clients, nor the market, have been listening to, or looking in the right place, to find what releases potential. Changing the economic trading model – properly aligning effort required to monitor and change practices based on failure analysis and rewards rather than compounding error because of cognitive dissonance. Future research could establish a procurement strategy where it is in the sustainability interests of the participants to harness learning from failure (Syed, 2015) to achieve improved outcomes from significant upticks in productivity.

If *Regional Delivery Partnerships* triggers a material shift in productivity, as it is designed to do, evidence can be amassed to maintain momentum into learning from failure and resist a regression to a mean of error denial that drives poor productivity - again. It could be one part of a jigsaw that has alluded construction for years. Harnessing the power of failure as a learning instrument to realise potential and secure evidence that learning from failure is more powerful than consistently repeated waste. Capturing how to do this against effective motivation in a competitive landscape is essential knowledge to the UK infrastructure client's market.

Establishing and motivating a whole community empowered to fail fast and learn under a sustainable improvement hub of open-source knowledge transfer would be unique. Education of client staff, changes to business infrastructure, and operational processes that allow this response to maintain any productivity shift is also necessary. Making such a shift is challenging. Making it sustainable could provide a key to exponentially release productivity of $1trillion in a global construction market, predicted by McKinsey to be worth $14 trillion by 2025 (Meggs, 2018).

Additional knowledge in this area is essential, currently McKinsey consider that productivity loss equates to seven to eight percent of all construction spend. Evidence from Highways England major project portfolio supports this in microcosm. If motivating the market through procurement models to focus on learning from failure and continually improving outcomes in customer value is possible, understanding how to transfer knowledge of this new disruptive thinking will be as important as a model itself.

Undoubtedly the hardest part of transformation is to change mindset – how and why people make choices. Henry Ford experienced this when transforming manufacturing in early 1900 America saying,

> *'Thinking, (making choices) is the hardest work anybody ever does, that is why so few people do it.' Henry Ford*

Moving focus from process inputs to outcomes is a deceptively significant shift. Add to that a need to consider how that outcome might consequentially add value, in the multi-facetted world of large infrastructure projects, is extremely complex. Work being done by Construction Innovation Hub in establishing a *Client Value Toolkit* (Hub, 2021) focuses construction decision makers on better outcomes. Using the findings from *Regional Delivery Partnerships* may reinforce this direction of travel for construction, contributing to reductions in waste where activity is undertaken with no discernible value.

All funding allocated to Highways England comes from taxpayers. Government recognise that challenge is needed to drive better value for money by setting efficiency targets within consecutive road investment strategies. Achieving these efficiencies is one of Highways England's accountable metrics. Historically value engineering of design has been used as a tool to focus on function and purpose. Improvements in delivery methodology and process has been left to a competitive market. This has resulted in risk appetite being the driver of change much more than process innovation. Legislative and regulatory constraints enforce compliance and, in most cases, administrative burden onto clients and deliverers alike. *Regional Delivery Partnership*s while recognising these, provides a pathway to value improvement by changing choice architectures towards opt-out rather than opt-in to efficiency. It requires a big shift in mindset. It is, however, one that is for the good and sustainability of all involved in this market.

Regional Delivery Partnerships harnesses nudging through a choice architecture that motivates and incentivises players to make predictable and efficient decisions while not preventing but creating economic consequences and less rewarding outcome for those that do not.

7.2.5 What has happened since deployment

Since the awarding of framework contracts to 13 Delivery Integration Suppliers in November 2018 a series of events have happened. First, in 2021 the Department of Transport changed the name of Highways England to National Highways. Second, the role of the Technical Advisor was tendered and let to 6 suppliers. This role acts as the technical eyes and ears of National Highways as well as the

NEC Supervisor for the delivery stage of a scheme. During the currency of Regional Delivery Partnerships, a total of 37 schemes have been let with a total at time of writing amounting to £7.3 billion. So far, two schemes have been opened for traffic (Taking over of the works) having been delivered in budget releasing a gain share to the Delivery Integration Partner. Three schemes have been opened for traffic having overspent the Budget. This has indicated suppliers need to experience the pain derived from not choosing the designed choice pathway to be able to confirm there is indeed a change in the way Highways England will act as the client under the contract. This lived experience is now (2023) triggering changes in the way delivery partners are acting. Some significant changes have occurred in corporate behaviour:

1. During the period of 2019 - 2023 the UK market has dealt with COVID19, high inflation, BREXIT, and a war in Europe. Throughout these events National Highways has continuously delivered projects through Regional Delivery Partnership. A recognised benefit in this period is an improved customer rating. It has also secured a record number of scheme approval Development Consent Orders (DCO's). Events have required 3 changes to the model under deeds of variation, all of which were agreed by the framework community in record time. There have been no disputes.
2. Early contractor involvement is being cascaded to the critical path second tier supplier specialists.
3. Designers are changing to design for a fixed price and to the production levels required by the DIP and its critical suppliers
4. Several DIP suppliers have realised that this model is not for them and are declining work under the model due to their inability to change operational practices related to risk management.
5. Lean Construction has been acknowledged as a route to achieve post efficient outcomes.

6. National Highways is changing how it makes decisions and its key staff competency to enable it to act as an effective integrated client.
7. National Highways is holding DIPs to their contractual commitments related to efficient working.
8. DIP subcontracts are changing to target cost from fixed price as integration of the supply community becomes recognised as key to integrated project delivery success.

While not all the designed beneficial outcomes have been seen in the five years since deployment, the trend of outcomes is positive. It is evident, from lessons being learnt from implementation, that change in the way the client organisation operates is as important as it's procurement model. There must be harmony and alignment to allow delivery partners to realise the potential productivity desired improvements. Capability improvement takes time. Clients that embark on the journey to productivity improvement must be patient, self-reflective, and adapt processes to empower project delivery staff to fully engage in collaboration to achieve integration. Change is hard to do. Practitioners sponsoring such change must manage the expectations of business and investment decision makers. This is evolution and not revolution and requires patience, tenacity, relentless education for participants, and dogged determination that, with time, the change and associated benefits will emerge. National Highways in deploying Regional Delivery Partnerships planned this timeline as 15 – 20 years. It is, at the time of this statement, 5 years into that journey and is only now seeing the evidence of slow change.

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9 Appendix

9.1.1 Primary Data analysis

9.1.1.1 Detailed themed analysis of case study data – and Nudges for change

1) **Decision** - Failing to fix a resource plan before starting - Starting work under Professional Services Contract, Option E is based on mutual trust and cooperation and is a rational behavioural decision. This Option is designed, based on a set of described outcomes using a fixed prediction of resource allocation to undertake each contracted task. Without fixing a task list, resource plan, or outcomes, productivity predictions are absent, and time becomes at large. This decision, by client or supplier, reduces supplier risk but compromises any ambition to hold a supplier to account. This allows a supplier to progressively determine productivity achieved without any reference to a prediction. It is exceptionally difficult to determine from this point if skill and care (the test of professional conduct) has been exercised in undertaking tasks. Or indeed if any task was done right first time. This results in evolving and unpredictable expenditure with little or no control. Additional consequences include difficulty in planning use of people with appropriate skills and experience having the unintended consequence of a supplier deploying available people rather than appropriate people. This usually results in ineffective and sub-optimal production and failure to achieve a high-quality outcome. This in turn drives unpredictable and inefficient outputs and productivity.

   a) **Nudge** – To improve predictability by protection of planned productivity, under the new model, suppliers fix a price for development as a proportion of Budget. This is to undertake all works previously delivered under NEC3 Professional Services Contract, Option E. This does not constrain a supplier from expending whatever it considers necessary to manage its risk, in delivery, but provides an anchor in competition for its prediction around what is reasonable. It allows, because responsibility for control is transferred to the supplier, for economic decisions to be made against project Budgets within overall risk strategies, de-risking design creep, and limiting client exposure from fluctuating expenditure in design. This

uses an anchor, from competitive tendering, positioning it as benchmark. A choice architecture against which to take risk and reward-based decisions by a supplier, but making it opt-out, rather than opt-in.

2) **Decision - Charging overhead as direct costs** – Audits of activity under Collaborative Delivery Framework, using NEC 3 Option E, found in some instances hourly rates, including business and local overheads, have been charged as direct cost for undertaking tasks that form part of business and local overhead. This occurred due to poor description under generic overhead headings that were open to interpretation. This led to a wide variety in interpretation of what was, and was not, included. Some suppliers developed an assertive approach determining any person deployed to a scheme was direct cost irrespective of their role. Others were more subtle and convinced client representatives to expand legitimate resource to create capacity to undertake overhead roles across a team. Either way these interpretations have coalesced into custom and practice with most secondary competition bids if overheads do not need to accommodate business and management activity as these costs will be paid for as direct cost, post contract. This is not recognised as value for money and undermines Option E and contract intent.

    a) **Nudge** – By motivating Delivery Integration Partners to outperform the whole Budget the temptation to overspend by adding unnecessary resources becomes counter-productive to scheme performance. From the review of practice under Collaborative Delivery Framework (Josten, 2017) suppliers repeatedly claimed they were better placed to control overall costs and manage design delivered right first time. By re-framing success to being performance against an incentivised outcome, control and commercial liability tension is designed in by creating a different choice architecture.

3) **Decision - Uncoordinated workflow** – Emergent design promotes in-effective workflow management and uneconomic working. Consequently, design suppliers undertake ‘invisible’ re-

work, at design function interfaces, contributing to fragmented design junctions that manifest into coordination-based change during construction. When coupled with a fluid resource plan (linked to decision 1), non-value adding waste is caused resulting in inefficiency and unpredictability. This, in some cases, is compounded if accompanied by *available* resource rather than managed appropriate resource with skills in a complex delivery environment. This cost is invisible to a client remote from the work face and can only be controlled by using benchmarks that identify "should" cost. Management of change resulting from this is extremely difficult as root cause is invisible and often described as "client instructed" change in lagging indicators. This can take many forms including a client considering it has to intervene due to deficient performance only identified when client's commitments to key stakeholders are compromised. Strong supplier management and effective use of leading indicators such as Earned Value Management is key to exposing this waste.

a) **Nudge** – Transfer of design coordination and aligning rewards for effective design management to a Delivery Integration Partner effectively incentivises better decision making through a risk transfer architecture. Ineffective decisions are not precluded but complicate and threaten achievement of rewards. Loss aversion, highlighted by pressure of spend against fixed allocation of Budget for design, uses the desire to outperform a Budget as an incentive to change decision making. The Delivery Integration Partner does not have to contain spend within its fixed Budget allocation for design, but it is likely that the choice to outperform the fixed budget will generate more conscious decision making rather than allowing design to emerge. Using tendered product costs as an anchor allows for conscious management of this through effective decision making.

4) **Decision - Re-invention** – Highways England *Project Control Framework* (Highways_England, 2017)contains a sizeable number of products. Each produced is delivered against a templated format. Due to historic poor-quality management client teams have adopted a custom for requiring products to be undertaken from scratch despite content and structure being similar for

every single scheme. Client representatives have, at times, insisted on this to address inferior quality control failing to apply project particular actions. This results in re-invention, as a quality management tool, and has resulted in excessive wasted talent, cost, and time.

a) **Nudge** – Incentivised management of talent is within a Delivery Integration Partners control using aligned rewards from predictability and efficiency. Client teams, direct and indirect, employed in assurance of documentation inform the new model. A Delivery Integration Partners decisions around integrating the client's project team and indirect wider business areas, can turn historic waste into Budget out performance. It simply requires both to decide on more effective quality manage to reduce non-value adding work. This allows a Delivery Integration Partner to rationalise production of standard documentation, albeit particularised. Changes in decision making are not mandated they are a choice with potentially better outcomes for both Client and Supplier.

5) **Failing to Share knowledge and best practice –** Under Collaborative Delivery Framework all work was secured through secondary competition meaning throughout the framework six suppliers remained in competition reducing the appetite for sharing to improve. Collaborative Delivery Framework includes an ambition to establish sharing "collaboration" forums amongst suppliers. These have worked for communication across the community driven by the Client. They have not been successful in creating a supplier driven sustainable improvement environment. The intent was there but the contract created counterintuitive outcomes.

a) **Nudge –** The new model introduces work allocation based on performance instead of secondary competition. This re-framing allows a reduced level of inter-supplier resistance to share. It establishes several forums at national and regional level. Regional supplier communities are brought together to establish what excellence looks like in a Centre of Excellence forum. It also establishes a regional Sustainable Improvement Hub allowing suppliers to share how to achieve excellence. By changing the motivation by enhancing

rewards for sharing and reducing the threat from competition, sharing can improve based on self-interest.

6) **Distraction through passive diversion** - Where a client's internal organisation and/or management is fragmented, delivery and support divisions, demand for effective Project Management and coordination is heightened. Without it there is opportunity for suppliers to suffer from, or use, fragmentation as a commercial opportunity. Poor internal communication leads to waste from passive diversion, instruction from one department contradicting commentary of another, or neither addressing an issue that later derails progress. Where poor internal controls prevail this, especially when combined with an unfixed resource plan, results in waste and poor productivity. It leads to the perception that fragmented clients are replete with post contract opportunity. Notwithstanding Client's obligations, in fact, these 'you lose we win' opportunities mask failure in integration and severely threaten outcomes.

    a) **Nudge** – The choice architecture in the procurement model motivates the integration partner to create an environment of active integrated communication within delivery teams. This provides for better choices and potential to reduce non-value adding 'policing' activity. It requires Delivery Partners to rationalise how to organise its integrated project team approaches to interact with client support functions. Changes in communication behaviour are not mandated activity, it is a choice with potentially better commercial outcomes. Performance metrics, in the model's balanced scorecard, will measure how well a supplier is creating understanding internally and externally to key stakeholders. This performance measurement forms part of complementary motivation creating a line of sight between sharing information, driving understanding and tangible commercial benefits.

7) **Mis-information** – Communication failures are always wasteful. Wilful miscommunication or visible information authority is destructive in every aspect of a project. It erodes trust and damages relationships, threatening schedules, and Budgets. It can however simply be a

consequence of poor lines of communication or misaligned objectives often because of fragmented organisation.

a) **Nudge** – Communication, and its effectiveness, is a corporate decision. It can be used as a tactic to protect against other issues. Misinformation and information authority, however, are individual behavioural decisions. The alignment of overall risk and reward to schedule and total Budget is designed to highlight to individuals' consequences of their decision making against whichever agenda they are supporting when within a Regional Delivery Partnership agreement. Getting things right first time is at the heart of successfully outperforming the planned productivity. Poor or misinformation, on purpose or by mistake, has no part in achieving right first time. Hence this is not mandated activity it is an integrated behavioural choice with commercial opportunity. Performance metrics in Regional Delivery Partnership's balanced scorecard measure how well a Delivery Integration Partner is creating understanding internally and externally to key stakeholders. This performance measurement forms part of the motivational landscape, creating a line of sight between sharing information, driving understanding and tangible commercial benefits.

8) **Failure to operate ISO9001 quality management** – A substantial number of project failures, and aspects of project failure, have their root cause in inferior quality management system application. Quality management compliance has been poor over the last five years. All suppliers appointed to undertake work for Highways England are obligated to work under an ISO9001 and related quality certified process. This supports all supplier's insurance cover reinforcing competence and suitability to work in complex and fast paced infrastructure enhancement delivery environments. Quality management process non-compliance can contribute to catastrophic events in safety as well as creating missed commitments, inefficient / uneconomic working, and significantly reduced productivity. It has potential to cause Highways England to breach its warrantee to UK Government for safe network operation at an improving rate and

compliance with the accounting officers' obligations to ensure probity in the use of public money.

a) **Nudge** – The nudge related to quality is to create a commercial opportunity from getting things right first time that is significant enough in visible consequence that it changes the choices of everyone in the process. Whilst a contract requirement, behavioural decision making in quality management was considered to need a nudge. As with 2) above, alignment of risk and reward to 'right first time' informs decisions relating to safety as well as production quality controls. Delivery Integration Partners have liability for failure to deliver safely, within Budget, achieving start of works, journey time commitments to customers, and open for traffic dates. Behavioural decisions are not mandated, they are a choice with potentially better commercial outcomes using integrated project delivery techniques. Consequences impact client and supplier alike.

9) **Change control management**- when operating under any NEC contract, all parties commit to effective management and control of change relative to original scope of service. This protects everyone from either, doing work without instruction and not being paid for activity legitimately undertaken, or expending money not available from the funding for additional work. Contracts under which change is not managed in a timely manner, or in accordance with the contract, and certified quality plans, expose workers to unsafe environments, expose a client to overspend or failure of objectives, and create inefficiency suppressing productivity.

a) **Nudge** – Change happening within schemes is almost inevitable due to inherent complexity, especially in live traffic environments. Changes in asset performance requirements are less likely. Regional Delivery Partnership changes choice architectures relating to change. In response to market feedback, Delivery Integration Partners are engaged earlier prior to a scheme's development stage (PCF Stage 3). In its contract, Scope 2a; High-Level Requirements, defines a schemes purpose. Delivery Integration Partners contract with single

point design responsibility to design an enhancement solution to achieving that purpose. To encourage Delivery Integration Partners to take better control of behavioural decisions around change and the factors affecting it; time, cost, and quality of performance, are established early and fixed. All motivations within the agreements are then deployed against those factors encouraging more active decision making around controlling change. This nudge sets asset performance as a constraint and not fixed design as a goal within scheduled time and Budget. Regional Delivery Partnership incentives relate change decisions to all gains and all risk. There is a direct tangible correlation between making or accepting a change and success or failure. Behavioural based decision making is not mandated, it is a designed free choice pathway with potentially better outcomes for using integrated project delivery techniques and controlled behaviours around managing change.

10) **Allocation of work to under-qualified incompetent people** – this challenge is derived from suppliers failing to identify all appropriate skills required to do a task. Instead, tasks are allocated based on availability of generic skill sets. This creates unsafe design and delivery environments that generate uneconomic working and suppress productivity. People with fewer skills make poorer decisions. People that make decisions without using the diversity offered by a competent integrated project team can only make poorer decisions.

    a) **Nudge** – motivating deployment of competent skills by a Delivery Integration Partner, rather than available resource, is influenced by several factors; 1) safety, 2) aligned risk and reward, 3) reduced client change allowing for better planning, 4) long term relationships, 5) an active learning community, and 6) forward visibility of work. The decision is completely optional, but RPD's commercial structure rewards integrated decision making and leaves all commercial consequences of transactional behavioural choice with a Delivery Integration Partner.

11) **Inappropriate competence - overqualified for the task** - In deploying highly skilled (expensive) people to undertake specialist tasks as part of a time-based service, highly skilled people may be tempted to undertaking less skill intensive tasks. This results in overqualified more expensive people being used to do simple tasks. While this is not an issue in terms of service quality, it creates waste and reduced productivity as its uneconomic working.

    a) **Nudge** –commercial incentives mean suppliers can decide to optimise available Budget by selection of skills appropriate for tasks within all development, design, and supervisory activity. Under RDP decision making around management of skill is entirely a supplier corporate behavioural business choice. These decisions are completely optional, but RPD's commercial structure (outperform the Budget and keep the gainshare) rewards integrated decision making and leaves all commercial consequences of transactional behavioural choice with a Delivery Integration Partner.

12) **Charging for travelling unnecessarily** - With activities, and suppliers, geographically spread travelling to meetings and discussions in person absorbs both time and money unnecessarily. This is often based more on business relationships and future work capture through rapport, than service effectiveness.

    a) **Nudge** – Attributing all costs, necessary and unnecessary, to a scheme measured against an overall Budget means management of effectiveness becomes a Delivery Integration Partner commercial choice. Budgets are derived from a tendered financial model based on tendered commitments around productivity and efficiency. Failure to manage non-value adding tasks and their associated costs is a commercial nudge for all participants. The choices around logistical management are completely optional, but RPD's commercial structure rewards integrated decision making and leaves all commercial consequences of transactional behavioural choice with a Delivery Integration Partner.

13) **Over-manning - e.g., attendance at meetings** – This issue is acute where knowledge services are procured using cost reimbursement. When objectives, agenda, and intended outcomes of meetings are not effectively managed and remain vague, meetings tend to be over attended "just in case." This is a waste that is so fragmented its extremely difficult to manage. Misalignment of objectives and rewards (paid by the hour) contributes to this behaviour.

    a) **Nudge** - Choosing to be clear about a meetings business, who should attend and why, can reduce uncertainty. Working within hard Budgets sets an environment for a supplier to manage who needs to take part in effective decision making. This decision is completely optional, but the procurement model's commercial structure rewards effective integrated decision making and leaves all commercial consequences of transactional behaviour with a supplier. It can offer a different choice architecture meaning decisions to move away from custom and practice, making use of digital environments and capability, also have a commercial motivation. Reductions in the necessity to travel also has the potential to improve safety and wellbeing across the workforce.

14) **Team fragmentation and lack of integration** - Highways England's Project Control Framework (PCF) is designed to offer a coherent view of a strategic highway development through process and products needed to create scheme success. PCF allows efficient deployment of resource for selected products necessary to secure success at minimum effort. This requires effective integration, coordination, and collaborative planning to get it right first time. Cost reimbursement for knowledge service agreements historically drove counter-intuitive behaviour and over production. This introduced constraints on productivity but presents an opportunity to reduce waste.

    a) **Nudge** – Creating a Delivery Integration Partner role is designed to empower realisation of this opportunity. Integration provides opportunity for package specific choice architectures with commercially motivated outcomes. Total Budget and design responsibility acting as a

counterweight to irrational behaviour is designed to motivate more effective process and product choices. This commercial strategy rewards integrated decision making and leaves all commercial consequences of choosing transactional behavioural with a supplier.

15) **Scope creep** – When entering a contract parties agree scope. Experience from historic agreements shows Highways England has been ineffectively in defining supplier's scope of work, deliverables, or service. If a supplier then begins activity, in all good faith, there is opportunity for any resulting outcome to be wrong. This failure can cause inefficient use of skills, wasteful rework when deliverables are eventually better defined, or value-less design. Without control of scope through effective management contribution rework causes either delay through unnecessary activity, cost without value, safety issues from unplanned work, or inappropriate positioning to future work.

    a) **Nudge** – Aligning risk and reward does not guarantee prevention of scope creep but commercial pressure to work within budget is positioned to nudge decision making using endowment theory. Surplus budget is available as gain only if activity is managed effectively. Through a change in choice architecture RPD's commercial structure rewards integrated decision making and leaves all commercial consequences of transactional behavioural choice with a Delivery Integration Partner.

16) **Clients editing products generates conflict of interest** – Failure to manage production of deliverables in line with quality management process has led to poor practice. This results in client subject matter advisors editing prior to quality controlled formal issue of a deliverable product. This practice has seen client time being absorbed in correcting basic English, technical content, presentation, and reformatting. This is all remedial work which should form part of a base quality service. Three consequences emerge from this:

    i) Client resource time is wasted.

    ii) Client's assurance role is diluted and in some instances liability diluted.

iii) Supplier costs has no value to the scheme.

b) **Nudge** – Both Delivery Integration Partner resources, on a fixed projection of time, and a Technical Advisor, on a fixed fee, create commercial tension motivating right first-time decisions. Client activity, not properly integrated by a Delivery Integration Partner, can jeopardise product delivery and threaten success. Changing Delivery Integration Partners decision making to "optimise client activity towards outcomes" is not mandated but nudged in its commercial interest. Again, the potential gain is there to lose bringing Prospect Theory (Kahneman, 1979) in to play, corporately for a Delivery Integration Partner and personally in measured performance.

17) **Continuation to develop past freeze points** – Project Control Framework is set up to undertake all reasonable development work in stages 3, 4 and 5 prior to notice to proceed. Historic evidence shows development and construction phase to be a difficult and highly pressurised interface. Time pressure can lead to designers attempting to produce detailed design for adoption by a contractor after the planned freeze date for that element of design. This causes disruptions in planning, procurement, costs, safety, and moral. It results in excessive waste in time and sometimes in materials.

a) **Nudge** – Integration of the project delivery team to be able to effectively plan and manage outputs across all stages from solution to completion of the asset enhancement creates the potential of a cohesive process. This is the single greatest motivation using prospect theory to generate gain by focusing the integrated team to outperform a budget. The optimum delivery cost is defined from an agile tendered model. This is used to set a stretch Budget. It is entirely reliant on effective decision-making behaviour and construction activity behaviour, by a Delivery Integration Partner and its supplier community, to realise this efficiency, achieve rewards, and avoid consequences.

18) **Over design** - optimism and uniqueness bias in design - historically, a designer agreement introduced little or no commercial tension. Client experience has been poor resulting in a perception that designers tend to over design / over engineer solutions. This is, anecdotally, with an intention of delivering best quality asset enhancement while deprioritising customer focused value for money. Routinely pressure on a designer has been either based on delivery timescales or from its own services risk management, resulting in an undesired outcome for the Client.

    a) **Nudge** – Introducing aligned risk and reward through a Delivery Integration Partner to manage the design which it will have to deliver. This motivates it to enter the design contract with realigned behaviour which, when combined with a not to exceed budget, should drive continuous value engineering to design to budget. As an integrated outcome it focuses on outperforming Budget and schedule while meeting its purpose statement and constraints.

19) **Over scoping (Development Consent Order safe)** - Highways Development requiring acquisition of new land requires a Development Consent Order (DCO). This is granted by the Planning Inspectorate. Because this process confirms statutory permissions, scrutiny by the Inspectorate is high. Historically teams have tended to over scope product requirements as a matter of caution. Even feedback from the Planning Inspectorate advises that submissions are often over provided. So, any work done to produce evidence more than the Planning Inspectorates requirements is waste. This point of balance is notoriously difficult to achieve but is being addressed by Highways England in consultation with the Inspectorate.

    a) **Nudge** – Decisions to determine the extent of work and number of products required to secure success will, under Regional Delivery Partnership, fall to an integrated team influenced and organised by that delivery integrator. This change is designed to break an existing status quo by introducing, through a Delivery Integration Partner's commercial

strategy, a different mix of incentives and desire to optimise products by introducing commercial tension into decision making. This is done through,

i) a fixed allocation of Budget within which to achieve outcomes,

ii) Permissions must, to be predictably efficient, be achieved right first time and meet schedule and overall Budget.

iii) Motivations inform decisions and influence the choices made by IPT members. Designed to convey “all win” or “all lose” decisions made by one, affect all equally well, or equally poorly. This outcome-based prompt drives the purpose of integration where individual parties might otherwise act unilaterally, its only by integration that success can be achieved.

20) **Delivering real “spend to save”** - In design, individuals can be motivated to take lessons learned from other schemes and deploy them through an improved design, both in terms of capital and whole life costs of a new asset. “Spend to save” is often used as shorthand for cost in use or whole life cost. In design management of large infrastructure asset enhancement, design is often fragmented to achieve tight timescales. Fragmentation of design constrains “spend to save” as spend is immediate but save is often delayed to later in an asset’s life. Without design being focused on whole life cost real value-based decision making is often asymmetric with savings unrealised.

a) **Nudge –** Spend to save is laudable under the right circumstances. To optimise its value an integrated project team must act in unison with the ability to measure whole life value. This requires any environment to create a decision to have an architecture that reflects aligned spend and whole life saving to reward. Regional Delivery Partnership has re-structured designer relationships within an Integrated Project Delivery team to improve the environment for decision making against a scheme’s high-level requirements and its investment baseline. Changing delivery integration partners decisions to optimise design to

budget is not mandated but heavily in a delivery integration partner's commercial interest. Again, the potential gain derived from value-based decisions is there to lose, using prospect theory as the basis for incentivisation.

21) **Inefficient design & rework** - Cost reimbursement-based agreements under Collaborative Delivery Framework resulted in counter intuitive but predictably irrational behaviour from participants. It has, by creating a perception of "the client pays for the design work whatever the outcome," frustrated control of design teams. Compounding this, scheme design is often fragmented and shared across specialists within a design house. This fragmentation, while effective in engagement of specialists, requires careful design management and communication to avoid inefficient design activity resulting in rework (the result of miscommunication or working on out-of-date versions). The perception of "client pays for what we do" dilutes any commercial pressure and directly contributes to design contracts overspending.

    a) **Nudge** – Regional Delivery Partnership has re-structured designer accountability within an integrated team to improve these value-based decisions against a schemes high-level requirements and budget. Changing decision making consequences to optimise design processes against a described purpose and budget can refocus integrated design activity.

        i) Detailed analysis of historic delivery-based decisions – and Nudges for change

22) **Untimely survey data - asset condition / intrusive surveys, site, and ground investigation** - Without the results of surveys, including intrusive asset surveys, design solution development is based on a series of assumptions. These assumptions are overly optimistic and result in delay and rework. Restriction in accessing survey information leads to designs being progressed 'assuming' a condition. This inevitable causes design rework and uneconomic design and sometimes working. Designing without survey information contravenes most ISO9001 quality management controls. To protect professional indemnity insurance, these controls call for such assumptions to be avoided, or form part of a comprehensive disclaimer, reducing the

effectiveness of outcomes. Yet despite this highway enhancement design has been making these assumptions regularly for a long time. These assumptions are carefully caveated from the design information and the client ends up funding the inevitable changes usually at a time in the project when change is at its most expensive. Estimates do contain 'uncertainty' provisions, but this is rarely enough to counter the impact of overconfident assumptions.

a) **Nudge** – Work in refining the designed solution, prior to commitment to a Budget, forms part of a delivery integration partner's contract. Regional delivery partnerships as a procurement model creates a choice architecture that encourages a delivery integration partner. It motivates the project team to investigate and establish existing asset data as early as possible in the process to de-risk design and construction and reduce change activity. Delivery integration partner's motivation is redirected towards collaboratively planning this activity in development to facilitate collaborative pricing. When the Budget is fixed and decisions to develop schemes become a delivery partner risk without existing asset information the delivery integration partner becomes exposed to commercial risk as overspend, while capped, is paid 100% by it initially. This alignment, risk, and reward with capacity to make better decisions, is again driven by Prospect Theory (Kahneman, 1979).

23) **Poor constructability advice** – Fragmentation of support supply through PCF stages three to five, under collaborative delivery framework, was used to evolve a solution but effectively disconnected design from constructability. Despite Highways England buying constructability advice separately it could not effectively be relied upon because appointment of a different constructor through secondary competition resulted in a different constructability approach. Issues include site access, delivery restriction and efficient workflow design, inefficient temporary traffic management, different material choices, and many other combined factors. Outcomes from these failures result in inefficient integration of design to construction. These gaps and overlaps create waste.

a) **Nudge** – Buying an integration service from PCF stage 3 – 7 transfers early-stage constructability (stage 3) to the integration partner where it should be owned. The integrator, in putting together an IPT delivering a scheme has accountability for design through construction. The Budget is fixed so decisions to develop schemes at risk expose the integration partner, leading an integrated team, to commercial risk. This alignment of risk and reward, with the capacity to make better informed decisions, is again driven by Prospect Theory (Kahneman, 1979) of losing budget outperformance opportunity.

24) **Activity focus rather than value focus** - this issue is a direct result of trading terms designed to give a client flexibility but resulting in predictably irrational behaviour. valueless cost for uncoordinated or abortive activity both by designer and constructor. In construction this results in performance below targeted production levels and task delivery overriding the value-based needs of customers and communities.

a) **Nudge** – Transition to this way of working will take time. The full potential of motivations generated from this will continually improve. Based on a different specifically designed choice architecture within Regional Delivery Partnership, incentives are aligned with client, customer, and value-based decisions.

i) Efficiency - generates 20% gainshare

ii) Customer metrics generate 30% gainshare

iii) Client value generates 50% gainshare

Changing decision making, and consequently creating and adopting a new availability heuristic, takes time. Value based decisions are at the heart of Regional Delivery Partnership. The choice architecture to motivate change is designed to align asset owners' value – *customer and economic benefits realised because of an enhancement*; with that of the Suppliers' – *making better margins and securing future work*.

25) **Land as a constraint** - The Development Consent Order (DCO) process grants Highways England statutory powers to compulsory purchase land so are necessarily complex and rigorous. A DCO may be required to purchase the extent of necessary land to effectively undertake an enhancement. Approval of a designed solution by the Planning Inspectorate, effectively fixes the land over which Highways England has compulsory purchase powers for a scheme. It is not determined by a future constructor. Until Regional Delivery Partnership, integration risk has been managed by the Client and, because of disconnected thinking, persistently leads to suboptimal delivery.

    a) **Nudge** - Buying an integration service from control framework stage 3 – 7 includes a delivery integration partner informing these decisions with constructability advice in the initial stages of stage 3. Outcomes are owned by an integrated team delivering the scheme through construction to hand-back to the owner. This enables Highways England to transfer risk to the integration partner. This transfer creates commercial tension for integrated teams to decision and act early. Alignment of risk and reward is aligned with the capacity to make better informed decisions.

26) **Departures from Design Manual for Roads and Bridges (DMRB)** - Design standards adopted for design and construction of roads and bridges in the UK is governed by Highways England's DMRB (England, 2020). This group of design standards simply determine design pre-approved by the Chief Engineer. They do not preclude departure just the environment where design that is compliant is pre-approved. As such there is, from time to time, a need to seek approval of departures for specific scheme situations. In some cases, the standard, if not updated, is departed from on most schemes. This requires resource cost that adds no value. Highways England owns DMRB and by failing to optimise the operation of these standards, inadvertently creates this additional cost.

a) **Nudge** – Regional Delivery Partnership requires delivery via an integrated team. Integration is not simply tier one supplier's supply chain; it is also of key stakeholders and client. Client project managers are tasked with creating an environment for scheme success. Delay, in approval of design by the Chief Highways Engineer or delegated representative, compromises scheme success. To achieve success integration partners are motivated by commercial gain and loss, to also influence client support functions to act effectively. Working as in integrated team the decision architecture establishes a means of reducing the impact of slow or fragmented design approvals to zero. Technical advisors play a role in this process and are motivated to reduce this process to right first time by means of a fixed fee. Working seamlessly, and achieving right first time, can become business as usual with the right behaviour.

27) **Corporate interference** - Across major projects, there are a series of opportunities for waste (cost without value) related to interference from corporate agenda, short-term profit thinking. Once competition is completed some practitioners behave irrationally, pursuing unilateral objectives for an enhancement project related to business turn over or margin. This creates bias towards a single party and compromises scheme performance.

a) **Nudge** - By expanding the scope of contracts, to include integration from stage 3 – 7 against a fixed Budget, aligns the integrated team with a scheme's outcome. This threatens loss, resulting from sub-optimal unilateral corporate agenda-based decisions, with a delivery partner. It is designed to motivate the integrated team to make commercial decisions jointly and co-dependently. Aligning decisions to outcomes, risk, and reward with the opportunity from making more better returns, is again driven by prospect theory, losing budget opportunity.

28) **Mismanagement of quality by Client** - Necessary, as a prerequisite to trade with Highways England quality management appears to not be managed effectively. Companies trade based on

robust processes and procedures creating compliance for accounting officers and confidence for clients, investors, and insurers. These safeguards are sometimes considered, by task focused teams, to be additional work not necessary to achieve a task outcome. When this happens these safeguards, that protect clients, investors, and insurers, can be compromised at the expense of delivery pace. Mismanagement of such suppliers happens when accepting uncontrolled delivery of products. This can, and often does, lead to rework, inefficient activity, misdirection and in a worst case, unsafe and abortive work.

a) **Nudge** – By expanding the scope of supplier's contracts, to include integration from stage 3 – 7 expands the integrators quality control to deliver a scheme through design and construction in the same way by the whole delivery ecosystem. This enables Highways England to incentivise decision making away from sub-optimal, unilateral behaviour to jointly make quality decisions. By aligning behaviours, risk, and reward with the opportunity to make better quality decisions changes the availability heuristic. Regional delivery partnership makes one of the delivery integration partner's roles to ensure quality control in the whole integrated team. By making it business as usual it reinforces it as *available thinking (*a heuristic)

29) **Gaming to win turnover - short term tendering strategy** - Collaborative delivery framework drove all framework participants to compete all work, both design and construction. This, under a restricted framework supplier market, required suppliers to review documentation to identify porosity, opportunity, and commercial advantage. Combined with an understanding of the client operating practices they bid to win. In cases where competition is tight and margins are very thin, winning is based on a strategy of gaming the contract at bid stage. Collaborative Delivery Framework procurement of new work continuously improved documentation to reduce opportunity for gaming. The effort and cost expended by everyone to maintain a sustainable environment based on this strategy, and to find new ways to beat it, is extremely detrimental to value. In the end clients pay for both sets of activity.

a) **Nudge** – Removing the need for secondary competition, in favour of allocation based on performance, shifts focus through a more effective choice architecture. By basing allocation of future work on performance based on objective metrics, derived from the operational data being used to manage schemes, uses two nudges:

   i) Data accuracy has a future work value - changing its importance

   ii) Putting effort into data accuracy is directly part of work winning - business sustainability

   These decision changes align effort to scheme success and business sustainability. Instead of short-term gaming being linked to business sustainability. Integrated teams need this alignment to remove the tension inherent in construction; that of winning the next job before the current job ends. When linked to visibility of future work, it changes some of the jeopardy informing long established behavioural decision making in construction company and employee life. Personal and corporate security is undervalued by clients as a motivation tool and diverts skill and talent to work winning instead of delivery.

30) **Suppliers holding asset information erodes value** - Motorway and all-purpose trunk road maintenance is managed historically by outsourcing it in medium term regional arrangements. Maintenance suppliers are made up of the same companies, different divisions, that undertake capital enhancement works. Consequently, it is in supplier's self-interest (perceived commercial advantage) to limit sharing of existing asset information. While not denying client access, supplier's holder asset information in bespoke formats making it hard to "join the dots." This, where it occurs, creates an asymmetric market, and puts clients, in post contract cost recovery activity, at a disadvantage. Better knowledge management between maintenance suppliers and Highways England is essential. One route to change this dynamic is a revised asset delivery model. In effect this is construction management style contract, placing asset data back with the client as the managing authority.

a) **Nudge** – Regional Delivery Partnership is a regional contract. It contracts four to five delivery integration partners in a region and seeks to create an integrated community that shares information for efficiency and continually improves data sharing and transfer. Framework contracts mandate the use of common and consistent data management software and a common work breakdown structure for the whole sector. Incentivisation through data accuracy and predictability promotes and rewards effective behaviours within integrated teams. Knowledge sharing becomes of greater benefit than knowledge protection. Alignment of behaviour towards knowledge sharing, with an opportunity to make better informed decisions, frames sharing as beneficial behaviour rewarded by allocation and opportunity.

31) **Business plans prioritised over trust and customer focus** - Each supplier has its own business plan. Despite attempts to improve alignment between client and supplier, creating action plans that drive improved alignment, suppliers continue to be driven by business sustainability decisions rather than customer or scheme success. Most suppliers have a diverse portfolio of customers, considered a healthy situation as it diversifies reliance on any single customer. Indeed, Highways England seeks to restrict exposure to single suppliers by limiting the extent of work they can undertake concurrently. Misalignment contributes to lowering productivity and waste.

a) **Nudge** – High performing enterprises need alignment between what drives clients' and suppliers to perform. Clients want the designed benefits of enhancement; Supplies' want margin and future work security. Regional delivery partnership, within the constraints of public funding, political announcements, and stakeholder management, seeks to improve alignment between these. By linking:

i) performance to future work allocation:

ii) efficiency, predictability, and outcome focus to gain and loss:

iii) economic growth, social value, and community benefit to gain:

It creates an environment in which decision making is incentivised but not mandated, there are consequences, but the choice can be made freely.

32) **Overdue payment** – Poor cashflow cripples' businesses. Construction is based on temporary management organisations, that may or may not be repeated, set up to service projects for clients. Misalignment of client, supplier and supply chain payment cycles and mechanisms historically causes cashflow issues. Larger project, due to their delivery timescales traditionally suffer less than short terms projects. Highways England is obliged to make payment within 14 days of agreeing a certificate for payment under the contract. It mandated the use of project bank accounts in 2015; all suppliers being joint account holders to facilitate direct access to money rather than cashflow controlled by tier one suppliers. This provides all tiers of supply with a view to improve predictability of payment. Overdue payment, if eradicated, makes this environment attractive to the best talent and suppliers supporting the ambition to deliver continuously improving value for money to taxpayers. Failure at any point in the processes erodes trust and contributes to finance overhead charges increasing cost unnecessarily eroding value.

a) **Nudge** – Regional delivery partnership's focus on decision making around predictability; accurate data, high performance in safety, right first time, outcome based on asset performance, etc., is geared towards improving information flow and making payments more predictably. Decision making in contracts that are short term, won in competition, and at low margins focuses on maximising opportunity; up-selling the scope; increasing turnover; creating a viable positive value change from design to construction; and improving margins; making more money with the same resource – depressing productivity. Decision making changes of this magnitude, completely reversing the availability heuristic to most people on

the project, will take time and effort. To support change the motivation must overtly change and create the opportunity to acquire more work at a higher margin.

33) **Failure to cost check during design** - This is a requirement of all design commissions and is not being done effectively. The consequence, of not cost checking during design, is unaffordable design and consequent value engineering. No abortive work arising from failure to cost check emerging design is within a budget based on right first time. No remedial work is value adding, it is all waste.

    a) **Nudge** – Right first time is the only method of working that is rewarded through incentivisation under regional delivery partnership. Completion within a fixed budget is incentivised with a significant commercial and financial risk of uncontrolled cost escalation. Decision making in cost control is not mandated, it is at the free will of the delivery partner. The level of risk and reward attached to unmanaged decisions is designed to promote behaviour that generate predictable outcomes and efficient solutions from control.

34) **Lack of collaborative planning** - working together is essential to integrate design and delivery capability and optimise scarce skilled resources to deliver economically and predictably. Inefficiency and waste result from failing to collaboratively plan and do work right first time.

    a) **Nudge** - Collaborative planning to deliver right first time is rewarded through incentivisation under Regional Delivery Partnership. Budgets are compiled using historic analysed costs which contain realised risk and extremely sub-optimal productivity. Completion within a fixed Budget is motivated by a significant commercial and financial opportunity for co-ordinated collaborative design, pricing, and planning. Decisions on how tightly to manage the schedule and resource usage is not defined by the client, it is at the free will of the integrated team. With risk and reward incentivising optimised management decisions the nudge is designed to promote behaviour that generate predictable and beneficial outcomes.

35) **Accommodating disruptions to productivity compared to planned industry norm** – Project schedules are based on published and recognised industry productivity norms for each type of typical activity. Innovation and improved methods of working encourages betterment of these norms. Performance in strategic road enhancement is impacted by many challenges including environments requiring maintainable of live traffic flows while working near vehicles. However, in new build major projects a substantial proportion of work is being done “offline” on new land obtained specifically for a project. Despite this productivity rates fall well below those even planned by delivery partners themselves.

a) **Nudge** – Integrated Project Delivery, to be successful, focuses on predictable decision making. When reduced to its basic elements, construction is about logistical optimisation and protection of the work environment to achieve planned productivity. Integration is designed to improve information flow and reduce efficiency loss to achieve norms predictably. The goal of an Integrated Project Delivery (Matthews and Howell, 2005) is to address four systemic problems of traditional contractual approaches:

i) innovative ideas are held back,

ii) contracting agreements limit cooperation and innovation,

iii) inability to coordinate, and

iv) pressure for local optimisation

In designing delivery plans and protocols to achieve this against a project’s fixed budget an integrated team is incentivised to eradicate waste. Decision making and behaviour to outperform norms is at the discretion of decision makers. The consequences of not doing it are designed to be tangible and visibility linked to commercial and sustainability outcomes.

36) **Disruption to productivity relating to statutory undertakers** - Work with statutory undertakers is a necessary part of developing strategic roads. Planning activity so that disruption is

minimised, in advance of critical path and optimised for the project, is crucial. Failing to design and plan for diversions of utilities can cause significant disruption, uneconomic working, waste, and inefficiency. This damages productivity.

a) **Nudge** - Integrated Project Delivery, to be successful, needs to focus decision making on predictability. Integration is defined by improving information flow and reducing waste to achieve planned productivity. To be successful integrated project delivery needs to harness innovative ideas, remove limitations to cooperation and innovation, coordinate activity and consistently, and use standardised solutions. To generate success delivery plans and protocols must reflect this. Under regional delivery partnership parties are motivated with aligned risk and reward based on key dates and a fixed budget. Decision making can define the behaviour to achieve or outperform production targets or fail to plan and protect the work environment. If decisions do not protect productive work environments there is a direct negative commercial outcome.

37) **Over designed of temporary works** - Temporary works form part of any design and build delivery partners means of delivery. It is, under Option C of NEC3, paid for on an actual cost basis set against a target price. In creating and agreeing a target price, over-designed or unmanaged temporary works can be a significant issue. These designs may include site accommodation, through to traffic management and temporary support of, or movement of, bridge structures. There is little incentive, under traditional Collaborative Delivery Framework Option C, for a delivery partner to optimise these costs to outperform the budget. The opposite, an incentive to accentuate costs to demonstrate a worst case in the target and then minimise risk to delivery irrespective of its impact on productivity. Road schemes often have temporary facilities in place for an extended period creating a temptation for poor decisions; designing a worst case for negotiation of the price and minimising the actual works to reduce costs and achieve windfall gains.

a) **Nudge** – Decision making around temporary works must be based on ownership of the outcome. In an integrated environment where development solutions are being owned, (stage three) to hand back (stage seven), decisions have greater impact on the ability to outperform the budget. Regional Delivery Partnership allows the integrator to engage temporary works supplier to design a solution they will then deliver against optimised productivity of the whole scheme. This changes the decision-making dynamic. Ownership is inherent. Risk and reward are in the right decision-making place. The Delivery Integration Partner's role is to ensure downstream agreements commercially motivate the whole supplier ecosystem to support this change in decision-making architecture. Integration, under Regional Delivery Partnership, does not mandate the use of any party to design or build anything. It motivates better decisions through both risk and reward. It seeks to remove barriers, historically perceived to prevent decision making being in the right place, allowing efficiency and predictability to improve.

38) **Poor safety behaviour** - Despite participants acknowledging a need to improve infrastructure construction safety and wellbeing there is a disconnect in application from productivity. Safe decision making prevents deaths. Safe decision making reduces harm, delay and disruption and improves wellbeing. Disruption caused by any safety related event is tangible and measurable in terms of productivity loss. Suspension of works due to injury has an enormous impact on planned productivity levels. Safety culture is entirely about behaviour and specifically eliminating irrational decision making.

a) **Nudge** – Letting regional contracts to regular suppliers, with opportunity to create a longer-term repeatable way of working, provides opportunity for better safety decision making. Predictability improves with safe decision making; individually and corporately. By linking a key performance metric like predictability to future allocation of work suppliers have a direct line of sight between safe decisions and reward. Decisions to be safer are not mandated, they are at the discretion of the supplier however, Regional Delivery Partnership

makes the risk and rewards of decision making more visible and tangible through its motivational structure.

39) **Uneconomic construction practices** - people tend to learn how to do something and then use that learning over and over – *availability heuristic*. Training people to undertake a well-known task in differently, to eliminate waste, is notoriously difficult – *regression to the mean*. The need for people to change to embed more efficient construction practices is widespread. In harnessing the benefits of lean, it is one of the things integrated delivery projects is established to improve.

    a) **Nudge** – As part of the integrator tendering process we did something that has never been done before under Highways England's procurement process. Each tenderer, in answering quality questions, was required to present its view of improving practice, in three strategic alignment and 14 functional areas, under the framework. In providing a response each was required to articulate its experience of controlling change in these areas in the past. From a former state to current state, with evidence. To achieve a high score respondents were required to articulate and commit to, using knowledge of controlling change, achieving, and outperforming planned productivity. Scoring reflected an evaluators confidence in the supplier's ability to manage change to a future improved state. Alongside this response bidders converted a selection of future ways of working into commitments. These committed it to adopt changes to more efficiently and predictably delivery under this procurement model. This nudge creates a motivation around efficiency and predictability where disallowable costs incurred because of not adopting its described improved way of working remain as a burden to the supplier as it has opted out of its promise. The procurement model sets a post efficiency budget assuming the supplier has integrity so the choice to act effectively or not change is free will. The implications of deciding not to change have a direct commercial consequence. Translating failure to deliver on promises made in tender has never had material consequences articulated in this way before. Commercial

decision making has a strong motivational architecture for positive change under this procurement model.

40) **Failure to, or slow, demobilisation** - The construction sector is a transient industry and deploys resources into temporary management organisations wherever work is, be it office or site. Temporary organisations are agile when setting up but sometimes inflexible in demobilising. While set up of temporary organisations can be efficient, demobilisation of teams and sites, when being paid for by the client, can struggle without motivation. This stems from visibility, or lack of visibility, of "my next job." If the next job is not visible demobilisation can lack pace to employ resource meaningfully retaining talent and skills at minimal burden on a company's overhead. This cripple's productivity being waste with no value.

    a) **Nudge** – While regional delivery partnership does not solve this issue as temporary project organisations will still be used. By setting in place several commercial motivations to isolate these costs from productivity, they will be more visible to all participants. On schemes in gain, suppliers may choose to use gain to mitigate transitional downtime costs to a business, in pain these costs will not be shared as they become disallowed. Identifying longer term visibility of work, through allocated future packages, is designed to mitigate anxiety in identifying future work to improve decision making behaviour at all levels throughout supplier organisations. However, his is dependent on Highways England being able to create follow on packages of work for suppliers from its portfolio.

41) **Poor handover between stages** - Under the project control framework transition between stages happens via a stage gate review. This control is designed to assure progress and ensure preparation for the following stage. A degree of independence is necessary at each review to introduce objectivity. Stage gate assurance validates project managers decisions to complete and exit a stage with robust product status. This independent process protects the accounting officer and provides effective governance and assurance, relied on by then investor. Failure to

undertake this process effectively not only jeopardises activity in follow-on stage, but it also exposes the accounting officer to risk and undermines suppliers' being held to account' in completing a stage. If handover between stages involves different suppliers, there is a threat to future success from incomplete or flawed information transferred between stages. Skills and talent deployed in correcting issues caused by weak review is non-value adding but waste.

a) **Nudge** – Between development and hand back; (stages 3 and 7) regional delivery partnership seeks to employ skills assembled by a delivery integration partner in organising and managing an integrated team. The agreement is designed to motivate and support this. Decision made early to engage with sub tiers and reduce the transactional knowledge loss is enabled in initial stages. It is not mandated but discretionary by participants of an integrated team. This nudge establishes the consequence of poor decisions and benefits of good decisions are visible and tangible within the integrated team. This is important to connect the motivation from the corporate agreement to work face decision making.

9.2 Lessons Identified Report

9.2.1 Managed Motorways Framework

9.2.2 Routes to Market

9.3 Consolidated market review

Describing the problem for Highways England

9.4 Workshop outputs records

9.5 Regional Delivery Partnerships

9.5.1 Delivery Integration Partnerships Contracts

(1) Invitation For Tender

(2) Scope One and Two

(3) Quotation information

(4) Framework, Package, Scheme Contract

(5) Framework Information

9.6 External governance review