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**Supply Chain Analysis into the
Construction Industry**

A Report for the Construction
Industrial Strategy

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RESEARCH

The views expressed in this report are the authors' and do not necessarily reflect those of the Department for Business, Innovation and Skills.

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Executive Summary

This report has been prepared by EC Harris LLP in support of the development of the Industrial Strategy, Construction 2025: Strategy.

The objectives of the study are:

- To identify areas where cost savings can be made in UK construction supply chains and the barriers to achieving those savings.
- To identify elements of the UK construction supply chain that tend to be imported and understand why domestic firms are not competing.
- To recommend actions that Government and Industry can take to improve competitiveness of UK construction companies by overcoming barriers to the achievement of cost savings in construction supply chains.

The methodology developed to meet the objectives of the study includes a literature review, a detailed study of supply chains made possible by direct support from main contractors and their supply chains, and a series of structured interviews with members of construction supply chains.

Why the study is valuable at this point in the business cycle

This study is concerned with the structure of the UK construction industry and the implications of this structure with regards to productivity, competitiveness and the future attraction of the sector to new entrants.

Research for the supply chain analysis review was undertaken in 2013 – five years after the commencement of an extended downturn in construction activity. In real terms, construction output in 2012 was 88.5% of levels recorded in 2008, and industry forecaster, the Construction Products Association, does not expect total output to start growing until 2014 (2.2% in real terms)¹.

The ability of the industry to respond effectively to a recovery in demand without suffering from capacity constraint or price inflation is of strategic concern to many sectors of the UK economy. With current low levels of investment affecting the UK's future productive capacity, the ability of the construction industry to respond to increased demand whilst remaining competitive and productive is a key issue. The study finds that construction supply chains are highly fragmented, and furthermore, that the level of fragmentation increases in supply chains that are directly involved in the delivery of construction work on site. The implications of a fragmented supply chain include relatively high transaction costs, increased requirements for management input and coordination of activities on site, and fewer opportunities to drive out waste or reduce cost.

¹ ONS, Output in the Construction Industry, June 2013, Table 2a. Construction Products Association, Construction Industry Forecasts, Summer 2013.

The study has also found evidence, through structured interviews, that challenging trading conditions, very competitive bidding for work and use of tougher commercial terms related to payment and risk transfer is contributing to a reduction of levels of cohesion in the industry. A number of respondents have indicated that many of the behavioural gains secured following the implementation of the Latham and Egan Reports risk being diluted or lost altogether.

Finally, the study has found evidence that supports the point of view that current pricing levels are unsustainable, in that price reductions have been achieved through price cutting rather than cost reduction. Examples include the practice of rebidding work within the sub-contract supply chain, acceptance of low margins and inadequate pricing of risk. The consequences of unsustainable pricing can be seen in weakened balance sheets, which reduce in turn the capacity of the supply chain to respond to an increase in demand.

Having insight into the capability and capacity of the UK construction industry together with an understanding of its structure and the factors which have the greatest impact on performance will be invaluable as the industry moves into recovery. This report provides evidence-based insight to address this need.

The long term impact of supply chain performance initiatives – Literature Review

The literature review included in this study focuses mainly on three reports published between 1993 and 2008 which sought to drive improvement in the UK construction industry through change, and which identified the construction supply chain as an area which could contribute to this improvement in performance.

The Latham Report, 'Constructing the Team', published in 1994 in the aftermath of an extended construction downturn, included a number of recommendations affecting supply chain behaviour and performance, in particular addressing issues of unfair conditions, payment and dispute resolution. Whilst implementation of the report may not have delivered all recommendations, the Latham Report is generally considered to have made a major contribution to the development of collaborative approaches to project delivery. The team's research indicates a perception that these positive values have been undermined as a result of the downturn, and need repair and reinforcement.

The 'Egan Report' published by the Construction Task Force in 1998 sought to improve the quality and efficiency of UK Construction – identifying issues of widespread underachievement. The Task Force identified the supply chain as being critical to performance improvement and identified commercial processes as a barrier to sustained improvement – advocating long term relationships based on clear measurement of performance and outcomes. The industry adopted many recommendations associated with 'partnering' when times were good but did not put in place all measures needed to assure the delivery of value across a full business cycle.

The Wolstenholme Review, 'Never Waste a Good Crisis' published in 2008, concluded that the construction industry had made little progress against Latham and Egan targets and identified a range of actions needed to drive performance improvement – themes

including the business model, capability and delivery are highly relevant to the supply chain agenda.

Results from the supply chain interviews presented in this report show that the implementation of recommendations from these reports has had an impact on behaviours within the supply chain – although it is less clear whether clients have benefitted from the change. There is also plenty of evidence that the industry has ‘returned to type’, becoming more adversarial and less integrated, as a result of the current downturn.

The structure of construction supply chains

A key element of this study is an analysis of Tier 1 and Tier 2 supply chains taken from a sample of five projects. In the analysis, Main Contractors with a direct commercial relationship with a client are termed Tier 1. Sub-contractors and suppliers with a direct contract with the Tier 1 main contractor are termed Tier 2. Sub-contractors and suppliers working for sub-contractors are termed Tier 3. Tier 3 sub-contractors also employ suppliers and sub-contractors, so in many cases there will be a fourth or even fifth tier involved in construction delivery. The study was not able to obtain details of spend beyond Tier 3.

Four projects are representative of the work of national contractors and range in value from £15 million to £25 million. A fifth project, with a value in the range of £1 million to £2 million is representative of the work of smaller, regionally based contractors.

The sample, described in the introduction to section 3, Supply Chain Structure, is based on projects from the private and public sectors, featuring mixed use commercial developments, academies and a hospital refurbishment. Projects have been sourced from London and the regions. So far as is possible with a small sample, we have set out to identify projects that are representative of wider trends affecting the non-residential construction sector.

The objective of the analysis is to build a better understanding of how supply chains are structured, and whether project organisation and ways of working have an impact on project performance. The analysis has three main components:

- An analysis of the structure and distribution of spend within the main contractors’ Tier 2 supply chain, together with a small sample of sub-contractors’ Tier 3 supply chains. This analysis provides an insight into the complexity of supply chain management and the degree of spend aggregation. This analysis is presented in section 3;
- An analysis of on-costs within the construction supply chain – identifying the costs of mark-ups for profit, overhead and risk, and considering whether any of these costs are duplicated. This analysis is set out in section 4;
- The results of a series of structured interviews with project participants, providing deep insight into how supply chains operate, and what factors could drive performance improvement. Commentary on the interviews is included in section 5.

The detail of the analysis, together with a graphical analysis of the distribution of work in the supply chain is presented for each project – enabling contrasting approaches to supply chain management and bundling of the work to be compared.

Most construction work is delivered at the Tier 3 level or below – meaning that there are two tiers of management activity, procurement etc. above most construction activities.

The implications of a complex supply chain for construction include issues of efficiency associated with the management of activities on-site rather than in a factory, and the opportunity costs associated with forming a new team for the delivery of each project – a common occurrence with ‘conventional’ procurement of single projects based on a competitive tender.

The key findings of the analysis of supply chain structure can be summarised as follows:

- All projects in the sample feature a large number of Tier 2 suppliers (that is, specialist contractors such as cladding, building services or finishes contractors). To have 50 to 70 Tier 2 suppliers and sub-contractors is not uncommon;
- All projects involved a large number of low value transactions within each supply chain. For example we found that typically 25% of Tier 2 contracts on large contracts with a value in excess of £15 million, were for values below £10,000;
- On all projects, between 50% and 75% of the total value of the work is accounted for by a small number of major Tier 2 sub-contractors and the main contractor’s Tier 1 site management team. Typically 4 or 5 sub-contractors are focused at Tier 2 on major packages associated with sub-structures, structures and envelope, and building services. Although much of the value of construction work is aggregated in this way, our study showed that actual delivery of these packages is undertaken by a disaggregated Tier 3 supply chain. As a result, coordination of activity on site has a crucial role in influencing performance;
- For the delivery of complex sub-contracts, we found at least three tiers within the supply chain, providing input into procurement, logistics and coordination, ranging from the main contractor (Tier 1) to the sub-sub contractor doing the work at Tier 3. Complex sub-contracts might involve elements of design, complex components and integration with other sub-contracts, such as the structure or building services. Given the degree to which final delivery of the work is highly fragmented, the study found that there is a limited opportunity to consolidate the supply chain by removing costs of Tier 2 intermediaries, due to their role in coordinating the work of installers at Tier 3 and below;
- Both Tier 1 and 2 contractors are involved in a large number of small transactions with contractors, service suppliers and material suppliers doing work on their behalf. Evidence from both Tier 1 and 2 contractors suggests that the supply chain becomes more fragmented for contractors involved in the actual delivery of work as opposed to its coordination. Analysis of the supply chain of a regional Tier 1 contractor and a Tier 2 structures sub-contractor both, who are involved in the direct delivery of construction work, shows that these businesses have the most complex supply chains;

- Results of the analysis point to the important role that material producers, plant hire businesses and intermediaries such as builders merchants have in facilitating the ready availability of construction products and services for small and low value transactions. These organisations operate at all tiers in the supply chain, from Tier 2 and Tier 4 and below.

The findings of the study suggest that the construction industry is not currently optimised for rationalisation of the supply chain. According to the review undertaken by the research team, the existing industry structure has affected previous initiatives to improve performance. Furthermore, the design of these initiatives had been influenced by a lack of appreciation of the structure and complexity of the supply chain. The conclusion is that whilst downward competitive pressure through the supply chain facilitates cost reduction, the current structure of the supply chain may not secure best value delivery through the coordination of activities on site.

Distribution of on-costs within the supply chain

The study includes an assessment of main contractor and sub-contractor on-costs. On-costs cover profit margins, a project contribution to central overheads and allowances for risk.

Due to the complexity of a multi-layered supply chain, the research team have hypothesised that the duplication of multiple layers of profit, overhead and risk could represent a source of non-value added cost and waste.

The team has been able to compile an assessment of the total share of on-costs based on results from the structured interviews.

Our findings are that the level of on-costs is determined in part by competitive conditions – many contractors, for example, have put in place cost cutting programmes to reduce overheads in the past 1-2 years, and profit margins are routinely adjusted as part of the bidding process. Reductions in additions for on-costs recovered by participants at all levels in the supply chain have been a contributor to reduced prices paid by clients over the past 4 to 5 years as a result of the recession. Many respondents commented that current levels of return from construction were unsustainable – particularly as allowances for project risk have also been cut. Falling profits reported by main contractors and sub-contractors point to the consequences of high levels of competition and the ‘buying’ of turnover through the submission of low bids.

The evidence from the analysis suggests that typical on-cost additions in the supply chain are as follows:

- Main contractor (Tier 1) – 5 to 6%
- Integrator (Tier 2) – 6 to 7%
- Specialist contractor (Tier 2) – 12 to 13%

The evidence of high overheads in some specialist sub-contracts may justify some de-layering of the supply chain structure.

A number of respondents, mostly specialist contractors, reported that they secured work on a zero per cent profit margin. Higher on-cost ranges tend to be associated with smaller packages of work, together with a greater work content associated with product design and manufacture. For example, a specialist fabricator of architectural metalwork will need to recover higher on-costs than a decorating sub-contractor.

Based on the results of the study, our assessment of the total proportion of a contract price that is attributable to supply chain profit margin and overhead margin is likely to be in the range of 18 to 20%. This assessment is not an average but takes into account the balance of work content on a typical project.

In the short term, and as the industry recovers from recession, these costs may increase as the supply chain takes steps to improve margins to levels which are sustainable. Given the volume of coordination of activity on site, we see limited opportunity to reduce costs through the 'dis-intermediation' of the supply chain.

The research team also set out to collect information on the level of pricing of risk within tenders. However, much less information was obtained and it is not possible to prepare an estimate for this on-cost. Results of the structured interviews indicate that risk is not being fully priced in tender submissions.

The pricing of risk represents a risk to both sides of the pricing equation. Current market conditions permit the transfer of high levels of risk to the supply chain at a low cost. As workload increases, this balance is likely to shift, with suppliers pricing risk on a more commercial basis – as well as seeking a change in the balance of allocation. Clients and main contractors will need to manage this transition effectively to minimise the effect of risk premium pricing on overall project costs.

Drivers of high performance in the supply chain

Through structured interviews with 40 representatives of contractors, sub-contractors and suppliers, we have isolated a series of enablers of high performance in the supply chain. These are highlighted in the figure below, which summarises the findings of the interviews, identifying the performance drivers which were mentioned most regularly by supply chain participants.

The study tested six hypotheses which describe the determinants of effective supply chain performance. The hypotheses are listed in the table below.

Table 1: Summary of the main hypothesis tested by the study

Hypothesis tested	
Hypothesis 1: Financial arrangements	Financial arrangements such as extended payment periods introduce additional cost and limit industry capacity by tying up cash flow, placing margins at risk and by limiting a business's ability to grow through increased workload
Hypothesis 2: Selection of the Supply Chain	Supply chain selection involves balancing competition and cooperation as means of developing best value solutions on behalf of clients.
Hypothesis 3: Design management	Design management has a crucial role in enabling improved project performance, by ensuring that design is complete and buildable, by unlocking supplier contributions to design development and through effective change management.
Hypothesis 4: Construction site management	Effectiveness of site management has a high impact on project performance as most of the integration and coordination of the supply chain is undertaken by the site team.
Hypothesis 5: Price determination	Work has to be priced realistically to drive effective project performance. The challenge for suppliers is whether the 'realistic price' meets the affordability constraints of the client.
Hypothesis 6: Supply chain integration	Greater integration of the supply chain is an effective means of reducing cost and eliminating waste.

These hypotheses were tested through structured interviews with Tier 1 and Tier 2 supply chains. An explanation of the methodology and a full description of the hypotheses are set out in section 5 of the report, *Structured Interview Analysis*.

Insight obtained from the structured interviews

The analysis published in the report describes in some detail the key findings from the structured interviews, providing a wider commentary in connection with the specific issues raised by respondents.

The following summary of the results of the structured interviews identifies aspects of supply chain management that were thought to have the greatest impact on project performance:

- **Financial arrangements – certainty of payment; prompt payment**
 - Prompt payment is described as building trust and encouraging flexibility in the supply chain. Conversely, poor payment performance disincentivises discretionary effort by the supply chain;
 - Sub-contractors state that payment performance is worsening and payments periods are being extended as a result of current market conditions; Payment delays reduce contractors' liquidity and in turn industry capacity and output.

- **Supply chain selection: - repeat workload, early contractor engagement**
 - Early contractor engagement is favoured because it enables greater supply chain involvement in solution development. Single stage tendering to design and build projects limits supply chain involvement in solution development and may not deliver best value;
 - Regular engagement of contractors in the context of settled relationships is seen by the supply chain as a positive because it facilitates effective site management and collaboration;
 - Very high levels of competition in supplier selection are seen to be having a negative effect on established supply chain relationships, which are at risk of 'breaking down'.

- **Design management – early contractor engagement; sub-contractor involvement in design solutions; incentive to contribute**
 - Incomplete design, design change and late variations are seen as a cause of significant waste; causing disruption to progress of the work, reducing efficiency and increasing site management workload. Barriers to the implementation of change are not high enough to discourage high levels of change orders;
 - Reduced levels of professional fees have reduced available design resource, which may in turn have affected the quality and reliability of initial designs;
 - Subcontractor engagement in detailed design supports improved project performance.

- **Management – good communication; well managed programme; good team relationships**
 - Good on-site communication is seen as the most critical driver of performance, emphasising the importance of a manager's ability to combine knowledge, experience and soft skills;
 - Supply chain members consider that there is a high dependence on the ability of the project manager to drive high performance. Effective application

of soft skills is viewed as being critical in driving high levels of project performance;

- Good programming is seen as being critical to coordinate the activities of multiple suppliers and to accommodate the results of change;
 - Extended lead-in times on projects are valued as they provide more time to build good project team relationships.
- **Price determination – realistic pricing**
 - Realistic' price levels are seen by project participants to be a positive contributor to project performance;
 - Under pricing is described as having a negative effect on project performance;
 - Eagerness to work with a client and overall levels of demand were described as the strongest determinants of the overall level of pricing relative to input costs.
 - **Supply chain integration – more effective coordination and use of project resources**
 - There was evidence from the sample of some vertical integration, with main contractors taking on the building services integrator role;
 - The team noted growing cynicism amongst sub-contractors with regards to supply chain integration activities. For example, there was little spontaneous mention of Building Information Modelling (BIM) and no mention of adoption on case study projects.

None of these performance drivers identified through the structured interview process are particularly innovative or new. However, the message from participants was that the industry did not manage the basics as well as it could, and that the supply chain did not perform as well as it could as a result.

Key themes emerging from the supply chain survey

The analysis has also identified five cross-cutting themes which illustrate how the performance of the supply chain is affected by the interaction of the issues raised in the structured interviews.

The themes and key issues described in an analysis of the supply chain survey are as follows:

- **Effect of behaviours and soft skills – Project Managers (PM) have a key role in connection with project performance**
 - Behavioural issues within project teams were identified as a very important positive improvement driver. Interviewees identified the contractor's project manager as having a key role in positively influencing these behaviours;
 - Due to the complexity of the supply chain, a high level of informal collaboration, the need to accommodate change and low margins – the research demonstrates that effective site management has a key role in delivering successful outcomes for clients and constructors;
 - Feedback from the supply chain suggests that investment in the improvement of site management skills will help to drive better performance.
- **Management of change – the low cost of change comes at a price for the industry**
 - Construction has developed processes to accommodate change in design and construction. However, by comparison with other industries such as IT, it can be argued that construction accommodates change too readily and at too low a cost at the point of change;
 - Evidence from the study suggests that the volume of change is high, comes from too many sources, and can be highly detrimental to project performance;
 - The ability to introduce change is the industry norm, but is seen by the supply chain as a source of waste, a cause of uncertainty and a catalyst for greater friction between trades. Many firms stated that the cost of implementing change outweighed any income premium they might receive as a result of the change;
 - Change is a major source of waste. The ability to introduce changes during design and construction is desirable, but the industry's presumption should be in support of managed change control in support of better decision-making.
- **Certainty of outcome and risk transfer – costs of risk transfer will be built into future project costs**

- Construction involves high levels of risk due to a combination of ‘one-off’ design and construction, site-based working, fixed-price contracting and supply chain fragmentation;
 - Risks transferred typically include compliance with planning, regulatory compliance, building performance, sustainability standards, team performance, programme, and cost and so on;
 - Risk transfer mechanisms generally work well for the clients. However, the allocation and management of actual risk is often erratic and inefficient, increasing uncertainty, and resulting in inefficient working, waste and unnecessary cost;
 - Tough market conditions have increased the level of risk held by the supply chain. However, the progressive transfer of risk from client through contractor to the supply chain may not result in optimal outcomes;
 - The effectiveness of the management of this transfer of risk into the supply chain affects overall cost levels in the industry, as well as productivity and profitability. Over time, the costs associated with risk transfer will be built into the cost of work, through the proper pricing of risks in tenders, potentially increasing project cost.
- **Effect of demand and market conditions – a low entry price may result in higher overall costs**
 - Evidence from supply chain interviews clearly shows that low levels of demand and continued tough trading conditions have a negative effect on firms, relationships and project performance;
 - Firms appear to be hoping that the market will return to conditions seen prior to 2008. There was little evidence either of innovative or adaptive responses to current market conditions, or of a belief that current conditions and price levels represented a new baseline;
 - This optimism, which is not supported by workload forecasts, weakens the industry’s current focus on cost and waste reduction initiatives that are essential to sustain long-term competitiveness;
 - Interviews provide evidence of a shift in bargaining power within the supply chain, which has been used push down prices, rather than to reduce costs by changing ways of working;
 - The evidence suggests that supply chain members will seek to repair margins when the supply and demand balance changes. Action will need to be taken to eliminate costs elsewhere so that the supply chain can be sustained whilst Industrial Strategy cost reduction targets are met.

- **Waste – the industry is focused too much on physical waste**

- Interviews show that the industry's focus is on the reduction of physical waste. Most respondents did not recognise other aspects of duplication or loss of value as waste;
- In our view, waste is embedded into industry's structure, risk management practice and working culture. Addressing the narrow view of waste as a physical by-product of construction will create opportunities for performance improvement;
- We found little awareness of opportunity, insufficient ability to act and only limited incentive to improve performance with respect to removing all sources of waste from projects.

The commentary in the report defines each issue, summarises the insight obtained from the structured interview, and sets out implications for industry strategy, feeding into recommendations for performance improvement.

Opportunities to reduce cost through the supply chain

The results of the supply chain analysis and industry engagement highlight the longstanding fragmentation of the construction industry supply. Insights also show that many of the practices associated with the current downturn in activity are reducing the ability and incentive of a project supply chain to work collaboratively to reduce waste and cost.

The report notes that there are risks that aspects of the supply chain are not fully aligned to set and maintain a trajectory towards high performance and lower cost, delivery. In order to address these potential shortcomings, the report has highlighted the main areas to reduce costs and improve performance across the supply chain, including:

- Early contractor and sub-contractor involvement in solution development, facilitated by appropriate procurement arrangements which incentivise and reward supply chain contribution;
- Greater coordination of design and assembly across the supply chain, possibly based on BIM, recognising the dis-aggregated structure of the supply chain;
- Improved management of change, focused on reducing the opportunity costs to the industry of unmanaged change
- Efficient and well-coordinated on-site operations, facilitated by an integrated and settled site teams, capable site management and proportional management of change;

- Wider adoption of the integration role of supply chain management, either at Tier 1 or 2, focused on the management and coordination of related trades in a dis-aggregated supply chain.

Recommendations from the research – actions to improve the competitiveness of the UK Construction Industry

The research has identified a series of actions that should be taken jointly by the Government and the industry to harness the potential of the supply chain to improve performance and productivity of the UK construction industry. These actions include recommendations to initiate maintain progress. Many of these recommended actions point towards small-scale, project level improvements, based on an agenda for change aimed at all levels in the supply chain. This change agenda is important, as in the view of the research team, current ways of working will not deliver Industrial Strategy outcomes. Actions identified by the research include:

- The promotion of an agenda for change at all levels of the supply chain, countering the view that current ways of working will deliver Industrial Strategy vision;
- Investment in the development of the quality and capability of site management staff in order to drive performance improvement through supply chain interaction on site;
- Better alignment of construction industry improvement agendas with the interests and priorities of the supply chain, including procurement and risk transfer practice;
- Encouragement through procurement practice of effective early sub-contractor engagement;
- Investment in capability development throughout the supply chain to increase the adoption of performance improvement initiatives;
- The review of financial arrangements including bidding and payment, with a particular emphasis on the role of supply chains in cost-led procurement, and maintenance of cash flow at all levels of the supply chain, including Tier 1;
- Promotion of effective change management practice, recognising that the opportunity costs of change are passed into the supply chain through waste and lost productivity;
- Promotion of the awareness of all sources of waste in the construction industry, not just physical waste;
- Encouragement of the development of commercial exchange models that increase the visibility of capability and reduce the transaction costs associated with delivering construction work through the construction industry's tail of small businesses – recognising that small businesses are a fundamental part of the UK construction industry.

Outcomes of the research

The findings published in an initial report contributed to the development of the Industrial Strategy. Specifically, the research has informed a better understanding of the fragmented structure of the construction industry, identifying the challenges of building integrated supply chains, and highlighting factors which influence supply chain performance. The research also prompted the inclusion of recommendations with regards to investment in the development of management capability and skills within the supply chain.

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1. Introduction

1.1 Project Objectives

The objectives of the project, commissioned under the direction of the Government Chief Construction Advisor to inform the development of the 2013 Construction Industry Strategy are as follows:

- To identify areas where cost savings can be made in UK construction supply chains and the barriers to achieving those savings.
- To identify elements of the UK construction supply chain that tend to be imported and understand why domestic firms are not competing.
- To recommend actions that Government and Industry can take to improve competitiveness of UK construction companies by overcoming barriers to the achievement of cost savings in construction supply chains.

Early findings from the study's research phase were incorporated into the Construction Industry Strategy – informing the evidence base and also forming the basis for recommendations focused on the development of capability within the workforce to increase the effectiveness of on-site operations.

1.2 Overview

The project has three components which are detailed in this report:

- An analysis of the structure of construction industry supply chains, based on an empirical analysis of actual project supply chains;
- Structured interviews with project participants, focused on the factors which determine the supply chain contribution to high project performance;
- A literature review, focused on the contribution of the supply chain and the impact of the 1994 to 2009 improvement agenda.

The report also includes an extensive discussion based on the findings of the study focused on identifying the main drivers behind improved performance.

2. Literature Review

The purpose of the literature review is to focus on the industry's understanding of the contribution of the supply chain to project performance and the impact of the most significant improvement initiatives on the ability of the supply chain to contribute to project outcomes.

The literature review also considers whether supply chain issues and constraints have been considered fully in the design of previous improvement initiatives.

2.1 Overview of the UK Construction Industry

Construction is one of the largest sectors of the UK economy. It contributes almost £90 billion to the UK economy (or 6.7%)² in value added, comprises over 280,000 businesses³ accounting for 3 million jobs⁴, which is equivalent to about 10% of total UK employment.

As a key enabler of the UK economy, the construction industry has been the focus of a number of reviews aimed at making it being more efficient and productive. Some of these reviews have involved direct Government intervention.

A key period for the sector was 1994 to 2009 during which a number of significant reports and reviews were undertaken, during which the industry also enjoyed significant expansion. The initiatives introduced over this period are generally acknowledged to have changed the way the industry worked. These reviews include The Latham Report "Constructing the Team" (1994), The Egan Report "Rethinking Construction" (1998) and The Wolstenholme Review "Never Waste a Good Crisis" (2009)⁵. Each report encouraged the industry to make improvements and address key issues, helping the sector's competitiveness by driving efficiency, greater client involvement and partnering as well as introducing a supply chain management approaches to construction projects and programmes. The key findings and recommendations from each report are discussed in the following introductory section.

² Source: ONS Annual Business Survey (ABS), 2011 provisional results. Data is for (i) construction contracting industry; (ii) provision of construction related professional services; and (iii) construction related products and materials.

The ABS is preferred as it is the only source with sufficient detail to allow for the calculation of GVA for the wider construction sector, and for comparison of wider construction with other industries. It should be noted that the ONS National Accounts (2011) gives GVA for construction contracting alone as £90 billion as it makes adjustment for output unrecorded by the ABS; a figure for wider construction cannot be calculated from National Accounts, but it is likely to be higher.

³ Ibid.

⁴ Source: BIS analysis of ONS Labour Force Survey data, non-seasonally adjusted; January – March 2013. Data is for wider construction sector as per definition in the opening paragraph.

⁵ Full references given in Annex 3

2.2 The construction industry reform agenda

The Latham Report “Constructing the Team”

In 1993 Sir Michael Latham was jointly commissioned by the UK government and the construction industry to review perceived problems in the industry and specifically procurement and contract arrangements (Designingbuildings.co.uk, 2013).

Constructing the Team was produced as the industry emerged from a four year downturn that had seen output volumes fall by 13% and prices fall by over 25%.

Latham produced an interim report in 1993, titled “Trust and Money” that largely focused on the relationship between the main contractor and subcontractor, identifying for example, the need for the mandatory use of improved subcontract terms (Latham, 1993:29). In “Constructing the Team”, Latham identified industry inefficiencies, condemning existing industry practices as 'adversarial', 'ineffective', 'fragmented', 'incapable of delivering for its clients' and 'lacking respect for its employees' (Latham, 1994). Latham made 30 specific recommendations, which are summarised in annex 2.

Many outcomes can be attributed to the Latham Report. In 1995, the Construction Industry Board (CIB) was setup with the primary objective of implementing the Latham recommendations, which, through various publications and codes of practice addressed a number of tender and wider recommendations of the report.

Some commentators are content that Latham lifted the lid on a number of seen but not heard issues in the industry. However, there are critics, including Davis (1995)⁶ or Cox and Townsend (1997)⁷, who suggested that all Latham achieved was to compile a set of viewpoints into a set of recommendations around which industry itself was required to form a consensus. Their own survey of similar industry stakeholders suggested that the consensus approach would not deliver the radical solutions needed at the time to drive improved performance.

In retrospect, “Trust and Money” (1993)⁸ identified many of the challenges facing the industry in the early 1990s. The main report may have suffered from having too many recommendations, whilst also relying on the industry to drive its own change agenda.

⁶ Davis, M. (1995) *Achievements, Action Plans and How Clients Can Help*. The Latham Implementation Plan Conference, 25/26 October, Cabot Hall, London

⁷ Cox, A. Townsend, M (1997) Latham as half-way house: a relational competence approach to better practice in construction procurement. *Engineering, Construction and Architectural Management* 4 | 2,143-158

⁸ Latham, M (1993), Joint Government/Industry Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry - Interim Report: “Trust and Money”. London, HMSO.

Constructing the Team – insight for the supply chain agenda

Discussions on the treatment, relationship (contractual or informal) and engagement of the supply chain are embedded throughout Latham's report as a major element of delivering "deeper client satisfaction" and a "brighter image and better rewards for a great industry". On this basis it can be argued that two thirds of recommendations relate to the better or fairer engagement of the supply chain as a delivery partner. Measures that have a specific focus on supply chain relationships include the following:

Tendering. In a review of the impact of Constructing the Team, Hughes et al (2006)⁹ highlight tendering and tendering processes as the key theme of the report, noting for example that Latham's report sees traditional tendering as "the root of adversarial attitudes" (Latham 1994: 58)¹⁰.

Four of the recommendations of the report refer to tendering:

- The need for a code of practice dealing with project management and tendering issues.
- Tender list arrangements should be rationalised ... and advice issued on partnering.
- Tenders should be evaluated ... on quality as well as price and recommendations on tender periods should be followed.
- A code of practice for the selection of sub-contractors should be drawn up ... with short tender lists and fair tendering procedures.

Main contractor and sub-contractor relationships. Another common thread relates to frequent references to tensions and issues between main contractors and sub-contractors. Latham stated that, whilst this was not the main focus of his report, it "has generated the most heat and correspondence" (Latham, 1994 p. 81)¹¹. Based on a survey of a sample of supply chain contractors the report identified at almost all stages of project delivery (from pre-bid to post opening) the main contractor performed below an acceptable level towards its sub-contractors.

This finding led specifically to recommendation 25 relating to unfair contract conditions. Evidence from the supply chain interviews in this report confirms how important these changes were and how much impact they had on behaviours in the industry.

Feedback from the survey shows that the Latham report is widely perceived to have resulted in the development of positive behaviours across the supply chain. There is a general perception that these positive values have been undermined by cost reduction

⁹ Hughes, W., Hillebrandt, P., Greenwood, D., & Kwawu, W (2006), Procurement in the construction industry: The impact and cost of alternative market and supply processes, New York, Taylor & Francis.

¹⁰ Latham, M (1994), Constructing the Team, Final Report of the Joint Government/Industry Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry [Latham Report]. London, HMSO.

¹¹ Latham, M (1994) *ibid*

activities that have been driven by the recent industry downturn. Our view is that some of the key tools needed to enable the supply chain to contribute to long term cost reduction and performance improvement are in need of repair and reinforcement.

The Egan Report “Rethinking Construction”

Sir John Egan’s Construction Task Force was appointed in 1997 by Government with the remit to “improve the quality and efficiency of UK construction”. The background to the report was the perception that although “the UK construction industry at its best is excellent”, “there is deep concern that the industry as a whole is under-achieving” citing “low profitability, too little in capital investment, research and development and training” with “low client satisfaction” (Egan 1998: paragraphs 4-6)¹².

In response to a slow rate of change following the issue of the Latham Report, the Construction Task Force was appointed to “guide it willingly, kicking or screaming toward the nirvana of improved quality, value and efficiency” (NCE, 1998)¹³.

The Task Force took expertise from the manufacturing industry, including the automotive sector, and was set up with the following terms of reference (Egan, 1998¹⁴):

- To advise the Deputy Prime Minister from the clients’ perspective on the opportunities to improve efficiency and quality of delivery of UK construction, to reinforce the impetus for change and to make the industry more responsive to customer needs.
 - Quantify the scope for improving construction efficiency and derive relevant quality and efficiency targets and performance measures which might be adopted by UK construction;
 - Examine current practice and the scope for improving it by innovation in products and processes;
 - Identify specific actions and good practice which would help achieve more efficient construction in terms of quality and customer satisfaction, timeliness in delivery and value for money;
 - Identify projects to help demonstrate the improvements that can be achieved through the application of best practice.

The report focused on five drivers of change:

- Committed leadership;

¹² Egan, J (1998) Rethinking construction: the report of the construction task force (The Egan Report). Department of the Environment, Transport and the Regions, London: HMSO

¹³ NCE (1998) <http://www.nce.co.uk/egan-peace-maker-as-sir-john-egans-construction-task-force-draws-together-its-conclusions-after-almost-a-year-long-battle-with-the-industry-a-distinct-truce-appears-to-have-been-reached-between-i/843003.article>

¹⁴ Egan, J (1998) *ibid*

- A focus on the customer;
- Integrated processes and teams around the product;
- A quality driven agenda; and,
- Commitment to people.

Opportunities for driving change and improvement were identified under the themes of improving the project process and enabling improvement – these are set out in more detail in Annex 2.

Rethinking Construction – insight for the supply chain agenda

When discussing the construction supply chain, Egan identifies “the supply chain is critical to driving innovation and to sustaining incremental and sustained improvement in performance” (Egan 1998: paragraph 45)¹⁵. Egan was right to highlight the critical contribution, but given the highly fragmented structure and organisation of the construction supply chain, its positioning as an agent of change may have been ambitious.

The Egan Report also examined commercial processes. In a review of the industry reform agenda, Hughes et al (2006)¹⁶ highlighted Egan’s particular references to the need to “replace competitive tendering with long term relationships based on clear measurement of performance and sustained improvements in quality and efficiency” (Egan 1998: paragraphs 67-71). This involves “new criteria for the selection of partners” based, not on “lowest price, but ultimately...best overall value for money” (Egan 1998: chapter 4).

The findings of the supply chain survey has shown widespread acknowledgement of the benefit of long term relationships, together with a low level of recognition of the use of performance measures. It can be shown that the industry adopted many of the behavioural recommendations of Egan whilst times were good, but did not necessarily adopt the disciplines required to assure whole-life value to clients over a full business cycle.

Hughes et al (2006) also noted outcomes related to the report including the Movement for Innovation (M4i) and the Best Practice Programmes managed by the DETR. The Egan Report also contributed to the development of “Best Value Procurement”, albeit within the context of European Procurement Regulation.

Taken together, Latham (1994) and Egan (1998) are seen as the start point for the partnering approach defined by Egan (1998, p.9) as “involving two or more organisations working together to improve performance through agreeing mutual objectives, devising a way for resolving any disputes and committing themselves to continuous improvement, measuring progress and sharing the gains”.

¹⁵ Egan, J (1998) *ibid*

¹⁶ Hughes, W., Hillebrandt, P., Greenwood, D., & Kwawu, W (2006), *ibid*

The Wolstenholme Review “Never Waste a Good Crisis”

Andrew Wolstenholme was commissioned by Constructing Excellence in 2009 to review progress in industry reform, some 10 years after the publication of the Egan Report.

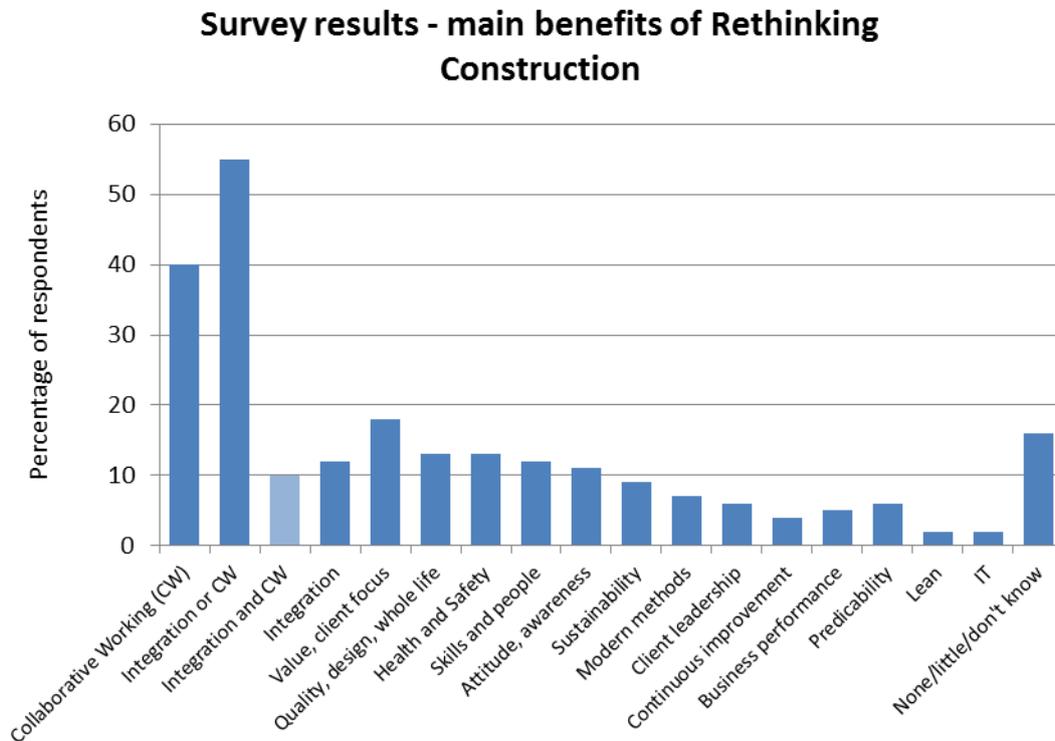
Wolstenholme’s review was published by Constructing Excellence as “Never Waste a Good Crisis – A Review of Progress since Rethinking Construction and Thoughts for Our Future” (2009)¹⁷. The report referenced a survey of 1,000 construction industry professionals. Some results of the survey are shown in Figure 2.1.

The key findings include the following:

- “There has been some progress, but nowhere near enough. Few of the Egan targets have been met in full, while most have fallen considerably short.”
- “Where improvement has been achieved, too often the commitment to Egan's principles has been skin-deep.”
- “In some sectors, such as housing, construction simply does not matter, because there is such limited understanding of how value can be created through the construction process”.

¹⁷ Wolstenholme, A. (2009) Never Waste a Good Crisis A Review of Progress since Rethinking Construction and Thoughts for Our Future, Constructing Excellence

Figure 2.1: The main benefits from Rethinking Construction identified by the construction industry



Source: Wolstenholme, 2009, p8

The Wolstenholme Report found that over half of those surveyed considered the benefits of partnering were 'patchy' and that people paid 'lip service to the Egan agenda'. The report claimed that commitment to collaboration was only skin-deep (Wolstenholme 2009, p.8), however, parts of the "public sector has made some significant moves in the right direction" (Wolstenholme, p.13)¹⁸.

The Wolstenhome review identified a set of blockers to progress under the following four interdependent themes and summaries:

Business and Economic Models

- *Lack of Cohesive Industry Vision.* A lack of joined-up thinking in Government and the industry about how the built environment contributes to the UK's long-term prosperity and the aim of achieving a sustainable, low carbon economy.
- *Few Business Drivers to Improve.* For much of the supply chain, there are few business or economic drivers to deliver meaningful change. They are prepared to accept stable, though unexciting returns, rather than attempt changes that are seen as being 'too difficult'.

¹⁸ Wolstenhome, A. (2009), *ibid*

- *Construction 'Does not Matter'.* The low impact of construction costs and outcomes on the client's business case means that in some sectors the performance of the construction supply chain is not sufficiently important to motivate external demand for change.
- *No Incentives for Change.* Most client business models are focused on short-term gain and do not reward suppliers who can deliver long-term sustainable solutions.
- *Construction is seen as a Commodity Purchase.* Too many clients focus on the upfront costs of construction, rather than the value created over the lifetime of an asset.
- *Industry culture is driven by Economic Forces.* Many clients and suppliers appear to have abandoned partnering behaviour (if they ever adopted it in the first place) and returned to transactional relationships (as a consequence of the downturn).

Capability

- *Lack of Visible Leadership.* The industry lacks enough leaders who can communicate their vision and engage employees to think about the value of their input beyond their tactical horizon.
- *Failure to Attract New Talent to the Industry.* The industry's poor image means that it does not attract sufficient high quality, highly motivated graduates, nor do we promote our industry effectively to women and members of ethnic minorities.
- *Narrow Degree Courses Prevent Holistic Thinking.* Universities perpetuate the industry model of separate disciplines and are restricted by the need to align with professional accreditation routes.
- *Failure to Develop Talent within the Industry.* Inferior graduate development programmes and the 'permafrost' of middle managers results in brain drain both overseas and to other industries. Leadership training at all levels of the industry is inadequate, particularly for junior leaders and supervisors.
- *Lack of Purpose.* The industry lacks a clear mission, based on a strong ethical stance, for the contribution it makes to society. As a result, it struggles to present an effective image to the public and Government.

Delivery Models

- *Few Clients Demand a Best Value Solution.* Clients struggle to articulate what value means to them, and too few projects develop a clear brief that defines their business, social and environmental requirements. Clients are unaware of the potential value that integrated supply chains can bring, and fail to engage them early enough, relying too often on consultants specifying traditional solutions through dated procurement methods, such as lump-sum contracts based on a consultant team's design.
- *Lack of an Integrated Process Results in Sub-optimal Solutions.* Designers are appointed in isolation. Contractors are engaged late and with a focus on lowest

price. Facilities management and operational integration are rarely considered at the design stage. As a result, there is a failure to develop a fully integrated design that reflects the whole life cycle of an asset.

- *Contractors would Rather 'Push' Risk down the Supply Chain than 'Pull' the Opportunities Back Up.* Contractors' mind-sets are to procure in order to pass risk down the supply chain, rather than to draw up opportunities to create value by working as an integrated team. The low penetration of cultural change has been exposed by the current economic downturn, with evidence that clients and main contractors are now reverting to type.

Industry Structure

- *Lack of a Single, Coherent Voice for the Industry.* Not only are the key messages from different industry bodies diluted, they are often contradictory.
- *Lack of Joined-up Thinking by Government and Other - Key Stakeholders.* Government struggles to combine its roles of chief client and industry regulator, and divides responsibility for the built environment amongst too many departments.
- *Too Many Industry Bodies.* The complex industry structure sitting in silos and too many industry bodies makes it hard to see the bigger picture.... trade associations focus on transactional issues within their own technical specialist silos.

Report recommendations

The Wolstenholme Report identified 8 future areas for action identifying them as “Big Themes for Action and Some Quick Wins” (Wolstenholme, 2009 p. 25-26). In the literature review, we summarise the headings. Further details are set-out in Annex 2:

- *Understand the Built Environment* – triple bottom line solutions.
- *Focus Much More on the Environment* – align with the climate change agenda to deliver a low carbon economy.
- *Find a Cohesive Voice for Our Industry* – promote a single industry voice and focus on delivering better performance to key clients like Government.
- *Adopt New Business Models that Promote Change* - find ways to incentivise long term value creation.
- *Develop a New Generation of Leaders* - Develop a generation of leaders who can communicate their vision and drive change in culture and behaviours.
- *Integrate Education and Training* - promote a wider strategic understanding of the built environment and how all disciplines inter-relate to deliver solutions.
- *Procure for Value* - All customers in the chain need to professionalise their procurement to achieve best value, rather than focusing on lowest price.

- *Suppliers to Take the Lead* - Clients will struggle to lead the way – we need suppliers to show how they can create additional value.

A further 22 additional “quick wins” are identified in the report. Organised by Industry, Government and Client they range from industry training and development of young staff and future leaders, to further government policy development to incentivise innovation. More effective client working with their supply chain is identified as an opportunity to develop more innovative options for risk transfer and to create relationships based on trust with consultant and suppliers and evidence a “pipeline of opportunity” (Wolstenholme, p.27). The quick wins are scheduled in Annex 2.

Never waste a good crisis – insight for the supply chain agenda

When the Wolstenholme report was published, some observers noted that as the economy and construction markets had grown, the industry had taken its eye off the reform agenda. From the perspective of industry performance improvement, the period up to the 2008 slowdown had been wasted.

The analysis presented in this report confirms the relevance of many of the report findings, at the level of the individual project supply chain. In particular, the themes of the business model, capability and delivery occur repeatedly in survey findings. Furthermore, the highly disaggregated structure found in the supply chain helps to explain why complex solutions to the construction performance challenge sometimes struggle for widespread adoption.

Given that the industry will be challenged to deliver higher performing buildings to an increasingly challenging cost and carbon agenda, the lessons that can be drawn from the Wolstenholme review are very important, as they highlight commercial and behavioural norms that will combine to limit the impact of performance improvement initiatives. Industrial Strategy needs to address these blockers as well as identifying the targets which will direct improvement.

The supply chain’s position in the improvement agenda

In summarising Latham (1994), Egan (1998) and Wolstenhome (2009) it is clear that a large number of report recommendations have a common basis. Constant repetition suggests either that the industry did not meet improvement targets, or worse still, did not deliver change at all.

Evidence from the supply chain interviews detailed in this report provides clear indication that the implementation of Latham and Egan recommendations did have some effect on improving behaviours within the supply chain. However, clients may not always have benefitted from these changes. With the downturn and increased competition for work, there is evidence to support the Wolstenholme view that the industry has returned to type as prices have been driven lower by competitive bidding.

Looking forward, the challenge for the industry is that current price levels need to be sustained or reduced to enable continuing investment by the private and public sector. The role of the supply chain in driving value, reducing cost and eliminating waste will be crucial. Implementation of the Industrial Strategy should take account of this.

2.3 Recent developments in UK Government Construction Strategy

The Government Construction Strategy (GCS)¹⁹ was published In May 2011, and was endorsed by the Minister for the Cabinet Office, Francis Maude. A One Year On update report and Action Plan update were published in July 2012.

The GCS reaffirms the validity of recommendations from previous studies and builds on them, recognising that the industry is “highly fragmented with over 300,000 businesses (99.7% of which are SMEs)” and “that construction under-performs in terms of its capacity to deliver value and that there has been a lack of investment in construction efficiency and growth opportunities” (Cabinet Office 2011, p. 5). Using more recent studies of sub-sectors of the industry as evidence, including the James Review, the strategy states:

“There is widespread acknowledgement across Government and within industry – backed by recent studies – that the UK does not get full value from public sector construction; and that it has failed to exploit the potential for public procurement of construction and infrastructure projects to drive growth” (Cabinet Office 2011, p. 3).

With a UK and Western economic backdrop of slow recovery from recession the ultimate aim of the GCS was stated as “reducing the cost of government construction projects by 15-20% by the end of the current Parliament” (Cabinet Office 2012, p. 4)²⁰. The GCS sets out an Action Plan to enable the public sector to “become a better client...demand cost reduction and innovation within the supply chain – rather than innovation focused on the bidding process” (Cabinet Office 2011, p. 3).

Government construction strategy – insight for the supply chain

From a Government procurement perspective, specific elements of the strategy that relate to supply chain include:

- A client brief that concentrates on required performance and outcome; designers and constructors work together to develop an integrated solution that best meets the required outcome;
- Contractors engage key members of their supply chain in the design process where their contribution creates value;
- Value for money and competitive tension are maintained by effective price benchmarking and cost targeting, by knowing what projects should cost, rather than through lump sum tenders based on inadequate documentation;

¹⁹ Cabinet Office (2011) Government Construction Strategy May 2011 [online]

²⁰ Cabinet Office (2012) Government Construction Strategy – One year on report and action plan update July 2012 [online]

- Supply chains are, where the programme is suited, engaged on a serial order basis of sufficient scale and duration to incentivise research and innovation around a standardised (or mass customised) product;
- Industry is provided with sufficient visibility of the forward programme to make informed choices (at its own risk) about where to invest in products, services, technology and skills; and
- There is an alignment of interest between those who design and construct a facility and those who subsequently occupy and manage it.

These are recurrent themes, seen in improvement strategies, from Latham (1994) to Wolstenholme (2009). Commentators have noted a greater focus on the use of managerial concepts to drive higher performance (Fernie et al, 2006)²¹ such as supply chain management. However, whilst commentators such as Fernie et al (2007)²² identify the high level of acceptance for the need for supply chain management theory, they caution that there is an apparent lack of informative and descriptive supply chain management in practice and even less reflection on supply chain management theory.

Industry Structure and implications for supply chain performance

The industry is famously fragmented. Wolstenholme (2009, p.22) identified the structure of the industry as number four of his key blockers to change, noting that the industry (in 2009) was “dominated numerically by SMEs, large firms (over 80 employees) accounting for 52% of the value of work done, 36% of employment but only 7% of all contracting businesses and a tiny fraction of the stock market”.

Egan (1998) suggested there were strengths and weaknesses resulting from the variance in size and scale of businesses in the industry and Wolstenholme (2009) agreed that a large number of small firms enable the industry as a whole to cope with variations in workload.

However, sub-contracting is at the root of a low level of vertical integration in the industry, which blocks the “free flow of information and innovation” through a significant number of industry bodies, and results in the lack of a single clear voice for the industry. (Wolstenholme 2009, p.22). Our supply chain analysis has helped to emphasise the extent to which on-site management and coordination activities contribute to overall project performance. Given well known skills constraints, a reliance on highly capable on-site management capability increases risks of variance in project performance.

Procurement and the supply chain

Some developments in procurement have sought to address a fragmented approach to project delivery through partnering and supply chain integration. New procurement options

²¹Fernie, S., Leiringer, R. and Thorpe, A. (2006), “Rethinking change in construction: a critical perspective”, Building Research and Information, Vol. 34 No. 2, pp. 91-103.

²² Fernie, S., and Thorpe, A. (2007), “Exploring change in construction: supply chain management, Construction and Architectural Management Vol. 14 No. 4, 2007 pp. 319-33.

have been introduced to increase integration or in response to other drivers including project finance or technological or process innovation. (Hughes et al, 2006)²³.

Hughes et al (2006) illustrates that, within the construction sector, procurement has become an increasingly complex area. Notwithstanding this complexity, there are aspects of procurement, such as different methods of selection and payment that have a direct impact on supply chain performance which are considered in this review.

In considering the relationship between procurement and supply chain, Gray and Flanagan (1989)²⁴ and Hughes et al (2006) both make the connection between procurement choices and complexity of decision making, noting the potential costs associated with tendering, which may increase with multiple layers of sub-contractors.

A common cause for high levels of sub-contractor fragmentation is the increasing complexity of the technology used in construction products and services. The building services supply chain is a good example of this. In our supply chain study, we have also identified very high levels of fragmentation in relatively simple packages of work – particularly at the Tier 2 and 3 levels of final transactions with suppliers. Construction projects involve very high volumes of purchasing activity and supplier coordination. The reality of increased supply chain fragmentation presents a challenge to performance improvement models that are based on value chain consolidation.

Skills and the supply chain

In May 2008 Construction Skills commissioned a report titled 2020 Vision the Future of UK Construction, the purpose of which was to:

- Identify key issues and challenges which the UK construction industry may encounter over the long term; and,
- Assess their potential implications for industry employment, skill and training requirements.

The report ran scenarios to support the identification of key trends and issues in the UK construction industry, as follows (Construction Skills, 2008):

Speed of innovation within the sector - Historically, the rate of innovation in the construction sector has been below par

Demographics - The industry is ageing and will compete for skills against the backdrop of the UK's ageing demographic profile.

Health and Safety – Investment in safety skills and attitudes.

²³ Hughes, W., Hillebrandt, P., Greenwood, D., & Kwawu, W (2006), *ibid*.

²⁴ Gray, C and Flanagan, R (1989) *The changing role of specialist and trade contractors*. Ascot: Chartered Institute of Building.

Information and Communication Technology (ICT) – accelerated adoption of integrated information systems, including the need to upgrade the skills of the existing workforce.

Modern Methods of Construction (MMC) – Development of new skill sets for site and factory environments, together with the development of multi-trade skillsets.

New materials – New skill sets and configurations of trades.

Carbon emission reduction – enhanced design, construction and assessment skills.

Whilst the skills development forecasts set out in the Construction Skills (2008)²⁵ report may not have identified all requirements, certainly skills associated with ICT (Building Information Modelling for example) have grown whilst others such as MMC have suffered as a result of difficult demand conditions. From the perspective of this report, the absence of a specific focus on process and site management reinforces our view that the industry tends to focus on outputs such as design or offsite manufacture, rather than processes used to deliver these outcomes.

2.4 Implications for the supply chain analysis

- The literature review has demonstrated the size of the industry and the strategic impact of its efficiency. The impact of supply chain structures in the construction industry is widespread and pervasive.
- There is a long term challenge associated with sub-contract relationships, contracts, and efficiency of tendering and so on. Initiatives have been in place to improve performance since the Latham Report in 1994.
- The construction industry has a challenge around productivity, dating back to Latham and beyond. Improvement targets have not been met and many of the improvement opportunities identified have only been partially implemented.
- There are well-established links between supply chain health, customer satisfaction and image and rewards for the industry. Most work and employment sits within lower tiers of the supply chain.
- The industry is affected by long term issues around under achievement, low levels of profitability, investment and training etc. The impact of the five-year long construction downturn has exacerbated these problems.
- The supply chain has a key role as an agent of change. The supply chain is rightly identified as being at the heart of performance improvement initiatives, but there

²⁵ CITB (2012), Blueprint for UK Construction Skills 2012 – 2016 [online]; available from <http://www.citb.co.uk/Documents/research/csn%20outputs/blueprint-uk-construction-skills-2012-2016.pdf> [accessed June 2013]

has been limited consideration of the ability of the supply chain to respond to these opportunities.

- Issues associated with the impact of procurement strategy and competitive tendering are endemic, and go beyond the 1st Tier into the 2nd and 3rd. In instances where frameworks and alliances are in place, the benefit of the extended relationship may not necessarily flow down to lower tiers of the supply chain.
- Improvement measures were only partially adopted when times were good. Industry commentary makes it clear that there has been a ‘reversion to type’ with respect to many commercial activities. It is also claimed that the industry focused on soft issues when markets were healthy but ignored many performance improving disciplines such as benchmarking.
- There is a continuing absence of the business drivers needed to accelerate change, which has held the industry back. Examples include the acceptance of low margins and low investment, often driven by commoditised purchasing behaviour. This means there is less incentive from within the industry to improve performance.
- There are many continuing challenges associated with supply chain engagement in common delivery models – including pushing risk down the supply chain, lack of integration, or limited early sub-contractor involvement. Often this is described as ‘reverting to type’. The implication is that there are deep seated barriers to improvement that need to be understood and tackled directly for change to occur.

The diagnosis presented in the three major reviews has been consistent in its identification of the challenge and its optimism that the industry is in a position to remedy itself. The low level of pick-up of the quick wins of the Wolstenhome Review is good evidence of how difficult it is for the industry to pursue its own long-term interest.

This very powerful inertia, potentially generated by the structure of the industry itself, needs to be at the forefront of planning for future improvement initiatives.

3. Supply chain structure

3.1 Introduction

This section of the report focuses on the structure of supply chains working under both Tier 1 and 2 contractors and sub-contractors. The analysis considers the number of sub-contractors and suppliers and the value of the contracts in each discrete supply chain.

The analysis addresses the objectives of the study which is focused on the achievement of further cost savings in the supply chain and understanding of choices with respect to the use of locally sourced or imported products and services. By analysing the number and size of subcontracts involved in the delivery of a project, this study highlights the disaggregation of the industry, the small scale of many enterprises involved and the limited extent of repeat work. The implications of a large number of suppliers and/or a large number of small value contracts include:

- Relatively high transaction costs related to procurement, bidding and contract/commercial administration;
- Increased levels of management and coordination of activities on site, related to a large number of separately contracted trades;
- Extensive learning curves associated with project processes, effective team working and other aspects of collaboration;
- Reduced opportunities to drive out waste and reduce cost through supply chain aggregation, volume purchases and so on.

With respect to the volume of imported materials and services, the implication of a large number of transactions is that the transactions become commoditised and the purchasing decision is made on simple commercial criteria such as price and availability. This is particularly the case for construction materials – a finding which is supported by the results of the structured interview survey. The implication of this finding is that there are few, if any opportunities to build a position of competitive advantage through product or service differentiation for domestically produced materials, where these are subject to overseas competition.

3.2 The supply chain sample

The analysis of construction supply chains relies on a high level of cooperation from the contractor supply chain. The work is potentially highly time-consuming for participating contractors. The research team developed an approach to analysis based on contractors' internal cost reporting processes. Whilst this reduced the effort required to produce the analysis, we also found that many sub-contractors were quite sensitive to issues of commercial confidentiality. This reduced the willingness to participate, and size of the sample, compared for example to the size of the questionnaire survey sample.

The analysis presented in this section is based on the following range of projects:

- Four main contracts (Tier 1) with a value range of £20 to £30 million. These projects are representative of the work of national contractors with managed supply chains. Two of the projects are located in London, one in the South East and one in the Midlands. A proportion of the construction work on some of these projects is self-delivered by resources from within the main contractor's organisation. The value of this work, which is managed as a sub-contract typically ranges from 20 to 30%. This pattern of dis-intermediation of contracts is discussed elsewhere in the report.
- One main contract (Tier 1) falling within a value range of £1-2 million. This project has been sourced from a regional contractor and is representative of medium scale public sector work sourced via frameworks. The main contractor uses some direct labour for self-delivery.
- Six sub-contracts (Tier 2) with values ranging from £1 to £5 million. The focus of the analysis is on large, complex sub-contracts which have an equally extensive and complex supply chain. These sub-contracts are associated with the projects undertaken by national contractors. We did not examine the supply chain structures associated with simple or low value sub-contracts, or sub-contracts for the supply of services. A detailed analysis of four of the sub-contracts is included in the analysis.
- The selected contracts have been chosen to reflect practice in both the private and public sectors, and involved the delivery of high quality commercial office buildings and the construction of new-build Academies. The project delivered by a regional contractor involved the refurbishment of a health sector building. Where possible, the team identified pairs of buildings that were delivered using contrasting approaches to procurement, so that the widest possible range of insight could be drawn from the analysis and the structured interviews.

The size of the sample set out in this report meets targets agreed with BIS, which reflect the team's recognition of the challenges associated with obtaining detailed financial data from the construction supply chain. Supply chains which are excluded from the analysis include:

- Consultant supply chains
- Labour-only sub-contract supply chains
- Manufacturing supply chains

Definitions of the supply chain terminology used in the analysis are as follows:

Table 3.1: Definitions of supply chain tiers

Tier	Description	Example
Tier 1	Designers and Constructor that have a direct contract with the ultimate client;	
Tier 2	Designers, constructors and suppliers with a sub-contract with the Tier one contractor	Novated design consultants Sub-contractors Manufacturers and material distributors Suppliers of major plant and equipment such as tower cranes
Tier 3	Designers, constructors and suppliers with a sub-contract with a Tier two sub-contractor	Designers providing working details; Specialist sub-contractors Manufacturers and material distributors Plant and equipment supply and hire firms

Tier 1 contractors are typically termed main contractors, and many Tier 2 contractors are described as specialist contractors. Labour-only sub-contractors typically operate at the third Tier. The supply chain interviews described in section 5 are focused mainly on Tier 1 and 2 contractors.

In a small number of instances, we found examples of Tier 2 work being delivered (or the delivery being managed) by a division of the main contractor – for example, the delivery of the building services sub-contract. This aspect of the analysis demonstrates that the final costs associated with physical construction work can occur at all levels of the supply chain.

3.3 The analysis of expenditure categories

The analysis of the supply chain is based on records of expenditure obtained directly from Tier 1 and 2 contractors. So far as is possible, we were able to analyse the contractor's direct and indirect expenditure on a project. Information derived from records of contractors' transactions on a project has enabled the team to identify the number of sub-contractors and suppliers on a project.

The team did not analyse the number or size of individual transactions with suppliers.

The analysis of each supply chain is broken down into a series of cost categories which distinguish, for example, between sub-contracts for construction and other sub-contracts for the provision of services and materials. This level of analysis is helpful as it provides important insight into the complex range of activities undertaken in connection with each construction project.

The structure of the supply chain described by sub-contractors and suppliers is analysed in more detail in sections 3.4 and 3.5 below.

The analysis also distinguishes between three cost categories that do not involve sub-contracting. Direct works describe costs that are related specifically to construction work. We have encountered a number of examples of contractors at Tiers 1 and 2 who undertake construction themselves, and this category highlights this allocation of work. Internal costs are costs related to management, supervision and logistics on a project – the activities normally associated with main contractors and some specialist contractors. External cost is a category that has been used to isolate incidental expenditure, where this was recorded by the contractor. A more detailed explanation of the categories used is set out in table 3.2 below.

Table 3.2: Supply chain cost categories

Cost category	Definition	Example
Sub-contractor	Sub-contracted construction, including design, components and materials, labour and supervision	Sub-structure, partitioning, fire-alarms and so on.
Supplier (Services)	Sub-contracted services including design consultancy and site services	Directly employed design consultants, multi-service gang, site services including cranes and hoists, temporary power and so on, utilities connections, insurances
Supplier (Materials)	Components or products purchased directly for incorporation into the works by direct labour or by others	Concrete and reinforcement, air-conditioning plant, consumables
Direct Works	Construction work undertaken by the contractor at the head of a particular supply chain	Actual construction work – sub-structure, building services and so on
External Costs	Incidental business expenses	Utilities costs for site accommodation and so on
Internal Costs	Internal costs of the contractor at the head of a supply chain associated with management, plant, overhead and margin	Contractor's project management costs, internal charges for plant and equipment, internal recharges for business-wide activities, contribution and allowances for profit and risk

Note: It is not possible to define sub-contractors or suppliers as being either Tier 2 or 3. The analysis presented in this report shows that Tier 2 sub-contractors typically have a complex network of sub-contractors and suppliers. In many cases members of Tier 3 will also source work from sub-contractors and suppliers.

3.4 Results of the supply chain analysis – Tier 1 contractors

Table 3.3 sets out the results of the analysis of the Tier 1 main contractor supply chains.

Table 3.3: High Level Tier 1 Supply Chain Comparison

	Project 1	Project 2	Project 3	Project 4	Project 5
	Commercial Office	Commercial Office	Academy	Academy	Health Refurbishment
	Tier 1 Main Contractor	Regional Main Contractor			
Number of Sub-contracts (Tier 2)	56	38	71	58	71
Average value	£229,500	£618,300	£171,700	£221,700	£7,600
Median value	£49,000	£250,900	£49,700	£29,500	£1,300
Maximum value	£1,820,000	£3,619,000	£3,445,000	£3,190,000	£127,300
90 th Percentile value	£708,300	£2,256,000	£446,000	£587,100	£18,000
10 th Percentile value	£3,200	£24,400	£2,835	£9,700	90
Suppliers >£100,000 (%)	41.1	63.2	36.6	29.3	1.4
Suppliers <£100,000 (%)	58.9	36.8	63.4	70.7	98.6
Suppliers <£50,000 (%)	50.0	18.4	50.7	60.3	98.6
Suppliers <£10,000 (%)	26.8	0	25.4	25.9	76.1

The analysis is focused on the number of suppliers and the size of the transactions – paying particular attention to the complexity and disaggregation of the supply chain. The analysis in Table 3.3 confirms that the construction supply chains analysed are diverse and complex. On 4 out of the 5 projects analysed, the main contractors have over 50 sub-contracts/suppliers in Tier 2. The average value naturally varies depending on the size of the contract, but on three out of the four large contracts, the average is close to £200,000

By contrast, the average value of contracts on the project submitted by a regional contractor is £7,600, which is not only a much smaller value, but also a smaller proportion of the contract sum – 0.5%. In this case, the project has over 70 participants in the Tier 2 supply chain. The low transaction size on smaller projects indicates a high level of SME involvement but also has implications for the level of administration associated with projects.

Each project features a small number of large value subcontracts at Tier 2. Typically there are 3 or 4 large value sub-contracts covering sub-structure, structure, envelope and

services that account for a high proportion of the work. Whilst this suggests a degree of economy of scale, the analysis of the Tier 2 sub-contract supply chain shows that the 3rd Tier delivering these works is also highly fragmented. The two Building Services sub-contract supply chains examined in section 3.5 each have over 25 Tier 3 suppliers. It should be noted that all of the analysis of Tier 2 sub-contractors was carried out in connection with complex works delivered by national main contractors. No analysis of Tier 2 contractors working on behalf of regional contractors was undertaken as part of this project.

The key findings of the analysis can be summarised as follows:

- All projects feature a large number of Tier 2 suppliers. Low median values for four out of five of the contract supply chains indicate that there are a high number of low value transactions within the supply chain;
- On all projects, between 50% and 75% of the total value of the work is accounted for by a small number of major sub-contractors and the main contractor's site management team. The allocation of workload into packages has the effect of aggregating much of the value of construction work, albeit that delivery is undertaken by a disaggregated Tier 3 supply chain;
- Despite the level of aggregation of spend around high-value packages, all of the supply chains examined had an extended 'tail' of smaller value, specialist providers. The evidence for this is:
 - The high number of suppliers with contract values of under £100,000. For three of the national contractors, over 60% of sub-contracts by number have a value under £100,000. For the regional contractor, only 1 sub-contract exceeds the £100,000 threshold.
 - The number of suppliers with contract values under £10,000. This ranges from 15 to 20 on contracts delivered by national contractors, to over 50 for the project delivered by a regional contractor.

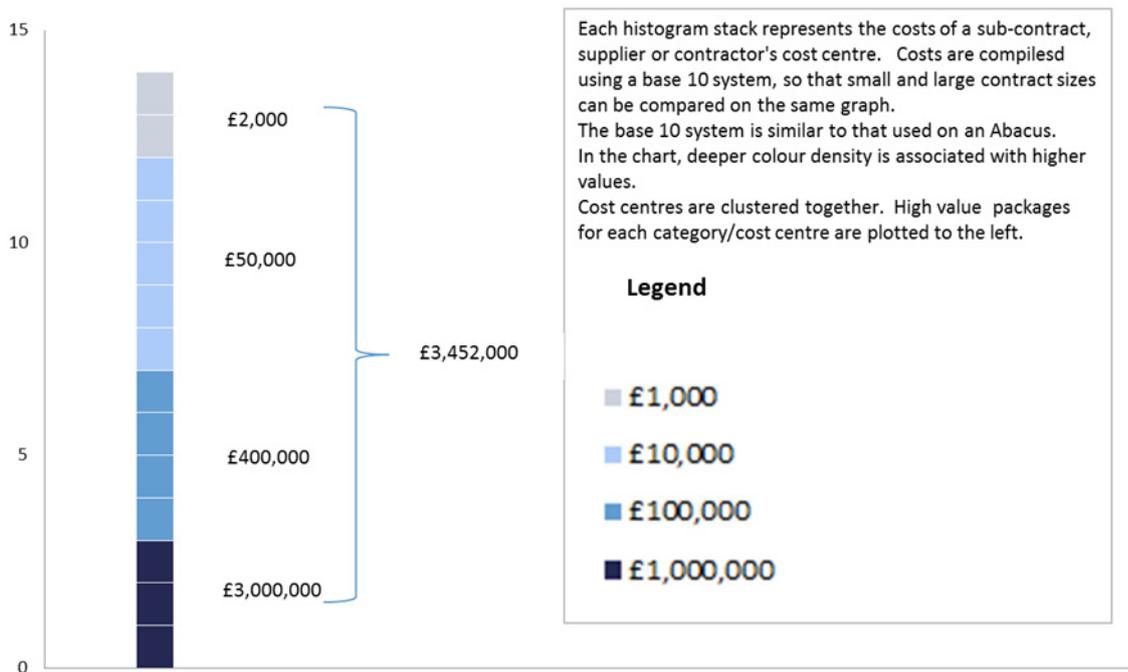
The low average value of transactions relative to the maximum sub-contract value. Two main contractors appear to follow a procurement strategy based on larger packages, and in this case, the average value is 30 to 40% of the maximum. For the other two national contractors, the average value was 10-20% of the maximum, indicating a more dispersed supply chain. For the regional contractor, the average value is 5% of the maximum – indicating a critical dependency on the performance of one specialist contractor, and a high volume of small transactions;

Main contractor supply chains – detailed analysis

Further details of the analysis are provided in the graphical analysis set out in figures 3.2 to 3.6. The figures present the value of each sub-contract and internal cost centre on a project in a stacked histogram format – illustrating the size of the supply chain, and the distribution of spend across each of the cost centres. Each column represents the costs of an individual supply chain member or Tier 1 contractor's cost centre.

An explanation of the data presentation is given in Figure 3.1. In presenting the results, we have adopted a base 10 number system, similar to the system used on a decimal abacus. Units of expenditure (millions, hundred thousands, ten thousands etc.) are plotted on the histogram. We have chosen this format for presentation because the value range across the sub-contracts is so wide that conventional representation of the value of each sub-contract cannot be used. The value of most packages is not visible if a conventional scale based on either length or area is used. Using the base 10 approach, packages ranging from £1 million + to £1,000 can be compared using the same axis.

Figure 3.1: Explanation of the graphical presentation of the supply chain analysis



By using a base 10 scale, we are able to communicate the key characteristics of patterns of expenditure within the construction supply chain, including:

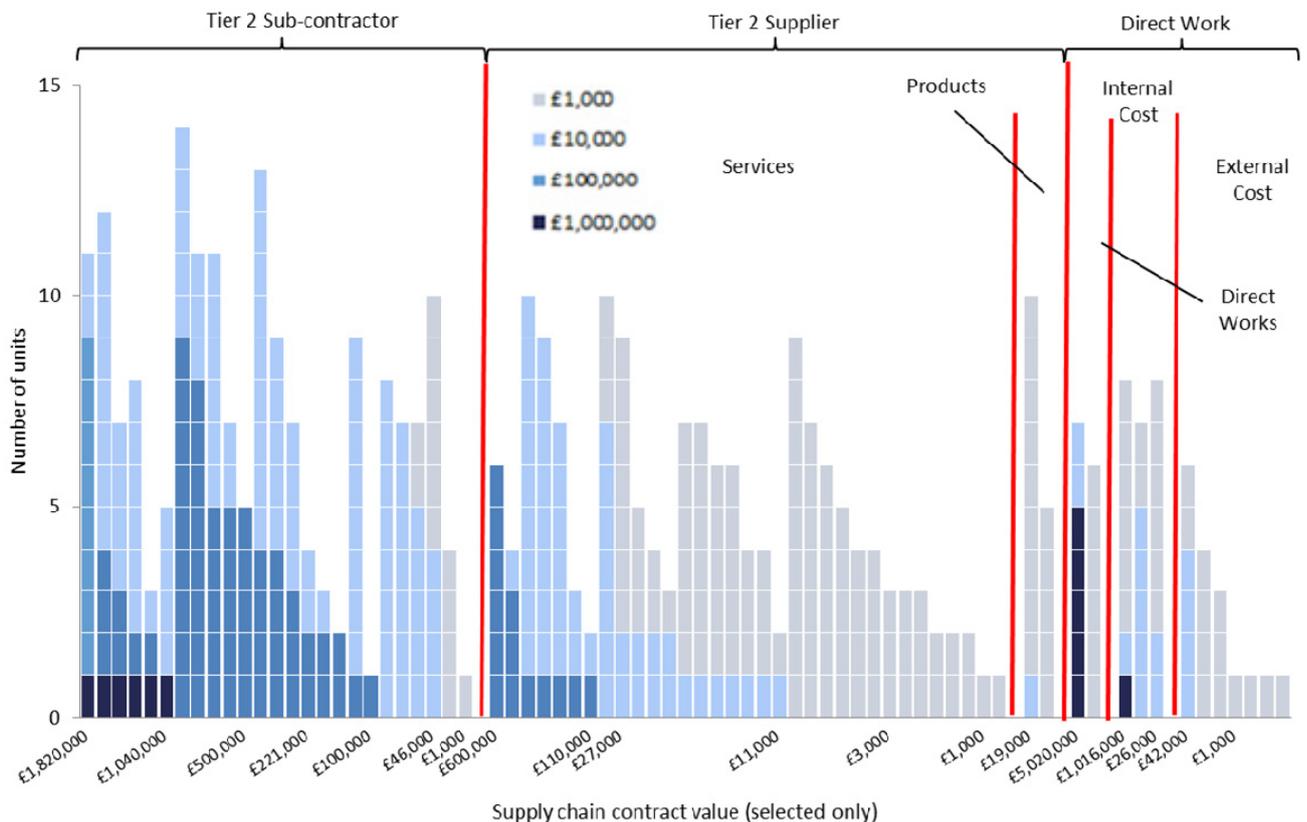
- The large number of sub-contractors and suppliers involved in the delivery of a typical construction project;
- the concentration of project expenditure on a small number of large sub-contracts;
- the presence of a large number of small value sub-contracts as part of the main contract and sub-contract supply chains;

Our graphical analysis breaks the sub-contracts further down into construction, service and product supply contracts described in table 3.2 and also plots details of the main contractors internal spend. In the case of internal spend this includes direct works as well as the management and overhead costs more commonly associated with the main contractor.

Project 1 - Commercial Office delivered by national contractor

Project 1 is an office development with mixed-use elements located in Central London with a construction budget in excess of £20 million. The project has a steel frame and a range of external envelope systems.

Figure 3.2: Project 1 - Commercial Office delivered by national contractor



Source: EC Harris LLP

This commercial project supply chain is characterised by a number of large specialist sub-contracts. There are five subcontracts with a value in excess of £1 million. The largest package – building services has been managed in-house as a sub-contract and is plotted in the chart as being part of direct works. Whilst the work is managed by the main contractor, all of the actual work is sub-contracted to lower tiers in the supply chain. Most of the high value transactions (e.g. in excess of £100,000) are associated with physical construction work as opposed to construction-related services. Some of these packages are quite complex with regards to the number of tier 3 sub-contractors being integrated at sub-contract level. The high value construction services contracts include design, cranes and hoists and so on. There are a large number of transactions associated with services suppliers, with the majority being low value – e.g. under £10,000.

The implications for the value agenda of this analysis is the range of services activities associated with construction projects – associated with design, logistics and so on. The extent of the requirement for services support increases with the extent of transfer of

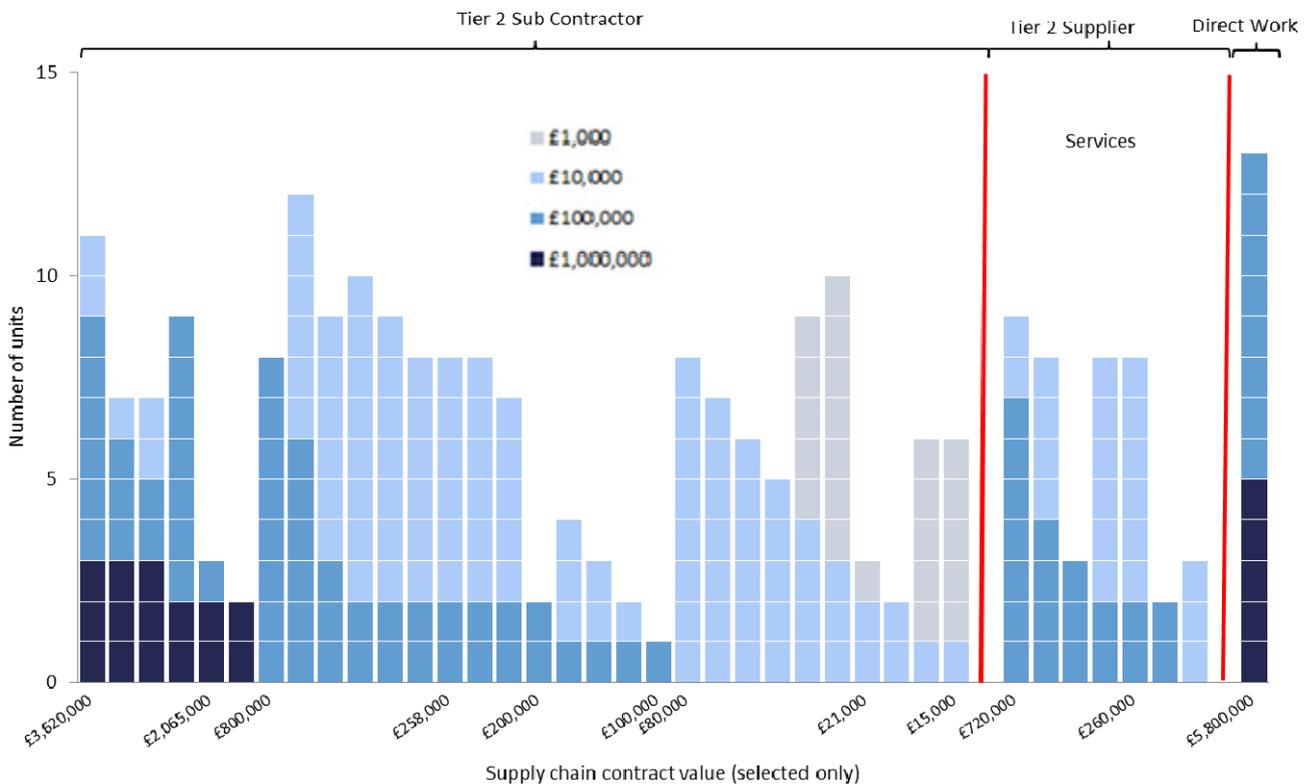
design responsibility and the complexity of the site. These services are difficult to aggregate and involve a high level of coordination.

With respect to the selection of products and the competitiveness of the UK manufacturing base, this analysis suggests that many of the decisions related to final product sourcing will be made in the second and third tiers.

Project 2 - Commercial Office delivered by national contractor

Project 2 is an office development with mixed-use elements located on a prestigious site in Central London with a construction budget in excess of £25 million. The project has an in-situ concrete frame and an external envelope based on a unitised curtain wall system.

Figure 3.3: Project 2 - Commercial Office delivered by national contractor



Source: EC Harris LLP

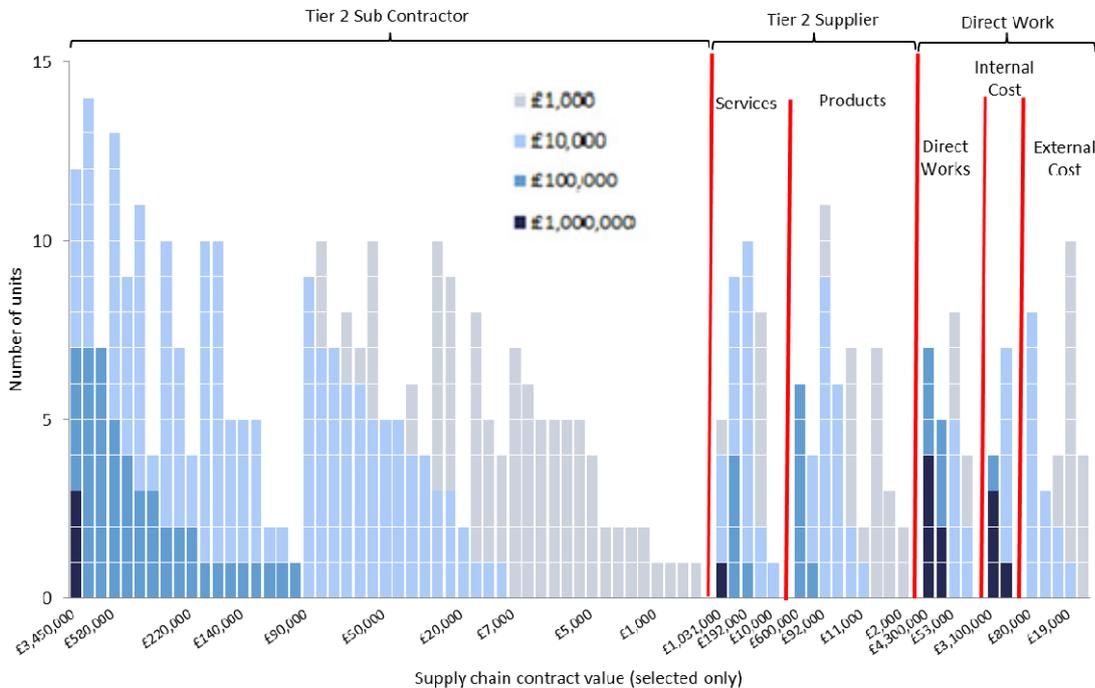
This supply chain is characterised by a larger number of £multi-million sub-contracts than other projects. Building services are delivered by more than one Tier 2 sub-contract. The analysis provided by the contractor was less detailed than some sourced from other project participants, so it is not possible to provide a definitive comment on the pattern of expenditure on smaller sub-contracts, as these may have been reported using summary data – particularly those associated with construction services suppliers. Nevertheless, comparison of this project and others in the sample shows that there is some variation in the configuration of sub-contracts, providing scope for aggregation.

The structures sub-contract on this project is subject to further analysis in section 3.5 – the analysis provides considerable insight as it has the most diverse and complex supply chain seen in this study.

Project 3 - Academy delivered by national contractor

Project 3 is an Academy constructed in South East England and delivered within reduced budgets set after spending reviews in 2010. The Academy is built on the site of an existing school using aspects of *modern methods of construction* including pre-fabricated wall and floor units.

Figure 3.4: Project 3 - Academy delivered by national contractor



Source: EC Harris LLP

This analysis is based on a project completed in the South East, using a combination of established and local suppliers.

This supply chain includes one very large, high value integrated structure and envelope package. The contract also includes the self-delivery of design and two £ multi-million packages. Interestingly, despite the high level of integration, this project features the highest number of sub-contractors and suppliers – 71 in total. Both the superstructure and services packages are analysed in greater detail in section 3.5.

This supply chain has a relatively small number of services and product suppliers. Most of the product suppliers are involved in the delivery of furniture and fittings as part of the hand-over of a fully equipped Academy. However, this supply chain has a comparatively

large number of sub £100,000 construction packages, some of which we understand were locally sourced in accordance with agreements with the local authority.

By contrast with the commercial projects, there are elements of this supply chain which are highly disaggregated – representing the potential for increased cost associated with transaction costs and coordination of on-site activity.

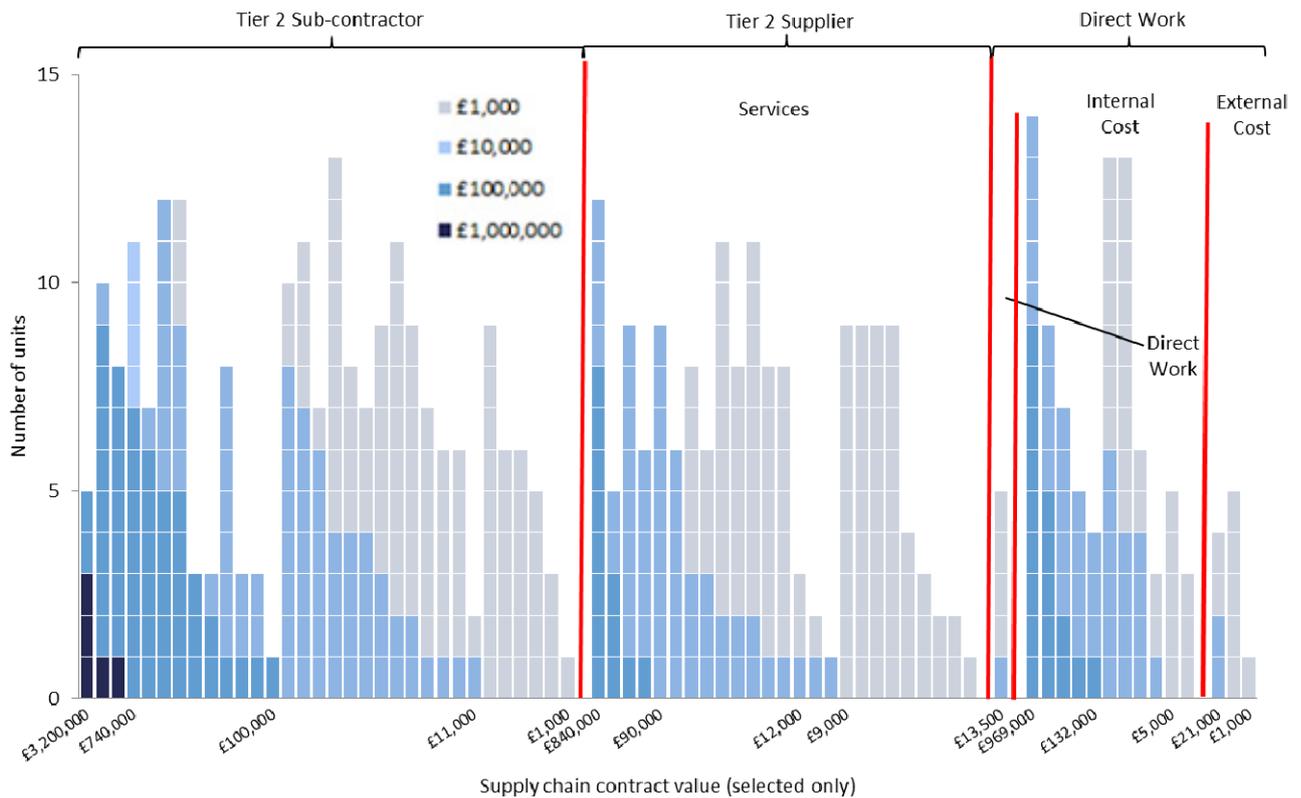
This project is particularly interesting as it contrasts a number of innovative delivery methods, including the vertical integration of detailed design and building services design and installation, and the adoption of off-site manufacture techniques. The evidence shows that even on a project where modern methods of construction are adopted, which should result in a streamlined supply chain, there remains a high degree of residual disaggregation in the supply chain. In this instance this is likely to be a reflection of Local Authority procurement policy, as well as a reflection of the contractor's structuring of the supply chain to gain maximum cost saving leverage on some trades.

The evidence from this project highlights that there is no direct link between measures taken to increase vertical integration and a simplified supply chain. The data also shows some evidence of the fragmentation of the supply chain linked to a competitive sub-contractor supply chain procurement strategy. The implication for the construction strategy is that even with a shift to greater use of pre-fabrication; it is likely that a significant portion of expenditure will continue to be directed through a fragmented supply chain focused on on-site works. Unlike the Egan Report, which assumed that factory-based construction methods could be introduced widely, the construction strategy should take into account that current supply chain arrangements are likely to remain widespread – even when advanced procurement approaches are adopted.

Project 4 - Academy delivered by national contractor

Project 4 is an Academy constructed in the Midlands and delivered within reduced budgets set after spending reviews in 2010. The Academy is built on the site of an existing school using conventional construction techniques.

Figure 3.5: Project 4 - Academy delivered by national contractor



Source: EC Harris LLP

Project 4 has a conventionally managed supply chain, with all construction and design work outsourced to the main contractor’s supply chain, comprising of consultants, sub-contractors and other service providers. Some of these sub-contractors will undertake the work themselves and represent the end of the supply chain – examples include specialist contractors involved in asbestos removal, tree surgery and so on. Other sub-contractors will have their own network of sub-contractors and suppliers. This supply chain can be taken to be representative of the regional delivery model for most national contractors. There is one very large sub-contract package (building services). The supply chain for both construction and services is characterised by an extended tail of smaller providers. Evidence from structured interviews suggests that this project is also associated with some legitimate but highly competitive procurement practices that have become common as a result of the downturn. Examples include the re-bidding of work to a panel of sub-contractors after a main contract has been won on the basis of quotations received from individual suppliers.

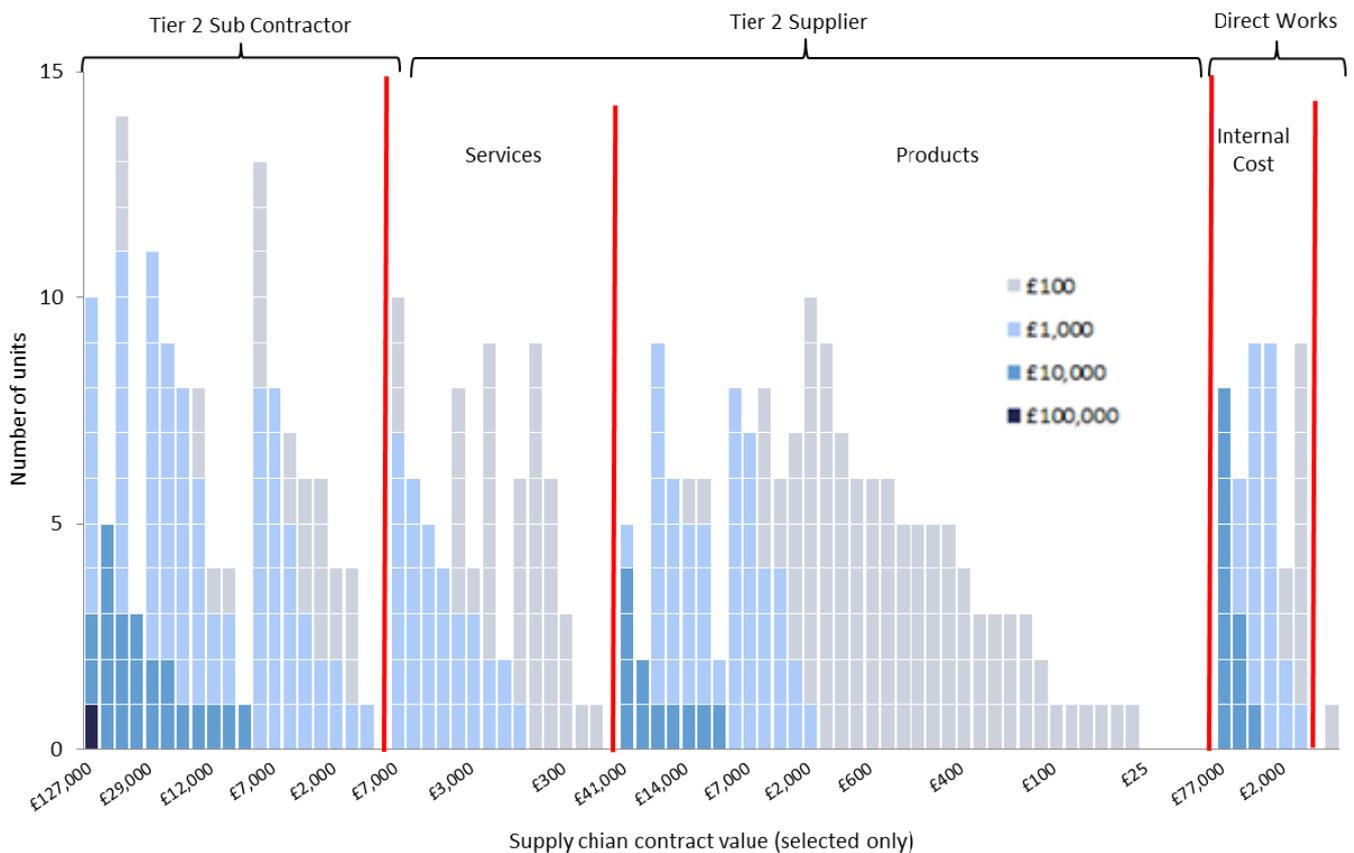
High levels of competition within lower tiers of the supply chain are also used by main contractors to meet the increasingly challenging cost targets set by clients. Comments obtained via the structured interviews also suggested that the incentive for members of

this complex supply chain to cooperate was being eroded by high levels of competition and by the re-bidding of work.

Project 5 - Health project delivered by regional contractor

Project 5 involves the refurbishment of a ward block in an operational district hospital. The project, which has a value in excess of £1.5 million, involves elements of ‘cut and carve’ as well as new work associated with the replacement of services and finishes.

Figure 3.6: Project 5. Health project delivered by regional contractor



Source: EC Harris LLP

Project 5 is the only example of project delivery by a regional contractor that we have been able to analyse. The project is delivered on a design and build procurement route and involves some self-delivery via direct labour.

The units in Figure 3.6 have been changed in comparison to previous Figures to reflect the size of sub-contracts involved. Only one sub-contract is worth in excess of £100,000, with most (54) being worth less than £10,000. By contrast with other main contractor supply chains, most suppliers were involved in the delivery of products and materials – these range from the large builders merchants to small specialist suppliers. The information provided by the main contractor points to a large number of transactions associated with

the 37 product suppliers in the Tier 2 supply chain – nearly 400. This is indicative of a supply chain operating on an on-demand basis – providing and invoicing for building materials and products in-line with activities on site.

This data provides evidence of a high level of supply chain disaggregation on two dimensions:

- The number of suppliers
- The number of transactions

This pattern of high levels of supply chain fragmentation need not be a barrier to cost reduction, but suppliers clearly do need to be set up to be able to deliver small lots of materials in a cost effective and timely way. Furthermore, volume discounts based on total annual spend may accrue to the contractor rather than the ultimate client – potentially limiting the extent to which supply chain improvement initiatives such as category management can be successfully applied to the construction model.

The results of this analysis, detailing a pattern of a large number of relatively small value transactions with a large number of suppliers, points to the challenge that many medium sized regional contractors will face in rationalising complex purchasing processes so as to drive value from out of their suppliers.

Whilst the procurement approach adopted on project 5 may not be representative of how all regional contractors operate, the analysis does indicate that at the scale of smaller projects, the securing of a sustained cost reduction will require effective working across a highly disaggregated supply chain.

Main contractor supply chain analysis - commentary

The analysis of main contractor spend through their supply chains that is presented in this report illustrates a number of key trends including:

- The concentration of spend on a small number of critical packages. Because of their high value, works associated with the substructure, frame, envelope and building services are likely to be areas of focus for the identification of cost savings – including efforts to drive cost out of the supply chain, through volume purchase or greater vertical integration. Evidence from the supply chain interviews suggests that the extent of alignment with these sub-contractors is varied, and is currently being undermined by the re-bidding of some complex packages. This could reduce the scope for cost reduction;
- The extent of services suppliers engaged by main contractors – emphasising the wider range of coordination and logistics activities managed by main contractors as risk transfer from the client has increased;
- The large number of material supplier contracts associated with the delivery of construction work – exemplified by project 5. Most of this work is delivered by sub-

contractors, but where main contractors self-deliver, then material suppliers have a substantial role as Tier 2 suppliers.

Most of the main contractors that contributed to the study undertook very little construction work and had supply chains with over 50 participants. The next section of the research, examining Tier 2 sub-contract supply chains considers whether the same level of complexity is replicated at lower levels in the supply chain. If the pattern of fragmentation is repeated at lower levels, then it is conceivable that a one-off, medium sized project with 25 Tier 2 sub-contract suppliers could involve the contributions of hundreds of individual suppliers.

3.5 Results of the supply chain analysis – Tier 2 contractors

Table 3.4 sets out the results of the analysis of the Tier 2 main contractor supply chains.

Table 3.4: High Level Tier 2 Supply Chain Comparison

	Project 1 ²⁶		Project 2	Project 3		Project 4
	Commercial Office		Commercial Office	Academy		Academy
	Interiors T2	Services T2	Structure T2	Superstructure T2	Services T2	Substructure T2
Number of Providers	12	26	106	27	43	16
Average value	£74,000	£147,000	£18,500	£126,900	£89,400	£66,900
Median value	£15,000	£86,800	£920	£12,000	£29,100	£22,000
Maximum value	£280,000	£485,500	£360,800	£1,550,000	£987,100	£272,500
90 th Percentile value	£182,100	£444,600	£28,700	£358,800	282,300	£214,000
10 th Percentile value	£740	£6,400	£100	£180	£3,100	£3,200
Suppliers >£100,000 (%)	25.0	42.3	5.7	25.9	25.6	25.0
Suppliers <£100,000 (%)	66.7	57.7	94.3	74.1	74.4	75.0
Suppliers <£50,000 (%)	58.3	38.5	93.4	74.1	62.7	68.8
Suppliers < £10,000 (%)	41.7	15.5	79.3	48.2	37.2	50.0

Source: EC Harris LLP

²⁶ Due to some issues of interpretation with regards to the extent of the Tier 3 supply chain, it has not been possible to produce a detailed graphical analysis of Tier 2 sub-contractor supply chains in this report.

In common with the analysis of Tier 1 contractors, the analysis is focused on the number of suppliers and the size of the transactions. Care needs to be applied to the results of the Tier 2 supply chains, as the research team had less visibility of source financial data. For example, it is likely that the analysis of Tier 3 contractors on projects 1 and 4 understates the complexity of the supply chain due to the grouping together of the costs of some materials suppliers.

Notwithstanding issues associated with the comprehensiveness of the results, the analysis shows that Tier 2 contractors dealing with larger packages also have a complex network of suppliers at Tier 3 and below. Furthermore, most of the Tier 3 suppliers do not represent the final layer of the supplier chain. For the services integrators for example, the third tier are specialist building services contractors who will have their own lower tiers of material and component suppliers, specialist labour and so on. The research team was not able to obtain data below Tier 3, so this additional level of complexity is outside of the scope of this analysis.

One sub-contractor on project two does provide an insight on the structure of the final level of the supply chain. This Tier 2 contractor uses no sub-contractors and accesses a large network of material and plant suppliers. This contractor has over 100 suppliers on the project, mainly associated with small transactions. The evidence from this single sub-contract provides an indication of the complexity of the specialist materials supply chain feeding directly into works on site. A similar pattern is seen in the supply chain structure for the region contractor discussed above in section 3.4.

The research team was not able to ascertain any specific reasons for a procurement strategy which results in such high levels of supply chain fragmentation. The team's hypothesis is that the procurement strategy will be in response to supplier specialisation, product availability and lowest price procurement.

The analysis in Table 3.4 confirms that Tier 2 construction supply chains are also diverse and complex. In 4 out of the 6 sub-contracts analysed, there are over 25 sub-contracts or suppliers, with one package having over 100 separate suppliers. It should however be noted that there is still a degree of aggregation in the supply chain. The average value of Tier 3 sub-sub contract is relatively high – ranging from £60,000 to £150,000 on five of the analysed projects.

We were unable to obtain details of a sub-contract from the regional contractor.

The key findings of the Tier 2 analysis can be summarised as follows

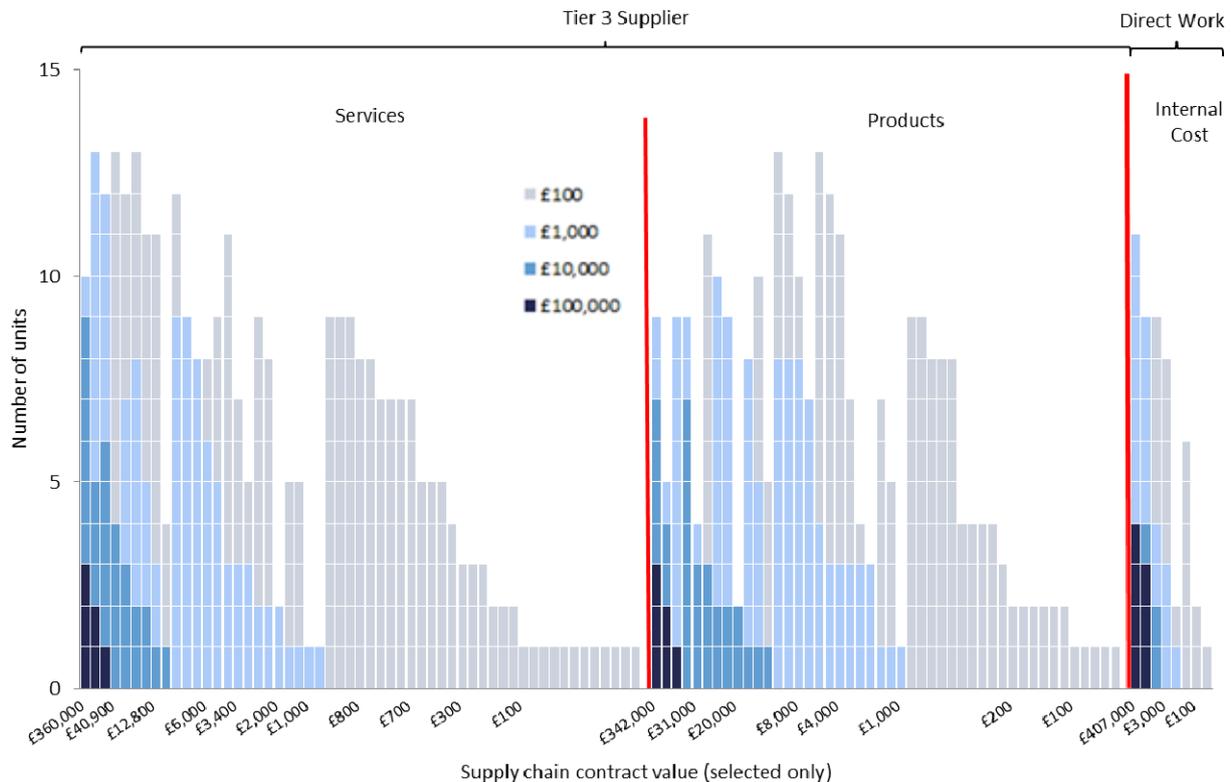
- The analysis demonstrates that for complex sub-contracts, which according to our analysis account for 50 to 70% of project value, there will be at least three tiers within the supply chain, each involved in procurement, logistics and coordination activities. Given the degree to which final delivery of the work is highly fragmented, we believe that there is only a limited opportunity to consolidate the supply chain, removing costs of intermediaries;
- This finding also shows that whilst a high proportion of construction work is aggregated at the Tier 2 contractor level the delivery of the work itself is broken down into smaller packages of work.

- We have seen very little evidence of the overlapping of contractor supply chains – e.g. sub-contractors working for multiple main contractors. There is plenty of evidence that supply chains do span across a wide range of contractor clients. However, in our small sample, which was geographically dispersed, there was very limited crossover of supply chains.
- Tier 2 contractors are also engaged in a large number of small transactions. Evidence from both Tier 1 and 2 contractors suggests that the supply chain is more fragmented for contractors involved in the actual delivery of work (refer to the analysis of the regional Tier 1 contractor and the Tier 2 structures contractor). The supply networks for in-situ construction (e.g. construction work undertaken on site such as concrete placement) are particularly disaggregated. This finding points to the important role that material producers, plant hire businesses and intermediaries such as builders merchants have in facilitating the ready availability of construction products and services at both a low price and also a low transaction cost;
- Despite the level of aggregation of spend around high-value packages, all of the supply chains examined had an extended ‘tail’ of smaller value, specialist providers. The number of suppliers involved ranges from under 10 to over 80.

Tier 2 supply chains – detailed analysis

The following analyses of the distribution of sub-contractor spend in the supply chains is focused on results derived from Projects 2, 3 and 4. Limitations on the detail of the supply chains received from project 1 led the research team to limit the extent of analysis on these contracts.

For the presentation of the analysis, the same base 10 number system has been adopted, albeit that scales are varied to reflect the smaller package value of many Tier 3 contracts. The same analytical framework of sub-contractor, supplier and internal costs has been applied to the analysis.

Figure 3.7: Project 2 - Structures specialist contractor

Source: EC Harris LLP

As discussed in the introduction (see section 3.1), this supply chain represents all resources required to construct an in-situ concrete frame. The specialist contractor, operating at Tier 2 does not use sub-contractors. As a result, this analysis provides a good insight into the way in which construction work on site is resourced.

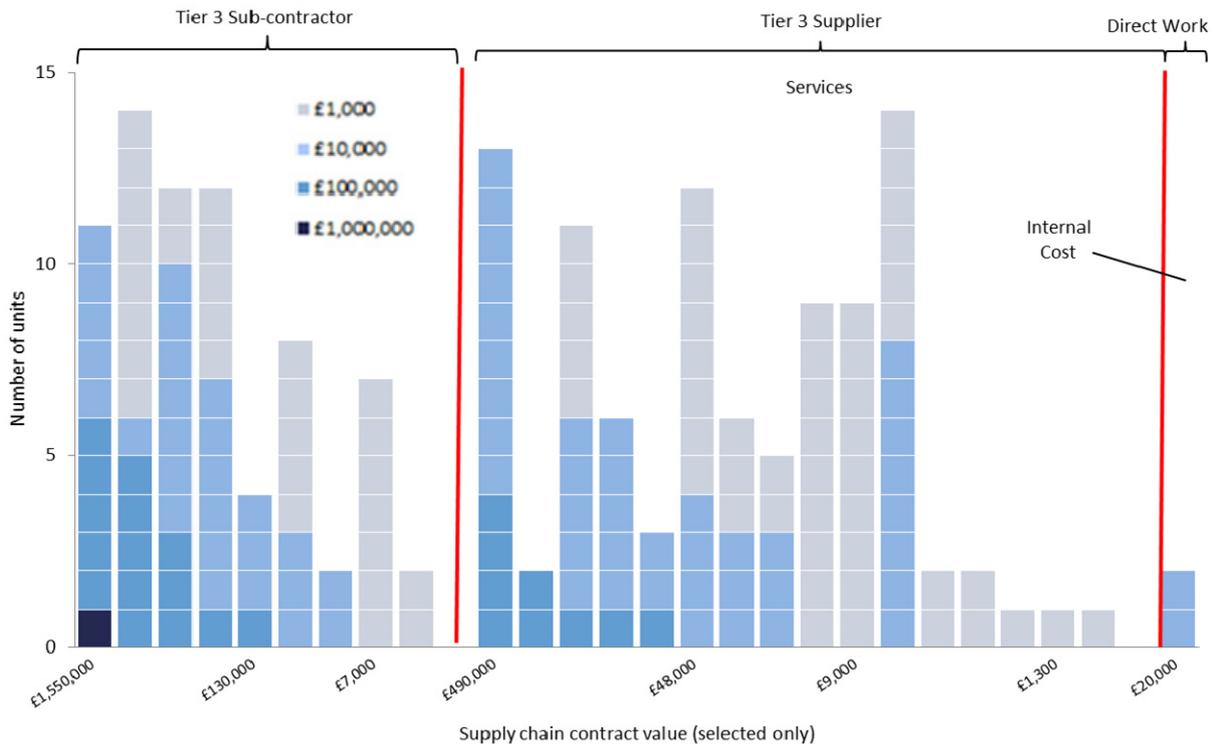
In this analysis, costs associated with labour and site management and preliminaries are all recorded as internal costs.

There are some large Tier 3 suppliers, focused on supply of concrete, reinforcement and formwork. Some of these supply chain members, concrete producers for example are larger businesses than the specialist contractors they service. This balance of supply chain influence suggests that the full benefits of economies of scale will already have been built into prices, and that specialist contractors are likely to be positioned as price takers – e.g. without sufficient commercial leverage to be able to influence overall price levels other than their enterprise specific discounts.

Tier 3 services suppliers are primarily focused on the provision of specialist plant. There are a large number of very small transactions in this segment. The total value of transactions for 31 of these plant suppliers which represent over half of the supply chain by number is under £1,000 each. Similarly, whilst there are a number of large material suppliers, there are also some 20 material suppliers with sub £1,000 transactions, totalling £7,000 in value.

Whilst these Tier 3 suppliers are unlikely to be procured on a project by project basis, the analysis shows that a high level of disaggregation of the supply chain means that site operations involve a very high degree of supplier coordination. This finding supports feedback from the structured interviews that emphasises the role of site management in the coordination of site operations and logistics.

The analysis of this supply chain also indicates that a high proportion of cost is related to sub-contracted plant and machinery. Some of this plant and machinery is self-delivered through subsidiary plant hire businesses. There are a number of reasons for this pattern of procurement, including taxation strategy, strength of balance sheet and so on. However, a highly fragmented plant supply industry, as evidenced by this single project may not be achieving optimum plant utilisation. Plant and equipment services account for over 30% of the costs of this Tier 2 structures contract, demonstrating that this is a significant area of expenditure where benefits might be secured through greater utilisation and efficiency in plant provision.

Figure 3.8: Project 3 - Structures Specialist Contractor

Source: EC Harris LLP

This Tier 2 sub-contract represents an integrated structure and external envelope package, including pre-finished external wall panels. By contrast with the supply chain from project 2, most of the work is undertaken off site by Tier 3 suppliers delivering relatively high value parcels of work.

We were not able to analyse the supply chain structure and costs of the 3rd Tier.

The key characteristics of the supply chain under analysis are:

- The relatively small number of participants in Tier 3 compared to other contracts;
- The relatively high value of the Tier 3 contracts;
- The greater degree of value-added off-site, related to a manufacturing process.

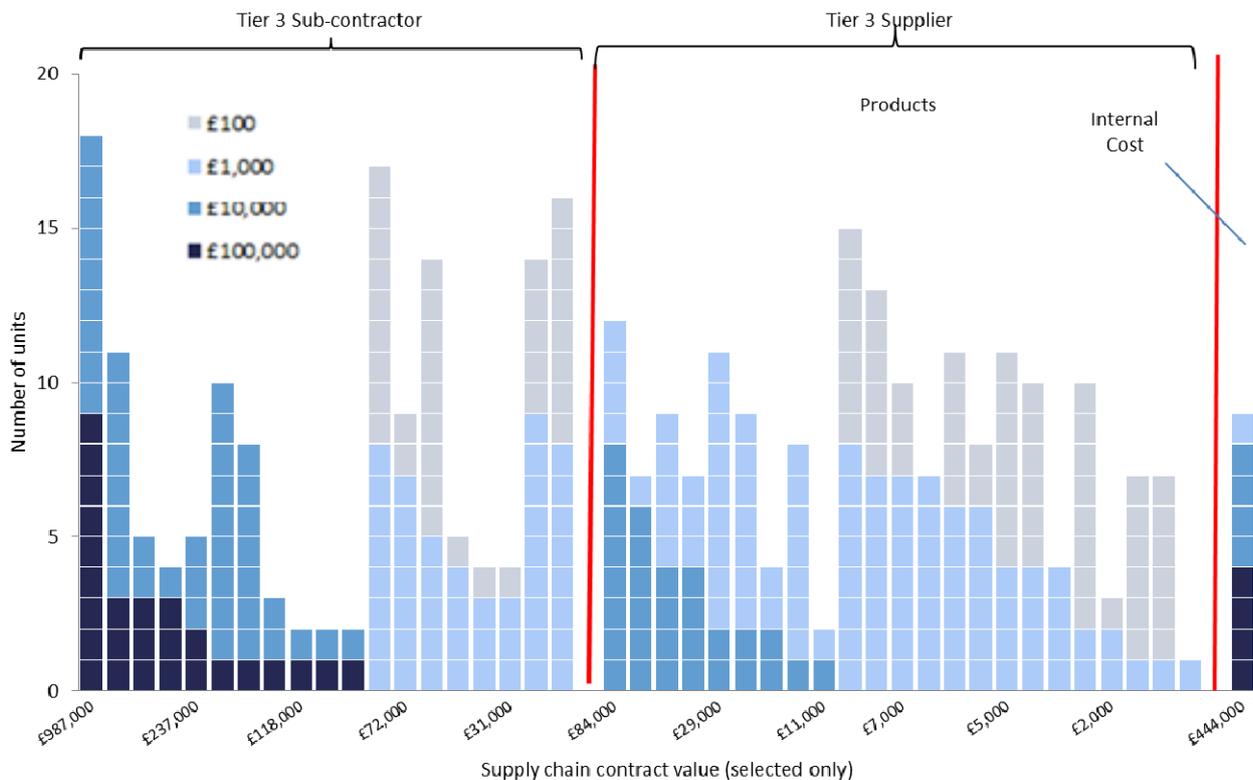
The analysis provides little visibility of the final supply chain below Tier 3, which could be as complex as the Tier 3 supply chain analysed for project 2. However, as components are assembled off site, the research team hypothesises that works will be easier to programme and that the integration of the inputs of lower tier suppliers has the potential to be organised in a more effective way. Furthermore, plant utilisation may also be higher as the result of greater standardisation around products.

The contrast between the structures supply chains for projects 2 and 3 is striking. Instinctively, the research team would expect the rationalised supply chain for project 3 to be the more efficient. However, we have no evidence to support this supposition. If, as

the evidence suggests, a large number of Tier 3 participants are involved in actual construction and assembly operations, then it is clearly better for this coordination to be undertaken as part of a factory supply chain based on repeated work processes. However, the pricing of in-situ construction has been shown to be highly responsive to supply and demand conditions. Furthermore, the costs of fixed plant and equipment are spread across a range of industry participants. The evidence gathered in this study cannot demonstrate whether in-situ or off-site approaches to delivery are the most cost and resource effective. However, we have shown that there are significant variations in the structure of the supply chains, which are more contrasted in terms of disaggregation than might have been expected.

Whether this variation is replicated across other in-situ and offsite contractors cannot be verified from the rest of the project sample.

Figure 3.9: Project 3 - Building Services Specialist Contractor



Source: EC Harris LLP

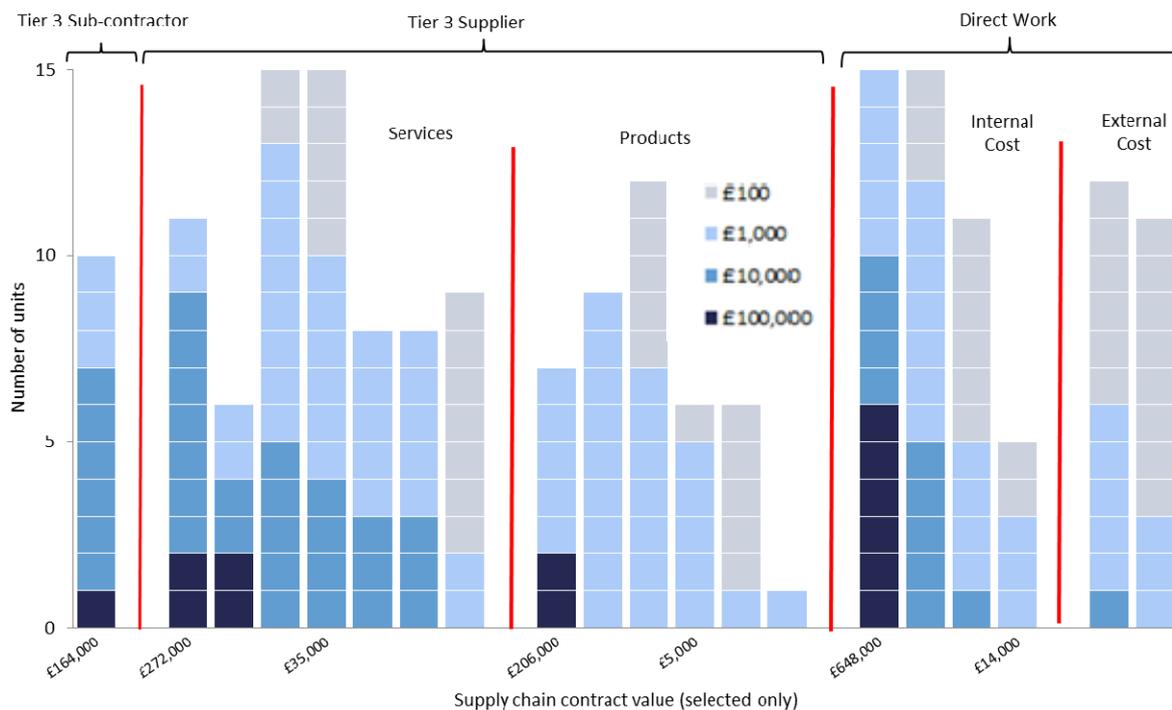
The Building Services installations on project 3 are self-delivered using a main contractor package management model. The analysis shows that whilst some direct buying of materials and equipment was undertaken by the main contractor, all of the installation work, including the coordination of the design, is delivered within the supply chain. Some of the packages, such as the electrical works, are large and are likely to involve extensive sub-contracting at Tier 3. However, some specialist packages which are usually procured as Tier 3, including lightning protection, data and the Building Management System (BMS) have been procured directly by the main contractor.

There are relatively few low value contracts at the Tier 3 level in this package, only one is for a sum under £1,000. A further 15 have a value under £10,000. This contrasts with a total of 85 sub £10,000 transactions associated with the structures supply chain. The low value items typically involve direct purchase of equipment from suppliers.

Self-delivery of packages such as building services should yield benefits associated with design and installation coordination together with potential savings associated with duplicate layers of overhead and profit on these works. Our working assumption is that contractors will aim to match the overhead and profit margin set by the sub-contract margin, but will not apply a duplicate margin on building services related to the main contractor role.

Whether the self-delivery route illustrated in this supply chain eliminates the duplication of management on-cost remains to be seen, and is likely to be driven by the setting of challenging target costs by the employer, rather than through conventional competition. We anticipate that main contractors will need to secure significant volumes of work in these specialist areas to be able to match the volumes of work undertaken by existing Tier 2 specialist building services integrators. These volume savings will be necessary to be able to pass supply chain aggregation savings back up to the client.

Figure 3.10: Project 4 - Structure Sub-contract



Source: EC Harris LLP

Data for this package suggests a lower level of supply chain disaggregation than the structures package on the commercial project. Specialist sub-contractors related to specialist post-tension technology are included in the supply chain – as well as material and plant suppliers. Not all packages are identified in the analysis. A sum of £85,000 was identified as miscellaneous materials and services, which could involve a large number of smaller value transactions.

The project involves elements of Modern Methods of Construction – particularly the construction of post tensioned floor slabs, an efficient form of construction where the strength of a thin floor slab is increased through the use of tensioned reinforcement bars. The supply chain is less extensive than other structures projects included in the analysis. This may be because not all packages have been identified.

The data does help to challenge conclusions drawn from extensive supply chains used to deliver other projects in the sample.

3.6 Supply chain analysis – overall conclusions

The analysis of the supply chain has confirmed the extent of the disaggregation of the construction supply chain. The headline findings of the analysis are:

- Main contractors (Tier 1) may access a project supply chain of over 40 sub-contractors and suppliers to deliver a typical £10 million plus contract;
- 50 to 75% of the value of the construction work in our sample was accounted for by 4 or 5 large, complex Tier 2 sub-contracts;
- The remaining project value is accounted for by smaller, simpler construction contracts at Tier 2, often related to finishes, and construction services;
- Complex Tier 2 sub-contracts are also highly disaggregated, typically featuring over 30 suppliers at Tier 3.

The current structure facilitates cost reduction through downward competitive pressure, which may not secure best value delivery through the coordination of activities on site.

A key insight from the analysis relates to the supply chains directly involved in the delivery of construction work, as opposed to the coordination of sub-contracts. The study featured two supply chains involved in actual construction. These are from projects 2 and 5, and are detailed in figures 3.7 and 3.6 respectively. They were the most complex and also involved the largest number of low value contracts – with a substantial number having a value under £1,000. In both cases, the bulk of the value of construction work was focused on large sub-contracts, so clearly where the aggregation of work is appropriate, then the opportunity is taken. However, the presence of a large ‘tail’ of small value suppliers, points to potential issues associated with opportunity costs to the industry associated with the coordination of a multitude of independently managed site operations and services.

The analysis demonstrates that there are a large number of individual participants on construction projects, all of which will be pursuing their own growth and profit strategies. Some of these sub-contractors are highly dependent on a small number of clients for most of their workload. Other suppliers, particularly in bulk materials markets such as in-situ concrete, will be larger than their clients, and could have more market power with respect to the setting of prices.

Another group of Tier 2 and 3 suppliers deliver relatively low value parcels of niche work on projects. There are a large number of these suppliers. However, they are insignificant

with respect to the proportion of the overall value of construction work delivered. These businesses are likely to rely on a very large client base on which to support a specialist business. In these instances, individual contractors will have less incentive to align with the needs of specific projects.

One challenge will be to align these different project participants to industry wide needs to cut costs and reduce project durations. The evidence from this project is that a considerable effort will be required to influence the actions of a wide number of participants.

Given the current depressed state of the market and high levels of competition currently observed in the supply chain, the immediate response to a recovery in workload is likely to be to strengthen margins and balance sheets to provide for expansion and investment. These findings set the foundations for the structured interviews, which focus in more detail on factors which improve performance in the supply chain.

4. Distribution of on-cost within the Supply Chain

This section of the report considers research findings related to the identification of layers of on-costs through the supply chain. Section 3 of this study has shown that for many aspects of construction work, there are likely to be at least three tiers of contractors involved in the management and delivery of the work. One of the team's research hypotheses is that as a result of these layers of sub-contract tiers, there is the potential for the duplication of profit, overhead and risk allowances across a highly fragmented project supply chain. If this proves to be the case, then the result will be high levels of management on-cost in addition to the basic costs of component manufacture and assembly.

For the purposes of the analysis the definition of on-cost is as follows:

- Addition for target profit – actual profit may vary as a result of the accuracy of estimates and the effectiveness of project delivery;
- Addition for overhead contribution – the proportion of business operating costs that are recovered indirectly from projects as a central charge rather than directly as a project cost;
- Addition for risk allowance – an up-front assessment of a contractors' potential risk exposure, taking into the risk transfer built into the contract and the characteristics of the project.

The setting of on-cost additions is subject to market conditions. On-costs tend to be priced more generously in rising markets. The context to the analysis presented in this report is that all of the projects included in the sample have been procured during the downturn. Most profit, overhead and risk allowances will have been subject to downward adjustment since 2008.

It is widely recognised that the construction industry is not currently generating sufficient return to cover costs and deliver a return. Measures of prices published by EC Harris²⁷ and others point to construction price reductions in excess of 20% since 2008. Furthermore, historic records show that construction prices rise after a downturn and in the long run increase at a premium to RPI. Research findings support this assessment of the current position of the industry. Taking into account that some projects were procured in 2008/9 and then put on hold, and other projects were procured more recently, we found projects where suppliers' margins were described as being under considerable pressure and others where returns were judged to be 'average'.

The implication for the Industrial Strategy is that there is likely to be an upward pressure on prices linked to on-costs when activity levels start to rise.

²⁷ The EC Harris tender price index reports that prices have fallen by 20% since peaking in first quarter 2008.

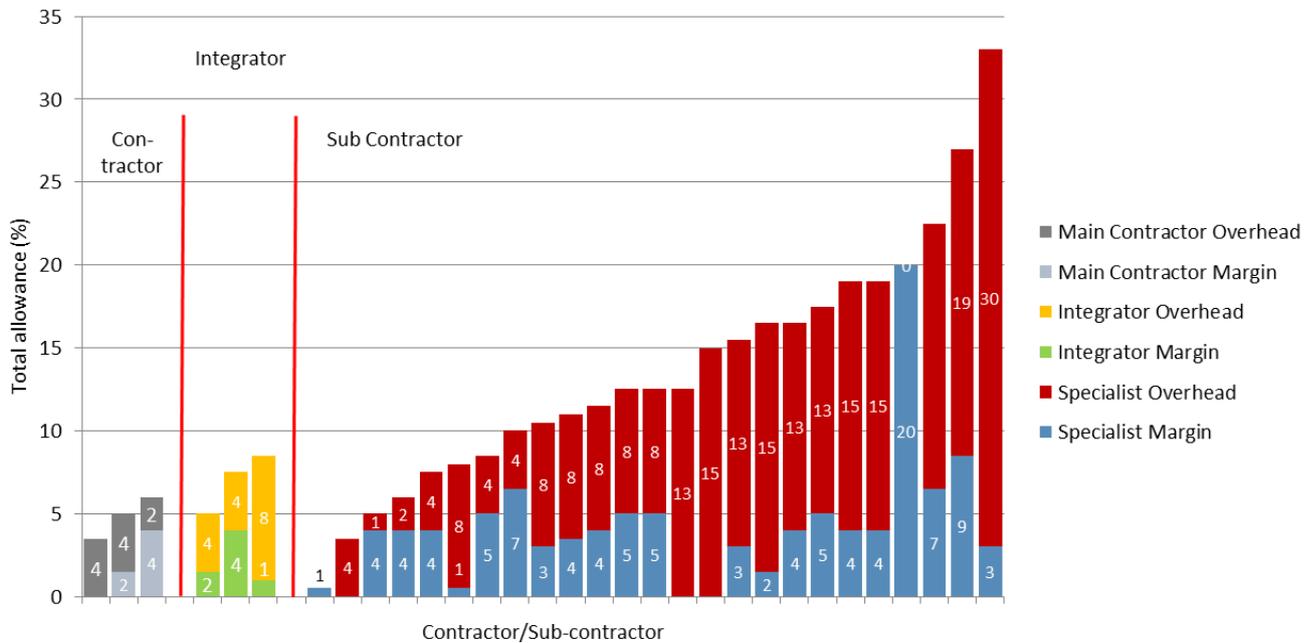
4.1 Analysis of contractor on-costs

As part of the structured interview process, we collected data on on-costs from 31 participants. All respondents provided information on margin and overhead. However, only 8 responded with details on risk allowances, which when priced as an addition to net costs typically range from 3 to 5%.

Figure 4.1 plots profit and overhead additions for a range of project participants:

- Main contractors (Tier 1)
- Integrator sub-contractors (Tier 2)
- Specialist sub-contractors (Tier 2)

Figure 4.1: Comparison of contractor and sub-contractor on-costs



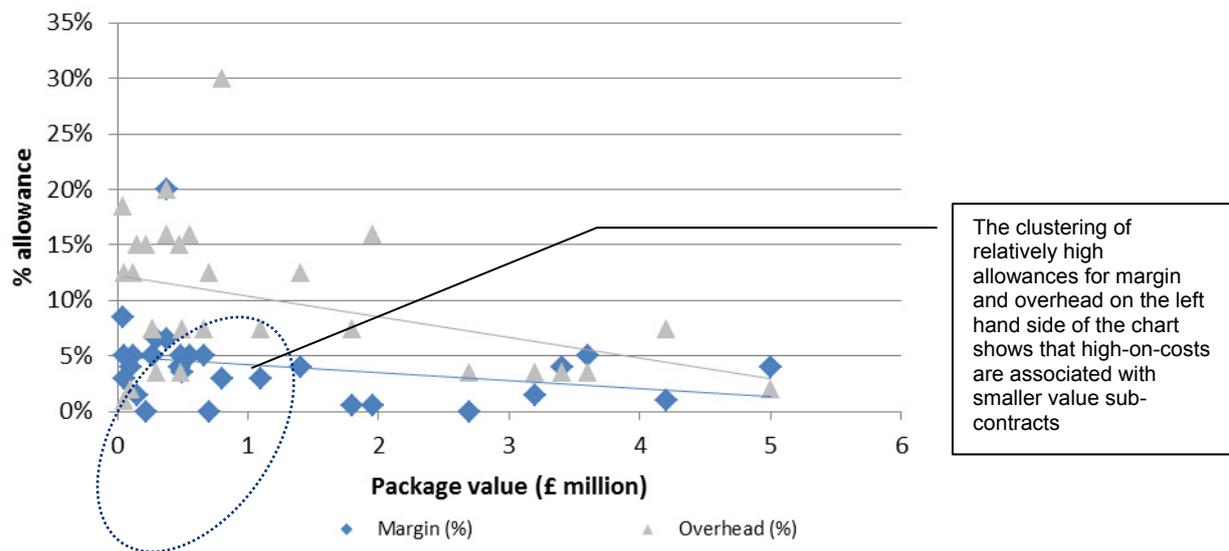
Source: EC Harris LLP

The analysis shows that main contractor and integrator margins are at the lower end of the scale. This partially reflects high levels of competition between general contractors, who are less able to differentiate by product or service quality than specialist contractors. Low initial margins amongst main contractors and integrators also however reflect an expectation that margins can be increased – either through the post-tender rebidding of sub-contracts or through provisions in contracts for recovery of costs associated with change. One implication of the expectations low margins amongst main contractors and integrators is that it ‘builds-in’ the need for high competition in the selection of lower supply chain tiers. Not all specialist contractor work can compete on the basis of product differentiation, and three Tier 2 contractors stated that they were working to 0% margins in the current market.

The specialist contractors included in this analysis are all Tier 2 suppliers. Overheads for this group range from 1% to 30%, with an average of 11%. The high level of overhead shown in figure 4.1 for a small number of contractors is associated with businesses with high fixed costs related to design and fabrication on relatively small value work – e.g. Architectural metalwork, AV systems etc.

We have compared package value and percentage additions for profit and overhead to assess the potential impact of high levels of on cost. Figure 4.2 plots on-cost additions against package value, together with linear trend lines, indicating an observed association between high on-cost percentages and relatively small package value in the current market.

Figure 4.2: Comparison on On-cost addition and package value



Source: EC Harris LLP

This analysis demonstrates that the proportion of high margin work found on construction projects is relatively low. However, it also should be noted that in the current market, levels of overhead have been depressed, and as a result, cost additions through margin recovery is a likely long-term inflation scenario. 80% of respondents described the on-cost levels recorded in the survey as 'average', implying that on-cost levels could increase from current levels.

4.2 Assessment of the impact of supply chain on-costs

Based on average levels of profit and overhead, the data presented in Figure 4.2 suggests the following composite on-cost ranges for profit and overhead are 'average' according to current market conditions:

- Main contractor (Tier 1) – 5 to 6%
- Integrator (Tier 2) – 6 to 7%
- Specialist contractor (Tier 2) – 12 to 13%

It should be noted that out of a sample of 31 respondents, four participants, most of whom are specialist contractors recorded pricing profit margins at 0%.

Based on a blend of main contractor costs, work delivered by integrator sub-contractors and work delivered by specialists, the total proportion of the costs of a construction project that is attributable to margin and overhead is likely to range from 17 to 20% on average²⁸. The share of on-cost attributable to the integrator level, where it could be argued that there is some duplication of margin and overhead is around 2%.

Our analysis shows that most contractors who have been interviewed continue to secure some margin and overhead, albeit at sub-optimal levels. On-costs secured outside of London and the South East are significantly lower, albeit our evidence base has in part been derived from frameworks which have protected reasonable margins.

The adoption of integrator roles by main contractors appears so far to have transferred on-costs to the main contractor, rather than to have reduced them. A reduction in overall on-costs may follow through the application of competitive pressure. In-house integrators are still winning work in competition with independent specialists – albeit the number of specialists is diminishing.

The evidence of high overheads in some specialist sub-contracts may justify further de-layering of industry structure – albeit there is also evidence that levels of management resource are being reduced to keep bids competitive whilst maintain profit and contribution. The analysis shows that high overhead costs are related mainly to smaller specialist subcontractors.

²⁸ This assessment is based on a blend of work whereby the main contractor recovers on-costs on 100% of net cost, integrators recover on-cost on 35% of net costs, and sub-contractors and suppliers recover on-cost on 90% of net cost. Suppliers' costs would be included in the main contractors' preliminaries addition, as well as the works of sub-contractors.

5. Structured interview analysis

5.1 Introduction to the analysis

The summary of the quantitative analysis of the findings of the structured interviews is summarised in Figure 5.1. This table reproduces the matrix of hypotheses that the interview team used to record the performance drivers that were mentioned most often during structured interviews.

The key for understanding the analysis is as follows:

1. The analysis is organised in a grid which sets out six research hypotheses described in section 5.2. The hypothesis for 'construction site management' for example is that site management activities will have a significant positive or negative impact on overall project outcomes. Quality of communication is identified as a dimension of effective site management performance – articulated as the opposing outcomes: good and poor quality communication.
2. In the analysis, we have focused on hypotheses which have attracted a relatively high level of recognition and agreement from respondents. The number of respondents that recognise a causal relationship with a positive or negative outcome is recorded in the matrix.
3. Clusters of positive and negative results are highlighted using coloured circles.

Construction site management
Quality of communication

Construction site management		
Quality of communication	H 27	L -

Red circles indicate a widely held perception of positive performance, whilst blue circles indicate a perception of negative performance.

Figure 5.1: Summary results and analysis of the structured interviews

Financial arrangements		Being selected		Selecting supplier		Design management		Construction site management		Price determination		Supply chain integration	
Fairness of payment terms	H 5 L -	Extent of repeat appointments	H 14 L -	Extent of repeat appointments	H 16 L -	Extent of formal design development	H 7 L -3	Quality of communication	H 27 L -	Realistic pricing	H 11 L -9	Extent of Vertical Integration	H - L -1
Certainty of payment	H 12 L -1	Selection by price or performance	H - L 1	Selection by price or performance	H - L 1	Extent of supply chain involvement in design development	H 17 L -2	Direct chain of command	H 9 L -1	Extent of Incentivisation	H 3 L -1	Extent of Standardisation	H - L -
Prompt payment	H 13 L -	Extent of early contractor involvement	H 19 L -1	Extent of early contractor involvement	H 3 L -2	Incentive to contribute to design	H 8 L -1	Management of Programme	H 12 L -7	Extent of risk exposure	H - L 1	Use of BIM	H - L -
		Competition vs direct appointment	H - L -	Competition vs direct appointment	H 1 L -	Extent of early contractor involvement	H 13 L -2	Management of Logistics	H 7 L -1	Competition vs. negotiation	H 4 L -	Extent of work with other Sub-Contractors	H 8 L -
						Completeness of design	H 8 L -12	Quality of team relationships	H 21 L -				
						Quality of Decision Making	H 6 L -6	Use of Performance Management	H 1 L -				

Source: EC Harris LLP

Detailed results related to each set of hypotheses are described in the following sections, dealing with each set of performance drivers in turn.

The analysis suggests that financial arrangements, the method of being selected for a project, design management and site management combine to have the greatest impact on project outcomes. By contrast, methods of selecting suppliers, approaches to price determination and the integration of the supply chain were picked out less often as drivers of performance.

These high level findings lead us to conclude that there is a close relationship between the disaggregated structure of the supply chain and the need for high quality management during the procurement and construction phases of a project. This places a premium on discretionary behaviours and inter-personnel skills.

5.2 Overview of the performance hypotheses

The following section of the report sets out more detailed findings from the structured interviews, organised by each performance hypothesis.

Hypothesis 1. Financial arrangements

Financial arrangements such as payment periods, retention funds and bonds introduce additional cost and limit industry capacity by tying up cash flow, placing margins at risk and by limiting a business' ability to grow through increased workload.

Key findings

- There is a widespread view amongst sub-contractors that payment performance is worsening and payments periods are being extended as a result of current market conditions;
- The payment performance of clients and main contractors affects the operating performance of sub-contractors;
- Payment delays reduce contractors' liquidity and in turn industry capacity and output;
- Uncertainty and delay in agreeing payments for changes increases risk to the supply chain;
- The practice of retention is reluctantly accepted but seen as a burden on cash flow and performance;
- Prompt payment performance builds trust and encourages flexibility in the supply chain;
- Poor payment performance disincentivises discretionary effort by the supply chain.

Table 5.1: Interview analysis – Hypothesis 1 - financial arrangements

	Rated as positive		Rated as negative	
	Count (nr)	Impact (nr)	Count (nr)	Impact (nr)
Fair and reasonableness use of retention and bonding	30	5	1	0
Certainty of payment	32	12	1	-1
Promptness of payment	35	13	0	0

Source: EC Harris LLP

The analysis is based on records of structured interviews. The count records the number of instances where interviewees described an aspect of the hypothesis as having a positive or negative causal relationship with project outcomes. The assessment of impact is the count of instances where the factor was considered to have a high positive or negative effect on performance. Only one instance per interviewee is recorded.

Overview

The analysis provides clear insight that payment issues are very important to supply chain members, and that positive behaviours drive better project outcomes. Almost all respondents mentioned payment related issues. There was a broad consensus that the timing and certainty of payment was a growing problem which affects performance. The results suggest that the perceived fairness of financial arrangements was seen by respondents to have less influence on performance than certainty and promptness of payment itself.

One insight gained from the interviews is the knock-on effect of payment performance on individual projects on the ability of a business to finance bids or expansion. Payment is a good example of an aspect of business behaviour that has a direct impact on the competitiveness of the industry, including the ability of sub-contractors to compete, win and expand.

Comments from interviewees emphasised that practice on our sample projects was significantly better than their experience of typical behaviours on projects. The data analysis shows that the sample projects were highly rated for fair and reasonable payment terms, and certainty and promptness of payment. Our understanding of certainty of payment is that it concerns valuation practice – such as being paid for variations – as well as the risk of employer failure. Certainty of payment was identified as an area where poor performance did trigger negative reactions from the supply chain.

In discussing payment practice, it is important to emphasise that we found a number of examples of flexible practice by main contractors, recognising the specific circumstances and cash flow positions of different sub-contractors. Examples included shorter payment periods for contractors with a direct labour force, higher frequency payments for SMEs

employed as part of a local employment support initiative, and support to sub-contractors that were known to be in short-term financial difficulty.

Detail of findings on financial arrangements

Retention and bonds

The practice of retention is to hold back a percentage of the value of work completed – in order to incentivise completion and the making good of defects. The practice of holding retention is written into most construction contracts and only a small number of clients have given up their rights to hold retention funds. Retention funds range from 3 to 5% of the value of completed work, and cascade from main contractor down the supply chain. Sums withheld by a contractor may differ from those withheld by the client. Half of the value of retention is paid on completion of work, and half is payable 6 months after the end of the contract rectification period. As well as a drain on cash-flow and a source of creditor risk, payment retention causes an administrative burden.

Most interviewees were resigned to the continuing use of retention and noted their impact on cash flow, particularly as most sub-contractors in the sample were self-financing and avoided bank borrowing. In the current market, the typical value of a retention fund – 3 to 5% - will exceed the target margin on a project, tying the money up during the construction and defects periods. The effect of retention is to reduce the cash available to fund sub-contractor businesses. As a result this practice constrains expansion.

No interviewee suggested that the cost of the retention was built as an extra into a bid price. However, industry commentary has suggested that the cost of retention can be built-in to the bid price in buoyant markets, when contractors and sub-contractors are motivated to move on to new work opportunities rather than spend time recovering outstanding monies.

Comments recorded from interviews included:

Sub-contractor: *“They’re the bane of my life. It hits cash flow and increases uncertainty.”*

Sub-contractor: *“You’re waiting a year to make your margin.”*

Sub-contractor: *“We can spend a lot of time chasing retention, which causes a headache”.*

No sub-contractors mentioned retention bonds as an alternative.

Very little comment was made with respect to performance bonds. They were mentioned by one main contractor who suggested that current market conditions were increasing their use – mainly due to the greater risk of sub-contractor insolvency.

Certainty of payment

Certainty of payment concerns the valuation of variations as well as the financial stability and credit risk of the immediate client.

Many of the concerns raised in interviews focused on the valuation of variations by main contractors. A common complaint was that the valuation of changes was left unresolved until the end of the project, when a subcontractor might be in a weaker bargaining position. Delay in the resolution of claims is a common practice across the industry involving clients, contractors and their consultant advisors. Contract provisions exist to encourage the agreement of costs in advance of the instruction of changes, and the findings of our survey underline the benefits gained from the certainty of agreed costs. Key issues identified by main contractors and sub-contractors involving payment certainty included:

- Scope of variations. Discussions concerning the scope of work and the extent of design responsibility associated with design and build procurement is a source of risk. This is an aspect of the 'cost of change' that we discuss elsewhere in the study
- The timing of the agreement of the valuation of change. The level of risk can increase as a project approaches completion, particularly if there has been a cost-overrun.
- Project profitability. Main contractor were described as being 'more sympathetic' to the valuation of variations when projects are profitable. As one roofing contractor observed: "When a main contractor has not made money on a project, it always becomes very apparent at Final Account stage – they just won't pay variations"

Certainty of payment associated with contractor solvency was also mentioned in interviews, albeit mostly in the context of the support provided to businesses struggling with cash-flow issues, through prompt payment by their immediate clients. An important and possibly overlooked benefit is a sub-contractor's willingness to respond more quickly to instructions when there was certainty of payment – mitigating potential delay.

Specific comments and insight on payment certainty included the following:

Sub-contractor: *"If you know you are going to get paid, you will respond to a variation quicker and go out of your way to help."*

Sub-contractor. An example of a subcontractor who "turned a blind eye" rather than discussing potential problems with a main contractor is a good example of the corrosive effect of bad payment practice. Missed opportunities to solve problems may have cost money, caused delay and introduced waste into other elements of the supply chain.

Prompt payment

Prompt payment was described in interviews as an enabler of goodwill and cooperation. Prompt payment is a hygiene factor and as a result, delayed payment inhibits good performance more than prompt payment incentivises improved performance.

Prompt payment is an important enabler of project performance but may not result in reduced waste or cost. However, prompt payment was seen by many subcontractors as a main contractor differentiator which influences the pricing of projects. Extended payment terms also reduce industry capacity. Many subcontractors interviewed said that they were unwilling or unable to work under extended payment terms because of the strains on cash flow and increased risk.

Little direct reference was made in interview to Project Bank Accounts (PBA), despite efforts to introduce them into the public sector. One specialist contractor acknowledged their role in providing greater certainty with respect to payment and cash-flow. Main contractors have observed that due to the effect on business models that rely on proactive management of cash, their prices may increase as the result of the widespread introduction of PBAs.

Certainty and promptness of payment is particularly important for regional contractors or sub-contractors that support a large direct labour force. There is currently a high level of awareness of late payment and the extension of payment terms – perhaps as a result of high profile actions by some main contractors.

Specific comments and insight on speed of payment included the following:

Sub-contractor: *“...the majority of money is going to pay wages weekly and so we must be paid on time. We have horrendous experiences on some contracts. This increases risk and wastes a huge amount of time chasing.”*

Sub-contractor: Unable to fund many jobs with long payment periods so had to decline opportunities.

Sub-contractor: Delayed payment or longer payment periods influenced performance, with one firm stating that it limited the labour resources allocated to a project to control cash flow.

Sub-contractor: Extended payment terms may be funded through the contract price, increasing the cost to the client. One sub contractor stated that it had increased prices by 3% to 4% in response to the extension of payment terms at the beginning of the recession in 2008/9.

Building Services specialist contractor: Careful management of subcontractors is required to mitigate the effects of wider cash-flow problems. The impacts on sub-contractor performance, including fluctuating labour levels, which create productivity problems on site. Problems associated with late payment may also cause delays in deliveries. The cause of the problem could be a completely different project.

Hypothesis 2. Selection of the supply chain

The selection of the supply chain concerns not only how suppliers are selected, but also how they select their own supply chain. Selection involves balancing competition and cooperation as means of developing best value solutions on behalf of clients. A key issue is whether price competition is needed to ensure best value, or whether a project team can deliver equivalent or better value by other means.

Key findings

- Early contractor engagement is seen as very positive for performance because it enables more supply chain involvement in solution development;
- Where subcontractors are selected in competition, they are wary of assisting main contractors with bids;
- The current application of single stage tendering to design and build projects limits supply chain involvement in solution development and may not deliver best value, even if it offers the lowest cost of entry;
- Regular engagement of contractors in the context of settled relationships is seen as positive because it facilitates effective site management and collaboration;
- Personal relationships and familiarity within teams still plays a strong role in supplier selection;
- In the current highly competitive market, price often trumps performance in winning bids;
- The re-bidding of packages by main contractors to drive down prices is having the effect of reducing lead-in times for sub-contractors once the work is awarded;
- Very high levels of competition in supplier selection are having a negative effect on established supply chain relationships, which are at risk of 'breaking down'.

Table 5.2: Interview analysis – Hypothesis 2a – Effect of Selection Method on Supplier

	Rated as positive		Rated as negative	
	Count (nr)	Impact (nr)	Count (nr)	Impact (nr)
Regularly selected	27	14	5	0
Price above performance	20	0	10	0
Early contractor involvement	25	19	4	-2
Highly competitive	15	0	4	0

Source: EC Harris LLP

Table 5.3: Interview analysis – Hypothesis 2b – Effect of Selection Method on Supplier's supply chain

	Rated as positive		Rated as negative	
	Count (nr)	Impact (nr)	Count (nr)	Impact (nr)
Regularly selected	18	16	0	0
Price above performance	7	0	1	-1
Early contractor involvement	3	3	1	0
Highly competitive	2	1	0	0

Source: EC Harris LLP

The analysis is based on records of structured interviews. The count records the number of instances where interviewees described an aspect of the hypothesis as having a positive or negative causal relationship with project outcomes. The assessment of impact is the count of instances where the factor was considered to have a high positive or negative effect on performance. Only one instance per interviewee is recorded.

Overview

The analysis of survey responses shows that both established relationships and early involvement in projects are enablers of high project performance. These practices also tend to be associated with reduced levels of competition. We have no evidence comparing the contribution to value generation of competitive and collaborative approaches to team selection, but there are clearly trade-offs between the two, such as the disincentive for a sub-contractor to support a main contractor in preparing a bid submission, when it is known that all work packages will be retendered once the project is secured. Interestingly, interviewees who saw a benefit in being selected on the basis of performance also recognised the role of performance in the selection of their own supply chain.

During discussions, most interviews made it plain that competition was fierce and that cost discipline in non-competitive situations was also high. The consensus was that clients expect prices to be very competitive, irrespective of the method of selection.

Evaluated purely on the basis of a quantitative analysis, early contractor involvement is perceived to be the strongest driver for improved performance. Furthermore, late selection was reported to have hampered the performance of two respondents.

Findings on regular selection within the supply chain indicate that this is a positive performance driver – also contributing to positive site management performance. Whilst the project sample may not be representative, interviews revealed considerable effort by team members to maintain stable relationships.

The interviews provided much evidence that methods of contractor selection were strained by current commercial pressures resulting from the downturn. Contractors at all levels of the supply chain described the erosion of perceived progress made after Latham and Egan, caused primarily by the cost reduction imperative that has dominated bidding behaviour since the beginning of the construction downturn in 2008. From sub-contractors, there was fairly widespread cynicism about how some main contractors are operating their supply chains and framework agreements. Given the extent to which price reductions have been pushed down the construction supply chain in the five years of the downturn, this finding is not surprising.

Detail of findings on methods of selection

Appointment as part of an established team

Both main contractors and subcontractors saw regular engagement with their immediate employer, as highly desirable and as beneficial to overall project performance, particularly as part of a long-term, trust-based relationship.

Claimed benefits of regular selection are derived from established relationships and include better and faster communication, more trust, shorter learning curve, quicker resolution of problems, more openness and a greater understanding of strengths and weaknesses within the team.

We were told that main contractors' project managers often sought to influence the choice of subcontractors to maintain continuity in project teams, as well as to influence the selection of personnel from winning subcontractors. The central role of project management and effective team relationships is discussed further in this report.

Specific comment and insight on the contribution of established teams included the following:

Main contractor: emphasising the importance placed on individual relationships: *“You will get a different performance from a different team, even within the same contractor – not just management, but negativity at any level has an impact.”*

Sub-contractor: On two projects most subcontractors felt that they were part of a select supply chain and viewed the main contractors as *preferred clients*.

Main contractors and sub-contractors. Ten respondents said that their selection was down to their performance rather than price, adding that this was beneficial to overall project performance.

Evidence of changing selection practice

Most interviews confirmed that price was the driving force behind selection in the current market. Many interviewees saw a shift in the balance between price and performance as being disruptive - *creating a downward spiral in prices*.

A common observation in interviews was that the benefits for main contractors of having a stable set of suppliers were being 'abused'. Examples of this included:

- Rebidding of sub-contracts when suppliers had contributed their name and expertise to the original main contract tender;
- Bidding outside of established supply chains to obtain highly competitive quotations based on a relatively low cost base, which challenge the prices received from preferred suppliers. These are sometimes termed 'rogue bids'.

There is clearly a tension here between the discipline of an open and contested market and the benefits of established, effective teams. We found plenty of evidence of sub-economic bidding which is likely to be at the expense of the health of the industry, project outcomes and team continuity. Main contractors in the survey were aware of the pitfalls but were also subject to commercial discipline.

We also found instances where public sector policies to promote local SME employment also disrupted established supply chains. For example, a contract may require a minimum level of local job creation or a commitment to use local contractors to deliver the work, requiring a contractor to employ resources from outside of their settled supply chain. These arrangements could also carry some financial risk for the supplier, particularly as the main contractor will typically have a powerful market position. *"This can be dangerous as small companies will often buy the work, especially on the first scheme for a big new client."*

Specific comments and insight on increased levels of competition included the following:

Specialist contractor: *"Businesses are not being able to make enough in the market to survive...Everyone I talk to wonders how long it can go on and how long can we survive"*.

Sub-contractor: *"Contractors are picking up jobs at low margins; bidders are fighting against the budget not competition."*

Early contractor involvement

Early contractor involvement concerns the formal or informal engagement of main contractor or specialist contractors in the development of design solutions. Designs developed with input from constructors, or with access to knowledge of proprietary solutions are likely to be more cost effective. However, programmes like Building Schools for the Future, have demonstrated that the combination of early contractor involvement in design and competitive selection can be wasteful and resource intensive if the selection process is not managed effectively. In the early waves of BSF, detailed proposals were developed by competing integrated supply chains in response to the specific needs of individual schools. These proposals were used as the basis for the award of contracts for a portfolio of work. The work of unsuccessful teams, including their design and construction solutions, was discarded as part of the procurement process. A simpler process has been adopted for the Priority Schools Programme.

The challenge is to find fair and effective means engaging supplier teams to develop and deliver cost effective solutions. Evidence from this study suggests that ‘cost-led’ procurement of main contractor-led programmes is currently being facilitated by high levels of competition within the sub-contractor supply chain. This ability to maintain price levels in line with a client’s affordability challenge may become more difficult to sustain as the industry recovers from downturn.

Survey results indicate that early contractor involvement is seen as an opportunity to enhance project performance at all levels of the supply chain. The literature review shows that this view is widely accepted, if not universally applied. The projects in the survey did feature high levels of early involvement. The schemes are high performing and not considered to be typical. Where contractors mentioned that they were engaged late two of the four said this had a negative impact on performance.

Benefits of early engagement that were mentioned in the survey included:

Main contractor: The opportunity to engage key suppliers with enough time to build relationships;

Specialist contractor: The time to value engineer solutions and enhance the programme for buildability;

Design consultant: Provides more time to resolve conflicts in the design.

Many participants noted that lead times were being reduced in the current market – reversing the early contractor involvement trend. Explanations included the rebidding of sub-contract work, and the impact of client-driven change.

Negotiation vs. competitive bidding

Four respondents had been directly selected. Two of these suggested that their direct selection had improved project performance. No participants suggested that competitive bidding had made a positive contribution. One of the benefits of the negotiation route was the opportunity to “....*open up dialogue and allowing you to price different options*”.

Main contractors observed that widespread use of single-stage tenders, often for design-build projects minimised the opportunity for negotiated deals with suppliers.

Hypothesis 3. Design management

Design management has a crucial role in unlocking improved project performance, by ensuring that design is complete and buildable, by unlocking supplier contributions to design development and through effective change management, avoiding the disruption of project delivery

Key findings

- Under-design and variations were seen as major blockers to project performance, causing disruption to the progress of the work, reducing efficiency, increasing site management workload and causing uncertainty with respect to payment;
- Incomplete design, design change and late variations lead to significant waste;
- Lead-in times available to check designs are being eroded by re-bidding of packages;
- Reduced levels of professional fees have reduced available design resource, which may in turn have affected the quality and reliability of initial designs. Some aspects of design particularly building services continue to suffer from content and coordination issues;
- Subcontractor engagement in detailed design supports improved project performance. However, opportunities are limited as a result of competition in supplier selection;
- Wider use of highly competitive selection is reducing the incentive for sub contractors to assist main contractors in solution development;
- Effective client decision-making and change management, including management of novated design consultants improves project performance;
- Evidence that the barriers to the implementation of change are not high enough to discourage high levels of change orders.

Table 5.4: Interview analysis – Hypothesis 3 – design management

	Rated as positive		Rated as negative	
	Count (nr)	Impact (nr)	Count (nr)	Impact (nr)
Formal design management	21	7	3	-3
S/C involved in DD solutions	23	17	5	-2
Incentive to contribute	10	8	7	-1
Early contractor involvement	22	13	3	-2
Deliverable design, few VOs	11	8	14	-12
Effective client decision making	7	6	7	-6

Source: EC Harris LLP

The analysis is based on records of structured interviews. The count records the number of instances where interviewees described an aspect of the hypothesis as having a positive or negative causal relationship with project outcomes. The assessment of impact is the count of instances where the factor was considered to have a high positive or negative effect on performance. Only one instance per interviewee is recorded.

Overview

Overall, results from the structured interviews provide an indication of the strength of supply chain opinion with regards to the contribution of design management to overall project performance.

The consensus of interviewees was that the sample projects benefitted from above par design management performance. Characteristics of good practice included formal design management practice and significant subcontractor involvement in detailed design. Even on well-run projects variations remain an issue, and we were given many examples of unnecessary costs or missed savings that resulted from changes to incomplete designs.

A striking aspect of discussions with the supply chain concerned the completeness of the design and the extent to which changes (VOs) might be needed. Given that these projects were procured on a design and build basis this suggests that whilst commercial risks associated with design might have been transferred, the risks themselves might not have been reduced or mitigated – potentially a source of waste.

Procurement options which encourage greater investment in design development – repeat projects or modular construction for example – may have a role in best value solutions.

As already discussed in connection with supplier selection, it is widely thought that early contractor involvement in design can contribute to improved project performance. Early involvement was common on the projects in our sample. However, we found that the use

of incentives to encourage engagement appears to be patchy and there was evidence that the potential contribution of some subcontractors has been overlooked.

The role of the ultimate client did not emerge as a significant issue for the supply chain, albeit it was recognised that intelligent and effective clients have a big influence on overall project performance.

Detail of findings on design management

Quality and completeness of design

Many subcontractors reported that the flow and accuracy of the information they received was poor. Poor quality information affects performance because operations cannot be efficiently planned, coordinated and scheduled.

Many respondents suggested that design was not fully resourced. One consultant suggested that: “Commercial pressures mean that gaps are forming in the scope (of design services)”. Gaps between the design produced by the consultants and the information needed by contractors caused coordination conflicts and wasted time. The same consultant stated, “we could have done more value engineering but there is not enough (time) in the budget. We could also design a more buildable solution.”

Examples of waste reported in the interviews included:

Reduced installation quality;

- avoidable design issues – in one case making up 40% of variation claims on a curtain wall sub-contract;
- sub-optimal sequencing of work, a concrete frame contractor suggested that on average at least 2% to 3% could be saved through early receipt of better quality information;
- late receipt of information and changes associated with building services. A masonry contractor commented that M&E never went well, and information was always late. Changes had cost 7% of package value and could have been 20% without mitigation.

We were given an example of a project where the cost of the structure could have been reduced by 25% through better quality information. Furthermore, we were also told that without the active mitigation of the effect of change by sub-contractors, costs would be even higher.

Earlier engagement of the supply chain

Earlier and more extensive engagement of subcontractors was seen as a very positive step towards improving project performance. Improvement could come from the avoidance of duplicated effort, adoption of value engineering ideas, improved coordination and buildability and the reduction of the number of design changes.

A good example of the potential benefits of early engagement and collaboration between consultant and contractor was a project where the structure of the lift core could have been designed to support a tower crane during construction at relatively little extra expense – improving access and reducing other temporary works costs. The option was not adopted because it was suggested by a subcontractor at too late a stage in the design process.

Few of the insights that came from discussions with the supply chains were new. If anything, our findings show that design management continues to be a challenge, even on more integrated projects where a contractor has overall responsibility for design and construction.

Key themes that emerged from the structured interviews are as follows:

- Effectiveness of the procurement of design and build projects. Issues included the ability of main contractors to fully consider potential value engineering options in a single-stage tender competition. Interviewees also mentioned conflict of loyalty issues associated with the novation of the design team, which in turn translate into tensions within the design and build team. These can also be interpreted as the tension between the guardianship of design intent and the delivery of cost effective construction.

Another issue associated with design and build was the compression of the overall design and construction programme. Some contractors noted that delays in main contractor appointment resulted in further reductions to overall project duration, which reduces the time available for design integration and value engineering “End-user clients are late in getting the main contractor on board and don't change the timescale for the start date. That knocks on throughout the project. We are seeing that more and more.”

- Split design responsibility. One M&E subcontractor stated that it is common to end up doing easily double the design/engineering work than was originally anticipated because of the exchange of information with ‘consultants who don't have the time or resource to respond effectively’. On building services, detailed design work is typically completed by sub- contractors. In this instance the sub-contractor would prefer to take total rather than partial design responsibility;
- Effectiveness of early sub-contractor involvement. Specialist contractors described resistance from novated designers to changes in design or specifications. One cladding contractor saved almost 10% through design changes, demonstrating the potential for a value engineering approach. Similar examples from building services emphasise the importance of timing: “If you are brought on late you get co-

ordination issues. You can't fit services in. They don't fit and you are reworking walls etcetera - that adds cost.”

Some specialists also believed that they could make a greater contribution to design development and value engineering. A good example was logistics which are not often considered at the design stage: “There are many opportunities to reduce costs that are missed because main contractors are not taking into account the logistics during construction.”

The effect of commercial practice on early contractor engagement

Early contractor engagement and sub-contractor involvement in design development were both identified by many respondents as drivers of enhanced performance. However, interviews identified the extent to which commercial practices such as single stage tendering and post-tender rebidding reduce opportunities for and the effectiveness of sub-contractor engagement.

Sub-contractors have often provided assistance on bids on the expectation that they will be awarded the work if the main contractor is successful. A number of subcontractors complained that they had invested in supporting tenders only to see the work rebid and won by other firms at lower prices. This practice is not sustainable and many specialists and subcontractors are very cautious about engaging in ECI without a firm commitment. The most likely outcome is a sub-optimal design solution.

The rebidding of work packages post-contract award to further reduce prices was a common explanation for reduced lead-in times.

Effective management of client change

The survey also revealed the contribution of clients to the incidence of change. Many complaints were made over the timing and management of the clients' decision making and their lack of understanding with respect to the impact of change.

Many subcontractors stated that they preferred to avoid variations even if full costs are recovered due to disruptions to the programme and wider knock-on effects. One concrete frame contractor noted. “Even if we make money out of change, it hits morale and affects the programme. The only way to make money is to do work efficiently.”

Another example of the indirect impact of change is the potential for the wider disruption to work sequencing. One flooring contractor noted: “Getting the floors in at the right time in the contract cycle is critical.....We need a clear run, otherwise we are scheduling (the) workforce inefficiently. Labour is about 20% of contract value, (low utilisation) could increase our labour cost by 50%”. This example shows how changes to the programme caused by variations affecting one trade can have a substantial and unintended impact on others.

Survey participants clearly recognised the impact on performance of late change, including waste and disruption to progress on site. However, there was a striking level of complacency amongst participants with respect to accepting change as part of the

process, even though many contractors claimed to make more money from straightforward projects without extensive change or claims. These findings were all the more striking given that projects in the sample were procured using design and build – which has some advantages with respect to increasing the main contractor’s control over design change.

Hypothesis 4. Construction site management

Effectiveness of site management has a very high impact on project performance as most of the integration and coordination of the supply chain is undertaken by the site team. The soft skills of site management teams are particularly important in creating an effective and cohesive team. The relationship between project performance and the abilities of one or two key individuals points to the importance of the ability to attract, train and retain management talent.

Key findings

- Good communication on site is seen as the most critical driver of performance, emphasising the importance of a manager’s ability to combine knowledge, experience and soft skills;
- There is a high dependence on the ability of the project manager drive high performance;
- Strong team relations also have a major positive impact on performance;
- A good project manager and good team spirit engender higher levels of discretionary effort;
- Personalities and personal behaviour have a high impact because they influence the commitment of suppliers on current projects and their interest and pricing behaviour on future projects;
- Good programming is critical to coordinate the activities of multiple suppliers and to accommodate the results of change;
- Effective application of soft skills is viewed as being critical in driving high levels of project performance;
- Extended lead-in times on projects provide more time to build good project team relationships.

Table 5.5: Interview analysis – Hypothesis 4 – Construction site management

	Rated as positive		Rated as negative	
	Count (nr)	Impact (nr)	Count (nr)	Impact (nr)
Good communication	31	27	1	0
Clear chain of command	21	9	2	-1
Well managed critical path	21	12	11	-7
Good site logistics	17	7	7	-1
Strong team relationships	26	21	1	0
Good benchmarking	6	1	1	0

Source: EC Harris LLP

The analysis is based on records of structured interviews. The count records the number of instances where interviewees described an aspect of the hypothesis as having a positive or negative causal relationship with project outcomes. The assessment of impact is the count of instances where the factor was considered to have a high positive or negative effect on performance. Only one instance per interviewee is recorded.

Overview

The most striking result from structured interviews was the level of unanimity with regards to the positive impact of good on-site communication on project performance.

Respondents emphasised that positive behaviours on site were critical to good project performance. Interviewees placed a very high level of importance on the quality of the project manager and site manager.

Interviewees told us that the key to improving project performance was good team relationships and communication. This emphasises the widely held view that construction is a people business – a point of view that sometimes gets missed in industry strategies and improvement initiatives.

With respect to both good team relationships and quality of communication, our case study projects were rated very highly.

With respect to ‘hard’ site management process as opposed to soft skills such as effective communication, programming was ranked highly, particularly as a poor scheduling can have a direct impact on progress and resource utilisation.

Other aspects of best practice management, including effective site logistics and benchmarking were rated fairly lowly as performance improvers. This suggests that management practice is at a low level of maturity and that there is likely to be plenty of potential for further improvement. 15 years after the publication of the Egan Report, these areas of best practice continue to have a relatively low profile in the industry, suggesting a slow rate of adoption of innovation.

Detail of findings on construction site management

Significance of the quality of relationships on project outcomes

Throughout the interviews, respondents highlighted trust, firm-but-fair decision making, understanding, listening and many other “soft skills” as very important attributes for the site team.

Significant emphasis was placed on team spirit, good communication and fair minded management on site. Most interviewees saw the project or site manager as the orchestrator of good behaviour and good relationships on site. *“Trust has the single largest effect on performance on site,”* said one main contractor.

One of the clear benefits of good relationships on site we found from the survey was evidence that subcontractors were more prepared, where trust was established, to resolve issues between themselves. This led to swifter resolution and less pressure on the main contractor’s management team

“When you look back in on a job that is a bad job and think what you could have done differently, you more often than not find you could have got over some behavioural or relationship issues earlier,” said one main contractor.

Effect of site management on commercial outcomes

Interviews provided evidence that project managers have some discretion in picking teams. Arrangements were described where key individuals or teams from subcontractors would be allocated to work with a particular project manager: *“Every PM has his favourite subbies,”* as one M&E commented. This behaviour is very important in creating the continuity of established teams described in connection with selection.

The quality of relationships with project and site managers was described as having an influence on the pricing of work. Many subcontractors said they adjusted the price of projects where they did not trust the project manager.

One groundworks contractor said that he would add a 20% premium to a sub-contract price on projects where he didn’t trust the project manager. Part of the motivation was to avoid winning the work. This feedback is an indictment of an industry where healthy competition is important, and where clients and contractors are both seeking early cost certainty.

More positively, project managers were associated with positive project outcomes - *“you know you will make money with him”*.

Variability of site management skills

Interviews respondents portrayed an ideal project manager as someone with a high level of both soft and hard management skills and a clear understanding of the building process derived from practical experience.

The sub-contractors' comment on the 'pricing' of project management performance points a degree of variability in the skills and the performance of project managers and site managers.

Recognising the contribution of an individual's personality, a main contractor stated that good attitudes and performance can be fostered by contractors through effective recruitment and skills development. His company's policy was to seek people with high aspiration and collaborative attitudes.

Importance of programming and site management processes

While soft skills were seen to be highly valued, hard skills were also deemed critical to project performance. The analysis found that the effective management of the programme was perceived as one of the most important factors driving performance. Many of the trades emphasised the need to have programmes that allow them a clear run at their work.

Given the number of trades and suppliers involved, the potential impact of variations and the inevitable problems that occur on site, the ability to programme to optimise the use of sub-contractor resource is an important enabler of effective performance and elimination of waste. For sub-contractors, the most important aspect of work sequencing was to be given clear, uninterrupted access to their area of work. Programming which results in discontinuous working is clearly uneconomic. The project management skills involved are not limited to programming, as they also rely on ensuring that contractors adhere to their original programme allocation.

Other aspects of process that drive improved performance include rapid turnaround of Requests for Information (RFIs), effective reporting and the effective use of meeting time.

Programming provides a good illustration of how hard and soft skills need to be blended to enable effective project delivery. Programming is a technical skill which relies on effective reporting of progress and experience to understand how trades coordinate with one another. This technical skill has to be combined with the management capability necessary to ensure that separate contractors are motivated to complete their work to schedule, that problems are anticipated and that the full impact of changes are understood, and if necessary, mitigated.

Hypothesis 5. Price determination

A key aspect of industry performance is cost effectiveness. Structured interviews indicated that a high level of price competition is being applied as a result of current market conditions. The price determination hypothesis is that work has to be priced realistically to drive effective project performance. The challenge for suppliers is whether the ‘realistic price’ meets the affordability constraints of the client. If high levels of competition are the only means of meeting the clients’ affordability criteria, then under-pricing will continue to be a challenge. Other means of meeting affordability criteria need to be strengthened so that there is less dependence on highly competitive price determination.

Key findings

- ‘Realistic’ price levels are seen to be a positive contributor to project performance;
- Under pricing is seen as having a negative effect on project performance;
- Negotiated contracts are rare in the current market;
- Eagerness to work with a client and overall levels of demand are the strongest determinants of the overall level of pricing relative to input costs;
- Some subcontractors will alter pricing depending on the project manager.

Table 5.6: Interview analysis – Hypothesis 5 – Price determination

	Rated as positive		Rated as negative	
	Count (nr)	Impact (nr)	Count (nr)	Impact (nr)
Priced realistically	21	11	12	-8
Highly incentivised	3	3	15	-1
High risk	3	0	14	0
Negotiated	5	4	13	0

Source: EC Harris LLP

The analysis is based on records of structured interviews. The count records the number of instances where interviewees described an aspect of the hypothesis as having a positive or negative causal relationship with project outcomes. The assessment of impact is the count of instances where the factor was considered to have a high positive or negative effect on performance. Only one instance per interviewee is recorded.

Overview

Findings on price determination need to be interpreted carefully relative to current market conditions. The projects featured in the sample will have been procured in 2010-2011 or earlier, which may mean that price levels were higher than in the current market, or that there were opportunities to secure savings through sub sub-contractors and suppliers.

The majority of firms interviewed for the study believed they priced realistically and that this was an important dimension of project performance. This finding is possibly surprising given the duration of the recession but it should be noted that firms were commenting on price levels in recently completed projects, rather than projects that have been secured at the absolute depth of the recession. Where firms said they had not price realistically, then a higher proportion, eight out of 12, believed this was detrimental to overall performance. Notwithstanding 'realistic pricing', overall pricing of projects continues to be very competitive. Interviewees told us that in many cases work has been undertaken at a loss. These are not isolated instances. Sub-economic bidding has occurred over an extended period of time, with a corresponding effect on the ability of some firms to trade.

In the survey, we examined in more detail the process and drivers behind pricing decisions. This examination is closely linked to the study objective related to cost reduction within the supply chain. A number of interviewees said either directly or by implication that their pricing decisions were in large part a judgement call, related in particular to levels of available work and the attraction of the client as a source of future work. This has implications for future price levels as previous patterns of inflation could occur as layers of suppliers and subcontractors take their cues from the market.

The questionnaire data shows that the level of workload is a major factor influencing pricing. Discussions with interviewees indicated that market conditions were much tougher in the regions than in London. Albeit on a small sample, this finding was supported by the questionnaire results which showed contracting firms working in the regions weighted the level of workload as a more important determinant of price.

The questionnaire data also reveals a high level of eagerness to work with certain clients. Interviewees frequently mentioned that they had priced very keenly or accepted less favourable terms to win work and build a relationship with a client, be they the ultimate client or a main contractor.

The questionnaire data shows that risk is considered to have a strong influence over contractors' determination of the final price. Perception of relative risk could result in projects being priced more or less competitively. We found plenty of evidence through commentary in the interviews that some firms are not pricing for risk in their bids given current, highly competitive market conditions.

Factors influencing decision making on the level of pricing are detailed in table 5.7 below.

Table 5.7: Questionnaire data: Factors influencing pricing

	Strong	Medium	Weak	Weighted score
Eagerness to work with the client	22	9	2	173
Level of workload	17	14	2	159
Level of project risk	12	16	4	133
Number of firms competing for the work	8	10	13	82
Uncertainty over sub-contractor/supplier availability	1	8	23	26
Cost of borrowing or access to finance	3	1	27	18

Source: EC Harris LLP

Interviewees were asked to rank the importance of the above factors in influencing them to increase or reduce their pricing. The categories used for ranking were strong, medium or weak/no influence. The response numbers are shown under the appropriate headings. In addition a weighted score is provided. The scoring is based on strong=2, medium =1 and weak=0. The results for each project are then weighted according to the average score for that project before a simple average is taken of all five projects, to provide the weighted score.

Pre-interview questionnaires included a section on factors which influenced decisions with respect to the level of pricing on projects. The objective of this line of questioning was to gain a greater understanding of the dynamics of price determination with a view to how this could affect the delivery of sustained reductions in construction costs in the UK. The factors discussed exclude input costs such as labour and materials, as the focus is on the pricing of margin, overhead and risk allowances.

The results of the surveys, completed by 33 respondents identified three main drivers of variability in pricing:

- the power and attraction of the immediate client,
- the perception of project risk; and
- availability of work.

The influence of the client in decisions related to pricing levels is an important insight, as it aligns with wider client thinking around supply chain management and buying power through category management. The implication is that client focus on a relatively small number of supply chains will influence pricing through a combination of dependency for work, expectations around repeat work and a greater understanding of the client's business drivers. An interesting example of this effect came from a main contractor discussing open book pricing with a knowledgeable client. The contractor explained that if the client and the supply chain both understand how much a facility should cost, then

suppliers should be able to focus delivering solutions which both meet the performance target and deliver a reasonable margin.

The availability of work is an obvious factor. With work in short supply, clients are clearly benefitting from very competitive pricing. However, in most instances, affordability levels have also been recalibrated, meaning that low costs are an essential contributor to project viability. The importance of the client relationship will be in helping to mitigate upward price pressure transfer once markets begin to recover. Consolidation of workload will be important in this regard, as there must be sufficient continuous workload to sustain an alignment of commercial interest between contractor and client.

Finally, the pricing of risk represents a risk to both sides of the pricing equation. Current market conditions permit the transfer of high levels of risk at a low cost. As workload increases, this balance is likely to shift, with suppliers pricing risk on a more commercial basis – as well as seeking a change in the balance of allocation. Clients and main contractors will need to manage this transition effectively to minimise the effect of risk premium pricing on overall project costs

Detail of findings on price determination

Pricing behaviour in the current market

During many interview discussions pricing was presented as a combination of the calculation of expected costs and the business decision around expected benefits and the anticipated level of competition. The business decision is often based on instinct and experience. In the words of one main contractor, price determination is *“a judgement call taken on a case-by-case basis....based on experience”*.

A roofing contractor described the process as: *“We adjudicate on final price and take a view in order to win the work.”*

We also found evidence of the impact of information quality on pricing decisions and associated risk. For example, price levels established in an original bid document may disadvantage the supplier with respect to the recovery of the cost of variations at a later stage in the project.

An example given by a ground works contractor illustrates the problem, where the scope of work changed as the result of design changes, but the existing rates were applied, resulting in a loss. *“We found ourselves pricing the wrong document. There was a lack of information. Descriptions (of work) tend to be loose...there’s always ambiguity in description. That requires a pragmatic approach from both sides to (the application of) rates. On this job we priced keenly and took a hit on rates further down the line.”*

In this example, poor quality information increased the uncertainty over pricing and resulted in a poor commercial outcome. Better quality information would result in a better outcome – and perhaps better decision making relating to changes in scope.

Given a perceived need for a flexible and pragmatic approach to pricing, many subcontractors said they factored in considerations with regards to the contractor’s site

team when they priced for work. The range of these discounts or additions varied widely, but was substantial. As discussed previously, premiums were sometimes applied to reduce the likelihood of winning the work.

Current price levels and their impact on business strategy

Most of the firms interviewed rated both their margins and overheads for the case study projects as average compared to their own business norms at the time of bidding, with a quarter rating margins as lower than average. A small number also rated their overheads as being lower than average.

To some degree, the analysis of data from the case study projects conflicts with the impression given in structured interviews, which reflected wider market conditions. The most commonly used phrase used in interview to describe pricing levels was “keen”. Firms were prepared to state that on projects they were discounting their margin to win work to cover overhead costs. In other cases, there was evidence of work being bought at a loss – which potentially necessitates the rebidding of supply contracts and so on.

The implications of highly competitive pricing behaviour for the ability of the industry to deliver truly cost effective construction are potentially significant and include the following:

- Risk is not being fully priced in tender submissions. This means that current cost levels are not commercially sustainable, and the supply chain are potentially exposed to significant financial risks, on which no return is being secured;
- Rebidding on sub-economic projects adds cost to the supply chain, reduces the early contractor involvement window and erodes cooperation in future bids;
- Contractors are not making sufficient returns to re-invest in the business. We found evidence of weakening balance sheets, falling investment levels and depleted levels of cash in businesses.

Examples of the impact of current price levels on business performance and stability included the following:

Specialist contractor with manufacturing capability: “Capital investment is not being supported by price. Looking back on it I wished I had shut the business down four years ago and gone on holiday..... that is how much it has cost us to stay in business.”

Main contractor support to sub-contractors with cash-flow issues: Smaller contractors with cash-flow problems tend to reduce site resources. We were given examples where lower tier subcontractors were being supported by main contractors with favourable payment terms to ensure they maintained their workflow.

Weakening balance sheets. Most of the businesses interviewed were self-financing and fund losses from reserves. Whilst company balance sheets had strengthened prior to 2008, they were now being weakened as a result of a drawdown on resources.

Hypothesis 6. Supply chain integration

Greater integration of the supply chain is considered to be an effective means of reducing cost and eliminating waste. Better coordination of activity would be expected to reduce duplication of activity and could increase the sharing and effective use of resources. Integration should lead to more effective coordination of activity. In addition to increased horizontal integration of suppliers, vertical integration could potentially see layers of management cost and overhead eliminated from project costs.

Key findings

- Stable teams are seen to enhance performance;
- Little spontaneous mention of BIM and no adoption on the case study projects;
- Evidence of some vertical integration, with main contractors taking on the building services integrator role;
- Growing cynicism amongst sub-contractors with regards to supply chain integration.

Table 5.8: Interview analysis – Hypothesis 6 analysis – Effect of Supply Chain Integration of Project Performance

	Rated as positive		Rated as negative	
	Count (nr)	Impact (nr)	Count (nr)	Impact (nr)
High vertical integration	2	0	14	-1
Highly standardised	3	0	14	-1
BIM	0	0	13	0
Work regularly with other teams	12	9	2	0

Source: EC Harris LLP

The analysis is based on records of structured interviews. The count records the number of instances where interviewees described an aspect of the hypothesis as having a positive or negative causal relationship with project outcomes. The assessment of impact is the count of instances where the factor was considered to have a high positive or negative effect on performance. Only one instance per interviewee is recorded.

Overview

The supply chains examined are typical for the UK with a high degree of subcontracting.

Three of the projects featured elements of direct delivery of construction work including ground works.

The results of the analysis show a very low level of awareness of formal integration such as standardised project processes. Some respondents did refer to the benefits of working regularly with other teams, albeit more reported the benefit of being regularly selected by their clients. Nine out of the 12 interviewees who mentioned regular work with teams said that it was beneficial to project performance.

On three out of five projects we saw evidence of greater vertical integration, with the main contractor taking responsibility for the management of building services, replacing the specialist M&E contractor/integrator. This is an accelerating trend.

Interview findings suggest that few participants see supply chain integration or fragmentation of the supply chains as an influencer on performance. Interestingly, given the current profile of BIM (Building Information Modelling), there was little spontaneous mention of BIM on projects. In some cases interviewees mentioned the absence of BIM rather than its presence, albeit within a context where BIM is in use.

The whole industry should take note that cynicism surrounding the application of supply chain management and integration in construction may be growing. On more than one occasion we were told that the Egan and Latham principles no longer applied to the industry.

Detail of findings on supply chain integration

Extent of sub-contracting

The level of sub-contracting on the case study projects was considered normal and was not perceived to be a cause of good or bad performance. The large number of contractual interfaces involved is also considered normal. Paradoxically, on one project which featured an off-site manufactured structure and envelope solution, integration issues became more complex, even though the number of trades was reduced, because design issues such as the positioning of socket outlets and other services needed to be fixed at an earlier stage on a project than normal. Clearly as the team's understanding of these disciplines increased, further performance gains could be secured.

The most important aspect of supply chain integration in the eyes of the interviewees was the stability and continuity of site teams. Many of the interviewees said that project performance was improved by teams working together regularly. Main contractors described effective teamwork as the foundation of successful project delivery.

The value of stability and continuity in support of good teamwork is clearly recognised by site management. We found evidence, mentioned under construction site management, that project managers often seek to keep teams together either by influencing the selection

process or by requesting key personnel from subcontractors which have successfully bid for work.

This finding has important implications for the strategic procurement of repeat work on a serial basis – demonstrating that there are additional benefits to be gained from repeat work other than buying power.

The benefits of stable project teams supported by repeat workload are well rehearsed and were mentioned often by the interviewees. These include common processes and jargon, lessons learned, shorter learning curves; faster team building, greater levels of trust and cooperation, effective collective problem solving and a reduction in the risk of conflict.

Evidence of vertical integration

The main instances of vertical integration found in connection with sample projects involved management of building services, together with the use of direct labour on high risk areas like ground-works where there are potential benefits to be gained from a higher level of control and risk management.

The motivation to integrate building services is complex. Firstly, there is the opportunity to reduce cost and increase access to margin. Secondly, the ability to risk manage delivery of a highly complex area of work is increased. Other benefits of the integration include earlier engagement in the design and coordination process. The vertical integration of building services is an accelerating trend, and some M&E specialist integrators contractors have withdrawn from the UK market during 2013.

The effectiveness and permanence of this realignment of the supply chain will continue to be tested. In particular, the risk reward balance will need to favour the main contractor for the vertically integrated model to become widely established. Furthermore, some clients may still want to appoint specialists contractors to this role.

One specialist building services contractor who was unsurprisingly sceptical focused on the business challenges involved, questioning whether main contractors had overestimated potential gains from the vertical integration, and whether a complete assessment had been made of the skills and resources required, and risks associated with the delivery of a portfolio of projects of varying complexity.

The other aspect of vertical integration found in the survey related to direct employment of construction operatives, which we saw on three projects. On the regional project studied, the main contractor maintains a high level of direct employment and trains its own apprentices. It also has a vertically integrated building services delivery capability. Despite the extensive in-house capability, the contractor maintains and utilises a large database of suppliers.

This firm's managing director was committed to the use of direct labour because it led to better quality of work and better communications on site. This contractor secured a high volume of work via public sector frameworks and their approach to employment aligned with the values of the public sector client. The MD recognised the value proposition

despite the higher cost of the direct employment strategy, potentially limiting the firm's flexibility when bidding in competitive situations.

Other aspects of supply chain integration

Findings from the structured interviews reinforce our view that the construction industry focuses on day to day issues of project management and coordination – which are effectively transacted through personal relationships and the effective operation of settled teams.

The low perceived value of other aspects of supply chain management and integration is an important issue as it provides a clear indication of the erosion of initiatives designed to drive efficiency and life time value for the client.

Key findings which came out of these discussions included:

- A widespread perception that the supply chain has been 'abused' in response to tough market conditions – examples of behaviour include rebidding work, extended payment and so on;
- Extensive use of cheapest price procurement, particularly at Tier 3 and below – including the use of sub-contractors from outside of frameworks to challenge the price levels of preferred suppliers;
- A perceived increase in 'me-first' behaviour by sub-contractors which affects the level of collaboration on projects;
- A reduction in levels of motivation of sub-contractors to assist in solution development and bidding;

Both implicitly and explicitly many interviewees stated that the approaches to project delivery developed in response to the Latham and Egan reports were in retreat. Some in effect said, to paraphrase, "*Egan is dead*". Cynicism over the notion of supply chain integration was very evident during interviews with sub-contractors.

One finding, which surprised the team, was the near absence of any spontaneous mention of BIM by either contractors or sub-contractors. Given that the projects in the study were unlikely to use BIM will inevitably have lowered the profile of new ways of working in the minds of the interviewees. BIM was only referenced twice when interviewees were asked directly about potential improvers of project performance. No other form of information technology was mentioned during interviews. Our conclusion, at least at this stage, must be that BIM is not at the front of mind of many supply chain participants.

6. Analysis - key themes emerging from the supply chain survey

The quantitative analysis of survey data provides a comprehensive overview of discrete issues identified by survey participants as having the greatest potential impact on project performance.

These factors include:

- Certainty and promptness of payment;
- Early contractor engagement, including involvement in design development;
- Regular selection by and repeat workload for the immediate client
- Formal design management practice;
- Good quality communication;
- Strong, positive team working relationships;
- A well-managed project programme and construction sequence;
- Realistic pricing of well-defined work;
- Regular working within settled teams.

As well as having a direct effect on project outcomes, these factors interact in a complex way to either inhibit or promote project performance, depending in part on circumstance and conditions.

Given the complexity of the supply chains that we have analysed as part of the project, the implication for Industrial Strategy is that levers for project performance will be subject to a range of contradictory, cross-cutting influences.

This section of the report seeks to identify and consider the impact of cross-cutting themes that have emerged from the survey. We consider how various factors and circumstances interact to influence project performance. The analysis has been prepared by drawing on the results of the structured interviews, by reflecting on the range of opinion encountered and by applying the aggregation of results presented in the survey grid.

In this analysis, we have focused on five broad themes:

- Effect of behaviours and soft skills;
- Management of change;
- Certainty of outcome and risk transfer;
- Effect of demand and market conditions;
- Waste.

6.1 Effect of behaviours and soft skills

Project managers are central to project delivery and there needs to be more focus on their skills development as part of a wider performance improvement agenda.

Defining the issue

Interviewees rated behavioural issues within project teams as a very important positive improvement driver. Interviewees identified the contractor's project manager as having a key role in positively influencing these behaviours. The Industrial Strategy should focus on attracting, developing and retaining premium management skills to drive performance improvement.

Interviewees also said there was a high degree of inconsistency in management approaches from project to project and company to company and a wide variance in the competence and capability of the management team. The structured interviews suggest that below par management performance has a direct impact on project outcomes.

Insight from the study

The interview process focused heavily on the contribution of site team and supply chain. The results focus on production rather than design or the client's briefing process – which clearly also have a significant effect on overall outcomes. Combining insights on the complexity of the supply chain, a high level of informal collaboration, the need to accommodate change and low margins – the research has demonstrated that effective site management has a key role in delivering successful outcomes for clients and constructors. The study also emphasises the importance of positive behaviours and central role of the project manager in facilitating a high performing team.

We were struck by how many issues were left unresolved at the early stages of the project – design, commercial or production related – which needed to be finalised on site. The effective resolution of these issues is very dependent on the capability and workload of the site team, and it is easy to see that the development of solutions on-site could result in the sub-optimal use of resources. A responsive approach to problem solving, combined with a diverse and potentially fragmented supply chain and challenging market conditions, demonstrates that the project manager's workload is complex and unpredictable.

Interviews emphasised the degree of influence a project manager might have on team selection, and the extent of the project manager's role in coordinating and motivating the project supply chain – sometimes based on ad hoc, quid pro quo arrangements. This pattern of behaviour occurred on projects managed by contractors with very mature and formalised management systems as well as less organised businesses.

Interviewees said the quality of individual project managers varied greatly. A range of capability within the pool of managers is essential to provides scope to match managers to projects. However, interviewees saw a gulf between “good” project managers and “bad” ones and their performance had an effect on project performance. Perceived failings were mainly seen in soft skills including negotiation and man-management. Main contractors also acknowledged the need for performance improvement especially with soft skills. As evidence of this need, some contractors are introducing new training initiatives for their project managers.

Many of the factors that create behaviour problems on site have been accentuated by the current tough market conditions. There was a view that many recent gains made in collaborative behaviour were being eroded as a result of highly competitive bidding and tightly resourced projects – placing a further premium on management capability.

Feedback from the supply chain suggests that investment in the improvement of site management skills will drive better performance. The opportunity for improvement may not be obvious to all construction businesses and we recommend that further work is undertaken in understanding the potential for up-skilling and the best means of delivery of these skills development programmes.

Our research provided greater clarity with respect to the coordinating role of the PM – particularly on projects with complex diverse supply chains. The PM role could be a single point of failure on a project, and from a policy point of view, awareness raising, skills development, and the attraction of talent will help mitigate this risk.

6.2 Management of Change

The low cost of change for the client comes at a high cost to the industry

Defining the issue

Some change during design and construction process is inevitable and the industry has evolved to accommodate this. By comparison with other industries such as IT, it can be argued that construction accommodates change too readily and at too low a cost at the point of change. Furthermore, it can be argued that most stakeholders: clients, designers and contractors all have a shared interest in the ability to readily introduce change.

However, the evidence from our study suggests that the volume of change is too high, comes from too many sources, and can be highly detrimental to project performance. Many sources of change are avoidable, and it could be argued that the introduction of higher barriers to change would improve industry and project performance.

Our structured interviews clearly indicate that the ability to introduce change is the industry norm, is reluctantly accepted, but was seen by most interviewees as a source of waste, a cause of uncertainty and a catalyst for greater friction between trades. Change disrupts progress, introduces cost and reduces industry productivity.

Given that changes may have a knock-on effect beyond the contractor who is doing the work, the full cost of change may be higher than the price paid by the initiator of the change. Any premium related to reduced efficiency will be paid by all clients of construction.

Insight from the study

A commonly held view is that construction firms thrive on change. Designers hone their proposals, mistakes get corrected, and constructors secure higher profits on variations. The study found little evidence of this, and many firms said the cost of implementing change outweighed any potential benefits. This does not mean the practice of profit recovery on variations does not go on, and in any case, not all parts of the supply chain will benefit.

Whilst we found a reluctant acceptance that a high level of change was part and parcel of the construction process, we also found a degree of ambiguity as to how change was initiated. With the increase in the transfer of design risk down to main contractors and specialist contractors, some change could fall within the scope of design responsibility, which may require main contractors and subcontractors to absorb these costs and associated disruption to progress. Furthermore, disputes with clients might be avoided to maintain client goodwill for the sake of repeat work.

Common sources of change identified by interview participants included:

- Extent and quality of design delivered by consultant design teams – a function of procurement route, appointment and scope of service and quality of resourcing
- Detailed design work completed by specialist sub-contractors – a function of the extent of contractor design, the timing of contractor appointment and design milestones
- Client initiated change – related to specification enhancement or end user requirement
- Extent of contractor engagement in the design process – related to procurement route and the design stage at which contractor appointment takes place
- Quality of client brief and capability of the client as a construction employer – including the effectiveness of stakeholder management of end users

Other sources of change include value engineering proposals initiated by a contractor, detailed design changes required to coordinate the works of specialist contractors, as well as changes in the sequencing of work.

With most projects being procured using variants of design and build contracts, an increasing proportion of the risk and cost of change is held by the main contractor and the project team. Discussions about certainty of payment centred on issues associated with variations, which it was claimed have become more difficult to agree as margins on projects have fallen. Other aspects of market conditions that appear to have accentuated the causes of change include downward pressure on design fees and later engagement of specialist contractors, which might delay the completion of design work.

Despite the fact that change increases uncertainty, reduces efficiency and might result in extra costs in the supply chain, we observed that the cost of change – which is generally accepted as high – does not feed back in the system to change behaviour or practice. The implication is that change management needs to be more effective, and change needs to be dis-incentivised – possibly by ensuring that the initiator of the change bears a greater proportion of the full economic cost.

The high incidence of change has been highlighted as an issue because it is endemic, and because of the potential negative effect of change on the efficiency of a highly fragmented industry. In our view, change is a significant source of waste. Furthermore, as not all costs of change are recovered through provisions in contracts, the costs of change affect all aspects of construction. Reduced volumes of change will increase efficiency, resource use and should take cost out of the design and construction process.

The ability to introduce changes during design and construction is desirable, but the industry's presumption should be in support of managed change control. A full understanding of the implications of change across the supply chain should lead to better decision-making.

Adoption of Off-Site manufacture and Building Information Modelling (BIM) may help to create further discipline to support the selective use of change. Given current endemic levels of change, some external discipline is likely to be necessary encourage appropriate behaviour and practice.

6.3 Certainty of outcome and the transfer of risk

It'll come out in the wash, but we all end up paying

Defining the issue

Construction involves high levels of risk due to a combination of 'one-off' design and construction, site-based working, fixed-price contracting and supply chain fragmentation. This is well documented and well understood. Risk has increasingly been transferred down the supply chain from client, through the main contractor to specialist contractors. The evidence suggests that whilst risk transfer mechanisms work well for the clients – the allocation and management of actual risk is often erratic and inefficient, increasing uncertainty, and resulting in inefficient working, waste and unnecessary cost. Risk transfer affects the performance of the whole industry – not just individual projects.

The context of the research is the widespread adoption of design and build as a procurement route for complex, high quality buildings. In each case, the constructor took responsibility for the completion of the design, either through the novation of the client's original design team, or through the transfer of the design responsibility to an in-house team. The transfer of the risk includes compliance with planning, regulatory compliance, building performance, sustainability standards and so on. Detailed aspects of compliance are transferred further down the chain to specialist contractors with design and coordination responsibilities. Effective management and mitigation of risk will reduce waste and cost, and will improve outcomes for the client and for the industry. By contrast, poor risk management practice has the potential to increase costs within the supply chain – affecting margins and reducing efficiency.

Insights from the study

Sections of this discussion dealing with waste and change underline the extent to which planned construction activities can be subject to disruption.

We found evidence that main contractors are taking on more risk. Evidence includes in-house delivery of the detailed design solution and the in-house management of detailed building services design, coordination and installation – an activity normally undertaken by one or more specialist Tier 2 contractors. Acceptance of these risks increases control, and the ability to pass risk further down into the supply chain.

The effectiveness of the management of this transfer of risk into the supply chain affects overall cost levels in the industry, as well as productivity and profitability.

When asked about risk, some subcontractors interviewed said that they did not price for it, particularly in the current tough market. Others said that lack of information at the outset made pricing risk difficult, and that an assessment was made on the basis of experience rather than a rigorous assessment.

Evidence gathered through the surveys suggested that the tough market conditions were increase the level risk held by the supply chain as a result of:

- Single-stage tendering based on incomplete design;
- Poor flow of design information, including ambiguity over design responsibility;
- Late engagement of sub-contractors reducing lead-in times;
- Uncertainty with respect to responsibility for and valuation of changes;
- Financial risks associated with low margins, extended payment periods and progress by other sub-contractors;

The progressive transfer of risk from client, through contractor to supply chain may not necessarily result in the optimal management of project outcomes – particularly if the

negative outcomes are absorbed by the supply chain. The study has demonstrated that, in the current market, not only are risks not been fully priced at tender, but also that project management reduces the ability of the supply chain to mitigate their risk exposure.

In common with all enterprises, construction firms manage their projects as a portfolio, with better performing jobs compensating for poor returns from under-performing projects. Our findings are that, through transfer down into the supply chain, risk management is increasingly being undertaken at a disaggregated level. Over time, the costs associated with this risk transfer will be built into the cost of work, through the proper pricing of risks in tenders, potentially increasing project cost. In the meantime, our findings do suggest that market signals for failure are being blunted, with the costs of risk on one project being offset by successful outcomes on others.

The study has demonstrated that risks are being passed further down into a very fragmented supply chain. The study has also shown that current commercial practice is increasing the level of risk related to incomplete information, reduced lead-in time and supply chain fragmentation driven by lowest cost bidding.

Risk transfer based on integration of design and construction is a key element of the industry efficiency agenda. The study suggests that the industry could manage the delivery of projects more effectively so that risks are reduced or avoided, cutting the costs of risk, and safeguarding profitability across the project portfolio.

The transfer of risk down into a fragmented supply chain potentially has the effect of insulating clients and constructors from the immediate impact of risk – but also reduces the efficiency of project delivery, increases overall cost and reduces profitability. Transfer of risk to a level below which it can be mitigated effectively has the potential to increase the overall cost levels of the industry.

In seeking to drive out cost and waste, the industry should ensure that risk management drives optimum outcomes – not simply least cost outcomes for the client and constructor on individual projects. Whilst supply chain members will always be required to accept design, performance and commercial risks, greater effort in the coordination of the activities of the project team, so that risk and waste is avoided, will help to drive these superior outcomes.

6.4 Effect of demand and market conditions

Squeezing the price may result in higher costs

Defining the issue

Evidence from supply chain interviews clearly shows that low levels of demand and continued tough trading conditions have a negative effect on firms, relationships and project performance.

These negative effects were described repeatedly during interviews. Our impression was that supply chain participants were waiting for normal trading conditions to return. There was little evidence either of innovative or adaptive responses to current market conditions, or of a belief that current conditions and price levels represented a new baseline.

Firms are hoping that the market will return to conditions seen prior to 2008. This expectation weakens the industry's current focus on cost and waste reduction initiatives that are essential to sustain long-term competitiveness.

Insight from the study

The study provides some evidence of industry consolidation –that poor performing firms and operatives had left the market. We also found widespread evidence of a reversal of gains made in terms of team collaboration and enhanced performance that stemmed from Latham, Egan and other improvement initiatives. The survey provided evidence of a shift in bargaining power within the supply chain. The prevailing view was that the shift had been used push down prices, rather than to reduce costs by changing ways of working.

The typical approach reported by supply chain members was to 'weather the storm' until prices bounced back. Many sub-contractors have eaten into cash reserves, have bid at sub-economic prices to cover overheads, and have accepted risks that they might have rejected in more buoyant markets.

The evidence suggests that supply chain members will seek to repair margins when the supply and demand balance changes. The implication is firstly that short-term effects of the recent downturn on the supply chain will need to be addressed, and secondly, that action will need to be taken to eliminate costs elsewhere so that the supply chain can be sustained whilst Industrial Strategy cost reduction targets are met.

The short term effects of the downturn on project performance include:

- Extensive use of re-bidding, reducing the incentive for subcontractors to engage in early design, cutting lead-in times and compressing programmes;
- Less cooperation within project teams, leading to a reduction in discretionary effort, and greater demands on site management skills;
- Short term cash flow constraints leading to erratic levels of personnel and oversight on site;

- Medium term cash flow constraints inhibiting bidding for work – potentially reducing competitive pressures during the recovery cycle;
- Low prices reducing the ability to price travel costs into bids – reducing the ability of businesses to be able to trade outside of their immediate local markets;
- Cuts in investment in plant and machinery – potentially reducing productivity, and requiring investment during the recovery cycle;

The Industrial Strategy is being set at a point in the economic cycle when low demand is straining collaborative working and reducing the industry's capacity for investment in capability and growth.

The challenge for the industry, in meeting long term cost reduction targets, is to channel the high levels of market pressure to induce genuine and sustainable improvements to performance, while reducing the short-term negative impacts created by low demand. Areas where attention will be needed in strategy implementation include the maintenance of positive, collaborative behaviours in the project supply chain, as well as the mitigation of the effects of supply chain fragmentation on levels of innovation.

We found evidence that supply chain fragmentation acts as a barrier to the flow of good ideas. Furthermore, that the effect is accentuated by the stress of low levels of demand. We also found that the market prioritises price over efficiency – dis-incentivising the long-term improvement in industry performance.

There is a risk that the bottom-up, industry view that “a building costs what it costs” will remain prevalent. This is the opposite of a “should cost” perspective driven by affordability, and by the purpose and value delivered by the asset. The implication of the bottom-up perspective is that when demand returns, margins and prices will rise, and the costs of buildings to clients will also increase – irrespective of affordability.

The construction industry's adaptation to the demands and dynamics of the market conditions associated with a “new normal” will take time. However, the lack of perception in the supply chain that change is needed was striking. The short-term need to cut prices to win work has resulted in a loss of perspective with regards to the long-term capability and performance of the industry. There is little evidence that the core messages of the Wolstenholme report have been absorbed by clients, constructors or their supply chain.

6.5 Waste

Waste is the stuff in the skip

Defining the issue

When interviewees were asked about waste in the construction industry, most respondents' instinctive response was focused on physical waste which 'ends up in a skip'. This narrow view of waste was not universal, but it was the norm.

This insight suggests that most participants do not recognise other aspects of duplication and loss of value as waste. The implication is that it is difficult for a highly fragmented industry to develop a common cause focused on the adoption of lean principles.

However, the structured interviews showed that other sources of waste are pervasive. Examples included ill-thought out design leading to sub-optimal and/or expensive solutions; unnecessary or late variations leading to work being redone; poor scheduling leading to inefficient use of labour; poor logistics leading to unnecessary and resource-hungry temporary works.

The amount of money, man-hours, materials, effort and time wasted is impossible to quantify from our survey. However, other studies indicate that potential savings are substantial – and could deliver a portion of Industrial Strategy performance targets.

Insights from the study

We have observed that waste is embedded into industry's structure, risk management practice and working culture. Addressing the narrow view of waste as a physical by-product of construction will create opportunities for performance improvement. As an example of what can be done, the linking of waste reduction to sustainability outcomes has been very effective. Most major contractors now report publically on their waste reduction initiatives, demonstrating that the industry can focus collectively on areas of performance improvement when it is directed to do so.

The narrow view of waste which we encountered and the sometimes blinkered approach to a wider range of potential waste issues is clearly a behavioural issue. But behaviour is not to be the only barrier to its removal. Many interviewees said they could significantly cut cost, time, reworking and material waste. But they did not.

There are many reasons, details of which are given in the summaries of the survey, they include:

- Discretionary effort by project participants continues to be critical to efficient project performance, but is undermined by risk transfer, tough market conditions, resource constraint and limited gain sharing;
- There is little evidence of a willingness to consider value engineering options;

- Main contractors and subcontractors are unable to influence design sufficiently due to the timing of their appointment;
- There is often too little lead-in time for contractors and sub-contractors to plan and coordinate works effectively;
- The rebidding of work to reduce cost has the effect of reducing the window for contractor engagement and lead-in. Re-bidding also potentially disincentivises early contractor involvement which might deliver better value solutions;
- The disruption and waste that can be caused by changes at all levels of the supply chain is not fully recognised and is not sufficiently disincentivised through pricing models;
- The full impact of decisions on the efficiency of contractors and subcontractors is very difficult to determine due to high levels of interaction within the supply chain.

In summary, we found little awareness of opportunity, insufficient ability to act and only limited incentive to improve performance with respect to removing all sources of waste from projects.

We have shown that aspects of behaviour and procurement hold back an industry-wide focus on the reduction of all aspects of waste in process, definition and delivery. Innovation to reduce waste in construction is inhibited by many interrelated factors.

Given that construction is not a process-driven industry and many of its products are “one-offs” the full extent of waste is disguised and the true value of savings is not recognised. Many of the examples of waste cited by interviewees were repeated from project to project, and have been known as issues for many years.

High levels of in-built waste will be a major source of opportunity for cost reduction in pursuit of the Industrial Strategy. However, the sources of waste are so deeply rooted in the way that the industry operates that even on best practice projects there is insufficient opportunity and incentive within the supply chain to cut waste.

Changes introduced in the Industrial Strategy may well address some aspects of waste in the system. However, as the industry is a complex system, other changes may be counter-productive, and other elements of the operation of the industry may create inertia. The complex interactions that result in waste will require determined action to drive improvement. Elimination of waste will require high levels of discipline and focus. The survey has shown that there is a desire within the supply chain to eliminate waste that can potentially be channelled to deliver better outcomes.

7. Conclusions and summary answers to the project objectives

This section of the study focuses on the key project objectives and considers how the findings of the research provide additional insight into the improvement of industry performance. The key project objectives are:

- To identify areas where cost savings can be made in UK construction supply chains and the barriers to achieving those savings.
- To identify elements of the UK construction supply chain that tend to be imported and understand why domestic firms are not competing.
- To recommend actions that Government and Industry can take to improve competitiveness of UK construction companies by overcoming barriers to the achievement of cost savings in construction supply chains.

7.1 Areas for cost savings and barriers to achievement of savings

The study has highlighted the fragmentation of the supply chain, which has long been recognised as a structural issue that needs to be accounted for to improve performance. The findings of the study suggest that the industry will be less able to manage the price impact of an improvement in workload than it was prior to the downturn, due to a number of factors, including:

- Cash flow constraints resulting from low profitability and limited availability of bank funding;
- Consolidation within the supply chain, resulting either from business closure, or limited re-investment in plant, equipment and people;
- A reduction in levels of cooperation across the supply chain, reducing the extent to which the supply chain offers integrated solutions; and
- The disincentive for sub-contractors to work with main contractors in the development of best-value design and construction solutions – stemming from an increased frequency of re-bidding work, post tender-award.

The literature review sets out how the Latham Report focused considerable effort on the improvement of the business environment for the construction supply chain. Evidence from the structured interviews indicates that there is a growing perception amongst supply chain members that a number of positive collaborative working practices that emerged

post Latham have been adversely affected by working practices that have evolved in response to the 2008 construction downturn.

Practices introduced to reduce cost, including rebidding of sub-contractor packages, transfer of design and commercial risk based on limited information and extended payment terms appear to be reducing the ability and incentive for a project supply chain to work collaboratively to drive out waste.

Challenging market conditions are also reducing the ability of the supply chain to fund increased cash flow associated with business expansion.

The performance agenda set by the Egan Review also identified the supply chain as an agent of change. However, based on the limited evidence of this report, the supply chain which the review had in mind is not as capable of driving the change agenda as it should be. This is partly as a result of the erosion of the partnering/early contractor engagement culture, and partly as a result of the reality of a highly disaggregated supply chain. It is easy to see that, even if there were a high level of cooperation between Tiers 1 and 2, then engagement with specialist contractors at tiers below level 2 could remain a challenge. One of the Egan performance improvement solutions was to encourage greater adoption of off-site manufacture. We have found outstanding examples in the study, but also continue to see high levels of on-site coordination of large numbers of sub-contractors. Performance has improved, but there clearly is potential for further gains.

Evidence for this potential comes from the industry's low take-up of benchmarking and performance assessment. Another key Egan improvement route was the use of performance measures to add discipline to long term relationships. The awareness of benchmarking and other measures of performance within the supply chain was shown to be quite low – evidencing many of the findings of the Wolstenholme Review, which concludes that industry commitment to reform had only been skin deep, and indeed that the industry had taken its eye off the reform agenda.

As the construction industry emerges from an extended downturn, it is arguable that the supply chain is ill-equipped behaviourally and financially to set and maintain a trajectory towards high performance and lower cost, time and carbon.

This conclusion is however premature, as it ignores many of the changes being driven by clients, contractors, technology and suppliers that will sustain momentum towards performance improvement.

Areas for Cost Savings - Conclusions

The supply chain will have a role in driving performance improvement, but as an enabler, the structure and capability of the industry is only one part of the solution. In summary, the main opportunities to reduce costs related to the contribution of the supply chain are likely to be:

- Early contractor and sub-contractor involvement in solution development, facilitated by procurement strategies which enable supply chain input to be directed to meeting clearly communicated *target costs*, where the main contractor and supply chain collaborate to deliver a facility to an agreed specification within a pre-set budget – e.g. the approach adopted by the Education Funding Agency (EFA) in delivering the Priority Schools Programme
- Coordination of design and assembly across the supply chain, potentially based in sharable asset information – e.g. BIM
- Effective management of change, including a shared understanding across the project team of the opportunity costs of unmanaged change;
- Effective on-site operations, supported by an integrated, established site team, capable site management, and proportional management of change;
- Wider adoption of the ‘integrator’ role of supply chain management, either at Tiers 1 or 2, placing greater emphasis on the management and coordination of related trades – optimising performance and potentially securing client and supply chain benefits through repeat work and volume savings.

The barriers to achieving these savings include:

- A predictable rebound in prices related to supply and demand conditions, exacerbated by industry consolidation and reduced levels of investment;
- Commercial behaviours throughout the supply chain that reduce incentives for collaborative and cooperative behaviours, driven by current market conditions;
- The highly fragmented supply chain – particularly related to complex sub-contractors. This potentially introduces waste and reduces opportunities for cost reduction via volume-based procurement, category management etc.;
- Methods of contractor selection and incentivisation, based on least cost rather than should cost procurement strategy;
- Inappropriate risk transfer down the supply chain, potentially introducing waste into solution development and on-site construction.

7.2 Identification of elements of the UK Construction Supply Chain that tend to be imported

The proportion of imported vs. home sourced materials and services proved very difficult to assess as part of the structured interview process. Feedback from respondents was that product selection decisions are based almost exclusively on price – assuming that the specification is met.

Where there was a client-driven selection of imported products, the reason for the selection was usually related to quality and performance in the context of internationally traded products and systems such as switchgear or external envelope systems.

These findings suggest that for many product segments, the product supply chain's route to increased market share is likely to be through cost leadership strategies rather than differentiation. However, at present, responding to the cost leadership challenge is difficult for many UK based manufacturers and suppliers, due to competition from low cost markets.

The implication for the domestic supply chain is that where there is potential for import penetration, markets will be subject to continuing commoditisation pressures, which in turn will require a sustained focus by domestic firms on the reduction of waste and inefficiency to remain competitive. Furthermore, as a result of these pressures, margins are likely to remain tight. This is good news for the wider construction industry, which is unlikely to see significant input cost inflation affecting material and product inputs.

During the structured interviews, alternative selection criteria that might favour UK suppliers, including security of supply, length of supply chain and sustainability impacts were not mentioned widely. This clearly creates a challenge if the industrial strategy is to play a role in strengthening the competitive position of the UK manufacturing sector.

7.3 Recommended actions to improve productivity of the UK Construction Industry

The study has focused on the structure and operation of supply chains associated with the on-site construction of non-residential buildings. The recommendations set out below are specific to this sector, and are not necessarily applicable to other construction industry segments.

Our conclusion from this research is that the supply chain will focus on relatively small-scale, project level improvement initiatives. The supply chain is likely to adapt to influences from the market rather than as a result of specific policy. Accordingly, the team's recommendations are as follows:

- Create and maintain momentum around an agenda for change that involves all levels of the supply chain. The agenda for change should counter widely held

perceptions that current working methods will deliver the Industrial Strategy improvement targets;

- The industry should invest in the development of the quality of site management. The investment should include recognition and profile, skills development, career paths and technical and people management capability necessary to optimise performance;
- Performance improvement initiatives developed as part of the implementation of the Industrial Strategy should be aligned with the interests of construction delivery teams. This will increase the likelihood of adoption. Opportunities for alignment include:
 - Alignment of aspects of Government Construction Strategy with supply chain interests. Examples from the strategy include performance measurement, “should cost” procurement and the appointment of teams to extended programmes of work;
 - Adoption of procurement processes which are consistent with the objective of encouraging enhanced value, low risk project submissions. Cost-led procurement is a good example of this approach;
 - Encouragement of the adoption of risk transfer practice that is consistent with allocating risk to the appropriate supply chain member. Procurement strategies such as cost-led procurement may result in further risk transfer into the supply chain;
- Encouraging continuing involvement of the supply chain in design development and bidding through early engagement of contractors in solution development. This agenda may benefit from the wider adoption of the cost-led approach advocated by the Government Construction Strategy;
- Investment in capability development throughout the supply chain to increase the uptake of performance improvement initiatives including BIM and managed collaborative working;
- Financial arrangements including bidding and payment:
 - Organisation of cost-led procurement needs to be organised in such a way as to incentivise early sub-contract engagement;
 - Initiatives to improve cash-flow within the supply chain need to balance the interests of all tiers in the supply chain, recognising that cash flow is also central to the Tier 1 contractor business model;

- Development of more effective change management practice, including recognition of the hidden costs of change in terms of cost and lost productivity. The team believes that the opportunity cost of change is under-valued;
- Wider promotion of the awareness of the process waste that is built into so much construction activity. Examples include procurement activity at all levels of the supply chain, rebuilding delivery teams on a project-by-project basis and the wider impacts of change;
- Encouragement of the development of commercial exchange models that address the needs of the construction industry's highly dis-aggregated supply chain. This supply chain structure is integral to contracting business models. It is a source of considerable inertia, but is also an area of performance improvement. Increasing the visibility of capability and reducing transaction costs associated with winning, delivering and being paid for work could deliver significant performance improvement;
- The UK Construction Industry should adapt to its structure, in the same way that the Amazon and E Bay business model has made a virtue of its highly distributed 'tail' of specialist small-scale suppliers.

Annex 1

Project methodology

This section of the report outlines the approach adopted by the team and critically reviews the effectiveness of the adopted methodology.

Methodology

The key components of the project methodology are as follows:

- Project identification – the team has used a ‘matched pairs’ approach where we selected sample projects which adopted different approaches to the delivery of a similar building type. The building types compared are commercial offices and schools, and the dimensions of difference included:
 - National vs. regional contractor;
 - Direct vs. sub-contract labour resources;
 - Main contractor vs. sub-contractor management of specialist sub-contracts (e.g. Building Services);
 - Utilisation of innovative construction methods – e.g. panelised construction.

Whilst it has not been possible to directly relate specific aspects of delivery method to project performance, the matched pair approach helped to ensure that the supply chain survey was representative of a range of industry practice.

- Value tracking through the supply chain – we have adopted a Commercial Cost Assurance methodology to provide an analysis of the supply chains of main contractors and selected specialist sub-contractors. The benefits of the approach include:
 - Details of supply chain on-costs obtained without reference to actual project costs;
 - Consistent and comprehensive overview of the principal contractor cost base;
 - Detailed but selective analysis of the supply chains of a limited number of specialist contractors.
- Structured interviews of contractors, sub-contractors and suppliers. Use of a structured interview format has provided a rich source of semi-quantitative data. Data sourced via the interview process includes:

- Margin and overhead pricing for Tier 1 and 2 suppliers²⁹;
- A quantitative analysis of the key drivers affecting pricing behaviour;
- Identification of the most common and influential factors supporting or holding back high performance on construction projects.

Structured interview methodology

40 interviews were undertaken with main contractors and members of the Tier 2 supply chain, including consultants.

The structured interview process set out to identify aspects of project which contribute to improved performance – including reduced cost, and other factors which act as blockers to improvement. The main output of the structured interview is a detailed insight into the key issues affecting contractors operating at a range of scales on building projects.

Structured interviews focused on the following areas:

- Details of the respondent, the respondent's firm and the project;
- Identification of key factors influencing performance on the project;
- Systematic testing of our performance hypotheses;
- Specific questions relating to waste, whole-life costing, imports, the economic climate and cost of bidding.

The structured interviews were supported by a pre-interview questionnaire which enabled the team to gather specific details on price levels, margins, extent of outsourcing, pricing of risk and other factors influencing pricing.

Whilst the interviews give plenty of flexibility for the interviewee to focus on key issues of their choosing, we used a survey matrix, based on a set of agreed hypotheses, to structure our analysis of the interview results. This analysis of factors influencing performance was confirmed after the interview.

The performance hypotheses considered in the project are as follows:

- Financial arrangements
- Method of supplier selection

²⁹ Details of 3rd tier suppliers will be obtained on a selective basis through later phases of the research

- Method of being selected to supply
- Design management
- Site management
- Price determination
- Supply chain integration

Each hypothesis is associated with a range of outcomes – e.g. prompt or extended payment periods influences project outcomes. When an interviewee mentioned the issue in the interview – and identified either a positive or negative outcome associated with the issue, then this was recorded in the survey grid, together with extensive notes of the interview. For example, one or two respondents mentioned that extended payment periods had the effect of reducing available cash flow, and increasing costs. This would be recorded as a negative outcome.

Use of the survey grid in this way has enabled the team to produce quantitative data from an informal, qualitative survey.

The methodology was developed in conjunction with the University of Reading. The research hypotheses were informed by work undertaken by Professor Will Hughes in connection with project procurement strategy.

Review of the effectiveness of the survey

Sample size

A total of 40 questionnaires were completed for 5 projects as part of the survey. Constraints affecting the sample size included the identification of suitable projects and the need to secure support from project teams. Given the challenges faced by many contractors in the current market, we were pleased with the size of the sample obtained. Financial data was more difficult to obtain. We designed the methodology to keep separate discussions on commercial matters such as margins and the details of specific projects. Nevertheless, a smaller number of survey participants were prepared to complete a pre-interview questionnaire – giving a sample size of over 30. We acknowledge that the sample size is small, which affects the reliability of results. It should be noted that engagement with the contractor supply chain was very resource intensive, and that barriers to obtaining commercial information are also high.

The pre-interview questionnaire proved very successful in freeing up effective time for the structured interviews and providing a useful source of consistently defined data that have been used for quantitative analysis.

Effectiveness of quantitative analysis

The application of a quantitative analysis to the results of the structured interview was developed in conjunction with Professor Will Hughes of Reading University. There are a number of methodological challenges to the approach – not least the consistent recording of insights from the structured interview, and the interpretation of the importance and impact of the performance factor under consideration. It would be possible to fine tune the approach adopted by the team, by for example removing ambiguities in the terminology used in the questionnaire or drilling deeper into certain aspects of supply chain performance. However, the experience of the team is that it was rare that issues raised by interviewees could not be analysed using the performance drivers described in the project hypotheses.

The benefit of the quantified analysis, presented in tables, is that the hard data can be used to support our interpretation of results from across the 40 interviews. For example, where very little mention was made of a performance driver such as benchmarking, we believe that this can be taken as a strong indication of the low level of performance measurement as a management tool in the construction supply chain.

Identification of causal relationships

In the development of the methodology, we explored whether it would be possible to identify causal links between performance drivers. So, for instance, we might have recorded that the instances of low levels of early contractor involvement led to high levels of variations and in turn led to delays to the programme. In reality while causal links were clearly articulated by interviewees and evidently present, the complexity of the interplay between different factors was too great to capture using quantitative data. The existence of causality was recorded as qualitative data and is a key element of our analysis and findings. In particular, the identification and recording of mitigating factors that compensate for poor performance elsewhere in the system is a key part of the analysis.

A common example concerns the contribution of good project management and good relations on site to project outcomes. These were cited by many interviewees as being the 'glue' that holds project performance together, compensating for performance failings elsewhere.

Other methodological issues associated with the survey that need to be acknowledged include:

- variation in the scoring by interviewers. This is unavoidable, although the team did consider the normalising of scoring;
- variation in responses from interviewees – based on the norms and experiences of each individual (e.g. what is good performance on a project);
- ambiguity within the hypotheses, such as differences between explicit (contractual) and implicit (self-interest) incentives to contribute to performance improvement;

- separation of project, enterprise and industry performance. Our objective was to capture project specific performance drivers, but it proved difficult to keep respondents focused on a single project – particularly when more pressing issues might be better illustrated by experiences from other projects in their portfolio.

Conclusions

In conclusion, the quantitative analysis provided an effective means of gathering structured information, enabling the team to quantify what are in essence qualitative survey responses.

In summary, given the constraints of time and risk that response rates would be low the survey achieved:

- A high degree and quality of participation providing insightful data;
- The capture of qualitative and quantitative data;
- Structured data providing the foundation for effective analysis;
- Fresh insights – enabling us to recognise and develop cross-cutting themes that are presented in the report.

Annex 2

Literature Review – main recommendations of Construction Industry Reports

This annex features brief summaries of the recommendations of the three major reports featured in the Literature Review, The Latham Report (1994), The Egan Report (1998) and the Wolstenholme Report (2009)

1. Summary of Latham Report Recommendations

Constructing the Team – Recommendations Summary

1. Focal Points – clients

- Government should commit itself to being a best practice client. A construction forum should be created to represent private sector clients

2. Guide for clients on briefing

- The Construction Industry Council (CIC) should prepare a guide to briefing. It should also be part of the contractual process that the client should approve the design brief by 'signing it off'.

3. Code of Practice

- The DoE should coordinate a construction strategy code of practice (CSCP) to inform and advise clients.

4. Code of Practice (guidance in the CSCP)

- The CSCP should be designed to assist clients to meet their objectives and to obtain value for money. The guide should also be designed to harness clients' purchasing power to improve the long-term performance of the industry.

5. Consultation of the process plant sector

- The European Construction Institute should be involved in the implementation of the CSCP.

6. Check-list designers

- The formulations of a check list, or the adoption of existing ones such as those of the British Property Foundation (BPF) or Building Services (BSRIA), should be an urgent task of the reconstituted JCT as part of the drafting of new duties.

7. Co-ordinated project information (CPI)

- The CPI technique should be made part of the conditions of engagement of the designers and be made a contractual requirement.

8. Allocation of Mechanical and Electrical (M&E) design responsibilities

- Whatever procurement system a client employs, the allocation of design responsibilities between design consulting engineer and specialist engineering contractor should follow the check list of guidance with a separate design agreement for the specialist engineering contractor.

9. The Joint Contracts Tribunal

- To amend the standard JCT and ICE forms to take account of the principles set in the report.

10. The Construction Contract Standards Joint Committee (CCSJC)

- The structures of the CCSJC and the JCT need substantial change.

11. Joint Liaison Committee

- A joint liaison committee should be formed to consider amendments to the NEC and to build up a complete family of documents around it.

12. Client use of the NEC contract

- Public and private sector should begin to use the NEC, and phase out “bespoke” documents.

13. Register for consultant and quality/price assessment

- There should be a register of consultants for public sector work.

14. Project sponsors and managers

- The roles and duties of the project sponsor need clearer definition. Government project sponsors should have sufficient expertise to fulfil their roles effectively.

15. Main contractors’ and subcontractor list

- A list of contractors and subcontractor should be kept for public sector work. It should develop into a quality register of approved firms.

16. Tendering

- Detailed advice should be included in the CSCP to all public sector clients on the specific requirements for selective tendering in accordance with European Union Directives.
- Clients should adhere to the recommended numbers of tenders for single stage tendering in the NJCC Code of Procedure.

17. Value for Money and cost-in-use interim arrangements

- The aim should be for the DoE to set up a central qualification list based on CMIS of contractors and subcontractors seeking public sector work. Such a list should also be supported by a national scheme of guidance for quality assessment of tenders.

18. Selection of subcontractors

- Set up a central qualification list based on CMIS of contractors and subcontractors seeking public sector work. Such a list should also be supported by a national scheme of guidance for quality assessment of tenders. This should include a commitment to short tender lists, and selection on quality and price as well as client engagement in the appointment of Tier 1 sub-contractors
- Sub-contractors should undertake to work in a win-win manner with other sub-contractors.

19. Partnering

- Public sector clients should experiment with partnering arrangements with the intention to build-up long-term relationships.

20. Training

- The industry should make specific provisions for training, from flexible modern apprenticeships to developed NVQs.

21. Image of the industry and equal opportunities

- The CIEC and CLG should set up a high-powered task force to report quickly on implementing the “Building Towards 2001” recommendations.

22. Professional education

- A task force should be set up with the CIC and Government to agree an implementation of the agreed desired objectives for professional education.

23. Research and development

- Expenditure on research and development in the industry is generally thought to be inadequate and dissemination of it faces real difficulties. Government should take steps to involve clients in its existing research strategy programme.

24. Productivity target

- A target of 30% real cost reduction over 5 years should be accepted by Ministers by the year 2000.

25. Unfair conditions

- The NEC or adjusted standard form JCT and CCSJC should be adopted to address unfair contract conditions, including timing and conditions of payment, the right of immediate adjudication and rights of set-off or contra charge

26. Adjudication

- A system of adjudication should be introduced within all the Standard Forms of Contract (except where comparable arrangements already exist for mediation or conciliation) and that this should be underpinned by legislation.

27. Trust funds

- Mandatory trust funds for payment should be established for construction work governed by formal conditions of contract.

28. Liability legislation

- The Construction Contracts Bill should include provisions to implement the majority report of the working party on liability.

29. Latent defects insurance

- The Construction Contracts Bill should contain a provision for compulsory latent defects insurance for 10 years from practical completion.

30. Creation of a delivery mechanism – a standing strategic group of the construction industry to address this report and industry level requirements

- A Standing Strategic Group of the Construction Industry should meet twice a year.

2. Summary of Egan Review Themes

The Egan Review set performance improvement targets to be achieved by taking opportunities in the following areas for improvement. The report is not structured by recommendation, so only the themes are listed.

Improving the project process

- Repeated processes
- Integrated project processes
- Focus on the end product
- Product development
- Project implementation
- Partnering the supply chain
- Production of components
- Sustained improvement

Enabling improvement

- Decent working conditions
- More and better training
- Design for construction and use
- Standardisation
- Technology as a tool
- Better regulation
- Long term relationships
- Reduced reliance on tendering

3. Summary of Wolstenholme Review Recommendations

The Wolstenholme Review identified 8 future areas for action, described as “Big Themes for Action and Some Quick Wins” (Wolstenholme, 2009 p. 25-26). The articulation of the major themes in the report is as follows:

- Understand the Built Environment

Both clients and suppliers need a better understanding of how the relatively small up-front costs of design and construction leverage much higher costs downstream for end users in terms of facilities management, business costs and ultimate value.

The latter may be measured in terms of business (financial), social (education, healthcare, etc.) and environmental outcomes. Such a powerful argument has captured audiences' imagination whenever Constructing Excellence has exposed it.

- Focus much more on the Environment

The construction industry must become a sustainability leader and adopt carbon efficiency into all our processes. Our failure so far to link ourselves in the public's mind with one of the major issues of the day, namely climate change, is a huge missed opportunity for our industry. A 'green recovery' from the current industry recession is now required. Put simply, our vision is of a future where young people who want a better world will be able to fulfil their aims by joining our industry to deliver a low carbon economy, rather than by devoting themselves to environmental protest.

- Find a Cohesive Voice for Our Industry

Our industry bodies and professional associations must collaborate to represent our industry effectively to Government and other key stakeholders. One option may be to give the Strategic Forum for Construction greater authority and resources. Alternatively, the UK Contractors Group or the Construction Industry Council needs to expand their sector coverage. If we want the attention of Government, we should focus on how improved performance in our industry can help to reduce Government costs.

- Adopt New Business Models that Promote Change

Business models are fundamental to changing behaviour. We must move away from models that encourage short term thinking and find ways to incentivise long term value creation. This could include incentivising developers to hold and manage property, rather than developing to sell, encouraging contractors to move away from subcontracting to business models based on vertical integration or integrated teams, or for suppliers to take a financial interest in the on-going performance of their completed projects, rather than walking away after installation.

- Develop a New Generation of Leaders

We must develop a new generation of leaders who can communicate their vision and drive change in culture and behaviours. We need leaders who can help the public understand our contribution to a successful society and economy and help to attract more of the best recruits to our industry. G4C shows that the younger generation has the right aptitudes and desire for change, so our challenge is to speed up the natural pace of evolution. There needs to be a major co-ordinated push across the industry to improve the quality of leadership development, both at a project team level but particularly at the top of the industry.

- Integrate Education and Training

Together with the education sector and professional bodies, we need to promote a wider strategic understanding of the built environment and how all disciplines inter-relate to deliver solutions.

- Procure for Value

All customers in the chain need to professionalise their procurement to achieve best value, rather than focusing on lowest price. They also need to be more open to invite and assess innovative proposals by suppliers. The inability to assess alternative bids or those based on outcome specifications, or to take account of both capital and revenue expenditure let alone value, severely constrains innovation at the point at which team members are selected.

- Suppliers to Take the Lead

In the current economic downturn, clients will struggle to lead the way – we need suppliers to show how they can create additional value. Industry firms and their clients have a strategic choice – turn back to the bad old ways of lowest-price tendering with negative margins and a subsequent claims battle, or embrace beneficial, sustainable change. This starts with proper collaborative working including integrated, lean processes. Evidence exists for this latter course of action, but Constructing Excellence needs to be more effective in presenting this data to persuade senior decision-makers.

The report also identified ‘22 quick win’ themes to encourage leaders in the industry, government and clients to re-consider current practice, focusing on how it might need to change to drive improvement. These themes remain highly relevant. They are described in the Wolstenholme review as follows:

Industry Leaders

1. Take the lead for the industry's change agenda. Do not wait for clients to give you permission to change. It may be another five or ten years before they will be in a position to help.
2. Exploit the recession to look for your own case for change – lift the industry by searching for better profits, funded through real value improvements, change and productivity.

3. Seek incentives for delivering innovative solutions. Your customers want them (and need them) but are not sure how to ask!
4. Do not rely blindly upon other people's recipes for success. Interpret and apply in your own way to gain full advantage and ownership of the changes.
5. The younger generation is telling you to look at construction as a part of a wider, and much more important, process that delivers the built environment. You are building stuff now that should still be fit for purpose in 2070. Are you?
6. Up your game by attracting, training and retaining your future leaders. A lot of them are choosing to bypass our industry altogether.
7. Graduates leave university with a technical qualification. Institutions will guide them to professional status. You have to convert them into people who you would trust to lead and grow your business. Steal some ideas from other sectors who understand what graduate and professional training really means.
8. People management should not be a transactional process – employees are not 'spanners on inventories'. Develop talent management as a core skill along with organisational design and change.
9. Continue to support efforts to improve the image of the industry by promoting the vital role of the built environment from an early age in schools.

Government

10. Understand the strategic value of infrastructure and develop a long-term vision for a sustainable UK built environment.
11. Develop policies to incentivise innovation and change in our industry to help speed up the modernisation process and focus the industry on the next steps.
12. Regulatory models have pulled the industry in the right direction in some sectors, along with many variants of the PFI model. Build on these to help the industry's change agenda succeed.
13. Plan for the nation's future infrastructure. It would help everybody if the plan was integrated and funded. If you are about to make cuts in infrastructure spending then you need to be honest with us. We will need to plan for the downturn or lose the momentum and skills that we are building.
14. Leadership makes a huge difference. Choose a Minister responsible for the built environment who has a real purpose and ambition and who can stay in post long enough to make a real difference.
15. Support the Chief Construction Adviser's mission to federate the departments who influence the Industry's agenda and who themselves have to act as exemplars in their

capacity as construction clients. He or she has to emulate the excellent profile that Sir David King has developed as Chief Scientific Adviser.

16. Supporting the education and professional development of the industry by working with universities to create 'system thinkers' who challenge silo approaches to problem solving.

Clients

17. Think strategically – the world is changing. Assume that legislation will get radically tougher in order to meet the environmental agenda. Understand how you need to rethink your business models to achieve a step change in sustainability performance. Achieving BREEAM 'Excellent' is a start – but it will not solve the big issues.

18. Improve your team's ability to develop and control the brief. You and your consultant teams are injecting waste into the procurement process by specifying one-offs and by introducing late changes when it is inefficient and expensive to implement them.

19. Challenge your consultants to develop more options for risk transfer. Passing the risk down the supply chain effectively turns off the innovation tap. The more innovative the solution the closer you will need to get to the supply chain and the greater the potential to generate long-term value. Work with the supply chain to understand where they are really best placed to manage risks on your behalf, and to deliver best value when they do so.

20. The supply chain wants your repeat business. An effective way to generate value is to incentivise real improvements in output in return for a 'pipeline of opportunity'. If you align longer term objectives in this way, you will create relationships based on trust with your consultant team and suppliers.

21. Few clients incentivise their teams to find radical savings in operating expenditure over the life of an investment – and yet the business case to do so is compelling.

22. Safety – always act as if you are personally responsible for safety. Your behaviour and attitude as a client will be reflected by the project team. If the moral case for investing in an environment where everybody goes home safely is not compelling enough, consider the true cost of poor safety on your programme and the reputational damage to your company.

Annex 3

Literature Review - Bibliography

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