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A STRUCTURED RESPONSE: THE EVOLVING STRUCTURAL ENGINEERING CONSULTANT

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ABSTRACT

During the past decade, the UK construction industry has experienced a number of significant government and industry supported initiatives to move construction into a safer, environmentally friendly and efficient industry.

This thesis reviews these wider construction industry initiatives and assesses their impact on the way that UK based Structural Engineering consultants carry out their work. This is carried out through a review of the IStructE (Institution of Structural Engineers) response to these initiatives, and interviews with Structural Engineering consultants on how their practices have changed as a result.

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1 INTRODUCTION

During the past decade, the UK construction industry has experienced a number of significant government and industry-supported initiatives to move construction into a safer, environmentally friendly and efficient industry.

This thesis reviews these wider construction industry initiatives and assesses their impact on the way that UK-based Structural Engineering consultants carry out their work. Four initiatives are reviewed and discussed:

1. The project brief
   A proposed change in focus to the end user of the building or facility, from the hitherto focal point of one's immediate contractual client.
2. Procurement
   A move away from traditional forms of delivery, where design and construction are separate, to alternative forms involving greater integration between all parties
3. Working together
   Collaboration leading to more integrated designs and long-term working relationships.
4. A wider knowledge base
   Increasing one's knowledge and project team input to be greater than that of specialised structural knowledge.

The impact of these initiatives is assessed in two streams. Firstly, through a review of the IStructE response to the above, with evidence drawn from IStructE publications and the presidential addresses of the last ten years, since 1997. Secondly, qualitative interviews were carried out with structural engineering consultants on how their practices have changed over a similar period.

These two streams represent an institutional or profession-wide response via the IStructE review, with the qualitative interviews providing a 'coalface' view of the impacts.

For the purposes of clarity, within this thesis, structural engineering refers to the design of structures within the medium of buildings only; this is in contrast to structural engineering in the broader civil or infrastructure-based fields where structures may include bridges, railways, tunnels, frame works etc.

Similarly, the reference to consultancy refers to independent firms whose primary product for sale is their skill set and associated information. They are independent firms in that they trade as professionals providing impartial advice to their client. This is countered against technical consultants within a broader organisation such as governments, contractors and client organisations.

2 DEVELOPMENT OF ENGINEERING CONSULTANCY

This chapter outlines the development of the broad discipline of civil engineering and the subsequent specialism of structural engineering from a UK perspective. To chart this, a brief history outlining the development of the primary UK professional institutions representing civil and structural engineers is presented, as the birth of professional institutions provides a convenient marker of when a profession is publicly accepted.

2.1 Development of Civil Engineering

Civil engineering is one of the first recognised engineering titles, and was the first to form a UK institution. Civil engineering is an umbrella profession with structural engineering maintaining many similarities. It should be noted that many structural engineers are educated as civil engineers prior to specialising in structures.

The term 'Engineer' is derived from the military. In this context, an engineer was concerned with the design and construction of tools to serve a military purpose, e.g. roads, ports and structures to facilitate military movements. During the late eighteenth century, a growing body of engineers carried out works that were similar to military engineers but were not for military purpose. For the simplicity of avoiding confusion, they adopted the title of 'civil engineers'[1], i.e. civilian, to differentiate themselves from military engineers.

Following a number of earlier evolutions from as early as 1771[2], in 1828 the Institution of Civil Engineers (ICE) received its Royal Charter[3] where it defined:

> *…the profession of the Civil Engineer being the art of directing the great forces of power in Nature for the use and convenience of man…*

and cited examples of its application in:

> *…roads, bridges, aqueducts, canals, river navigation and docks,…ports, harbours, moles, breakwaters, and lighthouses, and in the art of navigation by artificial power… and in the construction and adaption of machinery, and in the drainage of cities and towns…*

The title of 'civil engineer' (to differentiate against military) has itself become more tightly defined over time as engineers have adopted more descriptive titles to

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[1] Etchells, E.F. (1923B) Presidential Address: The Evolution of Engineering Institutions. In *The Structural Engineer*, v1, n7, 1 Jul., pp. 206-215. London: IStructE.

[2] Etchells, E.F. (1923C) Presidential Address: Formation of the Principal Engineering Institutions. In The Structural Engineer, v1, n8, 1 Aug., pp. 244-248. London: IStructE.

[3] ICE (2006) *Royal Charter, By-Laws, Regulations and Rules* London: ICE. p.3.

differentiate themselves from engineers of other disciplines. This differentiation has also allowed the creation of other specialist stand-alone engineering institutions, including the IStructE.

2.2 Development of Structural Engineering

Until the early 20th century, much of the knowledge of structures was exercised either by civil engineers or by 'constructors' that would rely upon their previous experience and published guidelines. In the early years of the 20th Century members of the ICE saw that there was sufficient scope for a body of practitioners whose area of focus was *'specialised structural work'*[4].

The IStructE (Institution of Structural Engineers) is now the world's largest professional body dedicated to structural engineering[5]. Initially starting in 1906 as the Concrete Society, its members soon became concerned with a broader structural engineering focus than that suggested by its original name. In November 1922, the Concrete Society was renamed the Institution of Structural Engineers and granted a royal charter.

Within its members journal, *The Structural Engineer*, the following definition for Structural Engineering is provided:

> *… the science and art of designing and making, with economy and elegance, buildings, bridges, frameworks, and other similar structures so that they can safely resist the forces to which they may be subjected.*[6]

It should be noted that the formal IStructE definition does not differ greatly from that defined in the ICE Royal Charter; this is not surprising given that structural engineering is a specialism of civil engineering.

The 20th century saw the introduction of large number of specific structural theories[7] and allowed structural engineering to develop distinctly from civil engineering. Notwithstanding this scientific progress, recent correspondence in *Veralum*[8] has offered alternative definitions of structural engineering[9].

> *Structural Engineering is the art of moulding materials that we do not really understand into shapes that we cannot really analyse so as to withstand forces that we cannot really assess in such a way that the public does not really suspect.*[10]

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[4] Etchells (1923D) Presidential Address: Formation of the Principal Engineering Institutions. In *The Structural Engineer*, v1, n9, 1 Sep., London: IStructE. p.278.
[5] IStructE. (no date b) *About IStructE*. [online] Accessed 18 Mar. 2006. [http://www.istructe.org.uk/about/index.asp]
[6] Stansfield, K. (Eds) (2006a) *The Structural Engineer*, v84, n1, 3 Jan., London: IStructE. p.3.
[7] Sebestyen. G. (1998) *Construction – Craft to Industry*. London: E & FN Spon.
[8] *Veralum* is the members' letters forum within the IStructE. journal *The Structural Engineer.*
[9] Stansfield, K. (Eds) (2006b) *The Structural Engineer*, v84, n3, 7 Feb., London: IStructE. p.40.
[10] Stansfield, K. (Eds) (2006a) *The Structural Engineer*, v84, n1, 3 Jan., London: IStructE. p.19.

This pun highlights that structural engineering is an applied science with its primary aim being to provide an acceptable solution to society, in contrast to a strict scientific answer to a problem.

2.3 The development of consultancy

Within the construction industry, the separation of building design from the act of building is an obvious example of the effects of the division of labour, and subsequent grouping of repetitive tasks, that developed with industrialisation. During the 20th century, both design and building have been further subdivided into individual specialisms.

Through separating design from manufacture, or design from construction, current-day engineering consultants are further removed from the site aspects of construction than they have ever been. This situation is justified by their time being better allocated in understanding the intricacies of design rather than intensely observing or partaking in the fruits of their labour.

The service that engineering consultants provide is that of specialist knowledge, on which they place a fee. By trading on knowledge, consultants must demonstrate that they have expert knowledge to deliver projects within set constraints, and that they can provide the requisite knowledge at a competitive and commensurate cost.

The role of an engineering consultant is to take established scientific principles, formulate these into simplified models, and then apply such models to fulfil social needs and desires such as infrastructure and buildings.

Up until the development of new materials, in particular reinforced concrete and mild steel, most structures that would require a structural engineer today would have been built by skilled tradesmen and master builders.

Over the period of the 20th century, with a particular focus on the latter quarter, structures have become increasingly more complicated, leading to many of the simple rules of thumb or past experience of master builders no longer being applicable. In the case of buildings, the move away from cellular buildings with regular load-bearing walls to large open floor plates has led to greater input from structural engineers.

From about the end of the 19th Century, consulting engineers began to be employed to give advice for a commissioning client only[11], rather than offer complete contractual solutions or products for sale. Thus, the role of a traditional engineering consultant is as an independent adviser of structural knowledge to the client. The extent of the remit did not extend past that of providing knowledge (i.e. preparing designs). Therefore, engineering consultants were not directly involved in the actual construction work, i.e. they did not act as builders or constructors.

[11] Grimes, P. (2005) Essay 2 – The demise of the traditional consulting engineer: opportunity or threat: A review of the UK engineering consultancy sector. Unpublished essay for MSt (IDBE) University of Cambridge.

This traditional role of the consultant has remained broadly valid in the current market place, although competition from alternative models is increasing.[12] It is worth noting that in some large civil engineering practices, both designers and constructors are employed together and thus these practices provides an integrated design and construction service.

[12] Ibid.

3 THE EVOLVING CONSTRUCTION INDUSTRY

The construction industry is an important industry for any economy and in 2001 it employed 1.4 million people across 186,000 small and medium-sized enterprises (SME) including 165,000 private contracting firms[13] across the UK. In terms of overall economic contribution, the industry's contribution varies between 5-20% of the UK's GDP[14] depending on the definition of what is included.

The UK construction industry is well recognised to be changing in a fast and significant manner[15]. There have been a number of government reports outlining why, and how, industry must evolve to deliver a more efficient, safe and sustainable construction. Three significant government reports include:

- "*Constructing the Team*" [16] in 1994 that focused on the importance of client and their needs, increased dialogue between parties and supply chain integration. This is commonly referred to as the 'Latham report'.
- "*Rethinking Construction*" [17] in 1998 as a follow-up to the Latham report. This is commonly referred to as the 'Egan report'.
- "*Accelerating Change*"[18] report of 2002 by the Strategic Forum for Construction, chaired by Egan.

These strategic reports spawned a number of further reports and initiatives by various government and industry-sponsored bodies, each with a particular agenda to deliver a better industry. Structural engineers are wedded to the construction industry and its overall performance and therefore should address the impacts of any change occurring within the industry.

This chapter will explore some of the key issues affecting the construction industry and comment on their importance to structural engineers. Due to the complexity of the

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[13] DTI (2001) *Constructing the Future; Built Environment and Transport Panel Construction Associate Programme*. London: Dept. of Trade and Industry. www.foresight.gov.uk.

[14] Connaughton , J. *An Anatomy of the UK Construction Industry*. Presentation to IDBE Masters students by John Connaughton, Davis Langdon Management Consulting. University of Cambridge, April 2005.;

Innes, S. *Sustainability: An industry perspective.* Presentation to IDBE Masters students by Sue Innes, Director, Constructing Excellence. University of Cambridge, December 2005.;

Saxon, R. (2005) *Vision for the Industry (formerly known as construction).* Presentation to IDBE Masters students, University of Cambridge., April 2005.;

Dickson, M. (2005b) An Institution for the future – safety, sustainability and much more. In supplement to the *The Structural Engineer*, v83, n19, 4 Oct.. London: IStructE.

[15] Hartley, P. (2000) *Consulting Engineering: Consulting the future*. Hertfordshire: Research Studies Press.;

Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.;

DTI (2001) *Constructing the Future; Built Environment and Transport Panel Construction Associate Programme*. London: Dept. of Trade and Industry. www.foresight.gov.uk.

[16] Latham, M. (1994) *Constructing the Team*: The final report of the government/ industry review of procurement and contractual arrangements in the UK construction industry. London: HMSO.

[17] Egan, J. (1998) *Rethinking Construction: the Report of the construction task force*. London: DTI.

[18] Egan, J. (2002) *Accelerating Change: A report by the Strategic Forum for Construction*. London: Rethinking Construction.

issues discussed, there is an inherent level of overlap between issues, and thus some repetition.

3.1 The project brief

The construction industry is recognised as traditionally being one where most parties are only concerned with satisfying those next above them in the contractual chain, with little regard to others involved. This has led to a very hierarchical and cumbersome chain of communication with narrow viewpoints for the parties involved.

Rethinking Construction signalled a focus towards the 'end user' as one of its critical drivers of change. Examples of end users are the shopper in a retail complex, or the individual tenants/owners in a residential development. Typically, neither of these people are likely to be the client for those involved in the design or construction. Critical to a greater focus on the end user is to understand the business of one's client. By focusing on improving the client's business, for example through improved rental returns emanating from better design, both the end user and client are provided with a better product. Hence the provision of added value.

The provision of added value is seen to be an opportunity that creates a much better product without considerable risks or resources, albeit a change in mindset and the way that relationships are managed.

The benefits of good design are well known and it is recognised that they can be exploited in broader economic and social terms[19], although the benefits may not be immediately recognised to the constructor or design team, particularly if they are members of a fragmented industry.

One proposed measurement of good design is through the use of whole-life costing. With whole-life costing, all the costs and opportunities involved in a project from cradle to grave are accounted for, thus giving a more holistic approach to a building's real cost. Typically the costs of maintenance, refurbishment and upgrades and disposal are included in addition upfront acquisition and capital-build cost. The introduction of such measures led to them being incorporated into some alternative procurement methods, the notable example being Private Finance Initiative (PFI).

3.2 Procurement

There has been much discussion about the need to move away from the traditional strategy of procurement, where design and construction are tendered separately, to a more integrated approach. With an integrated approach, there is an increased ability to consider the different demands of design, construction, quality, end-user requirements and whole-life costs when compared to traditional routes. In addition, different forms

[19] Egan, J. (2002) *Accelerating Change: A report by the Strategic Forum for Construction*. London: Rethinking Construction.

of procurement are designed to transfer risk from the client to those best able to manage the risk[20], the construction industry.

Examples of integrated procurement routes include: Public Private Partnerships (PPP) of which Private Finance Initiatives (PFI) are common in buildings; Design and Build; and Prime Contracting. The choice and suitability of method are determined by the needs of each individual project.

An example of the UK government's internal push towards integrated procurement is demonstrated in the Office of Government Commerce (OGC) procurement guide *Achieving Excellence*[21]. In this guide, public sector client's are advised that 'traditional' forms of procurement should not be practiced unless explicitly shown to be in the public interest when compared to more integrated procurement routes[22].

A move towards a delivery method where price is not the key decision point allows quality and value to be more readily incorporated. The impact of competitive fees for consultants on the quality of construction was presented by Latham[23] where he cites with regards to engineers that:

> *d) 74% admit that they are producing simpler designs to minimise the commitment of resources to a task;*
> *e) 60% consider that capital costs of construction and operations are higher as a result of (d);*

Against such information it is perhaps not surprising that Latham recommends that "*consultants should be selected on a basis which properly recognises quality as well as price*"[24].

Egan identifies an inefficiency in the overall process in the "*…fundamental malaise in the industry – the separation of design from the rest of the project process… design needs to be properly integrated with construction and performance in use*"[25]. It can be surmised that one driver for alternative procurement is to create greater integration of design with construction, and to resolve this distance. It is interesting to note that this statement appears to be directed towards the designers, as it is the design that needs to be integrated.

However the integration of roles brings obvious changes to traditional roles. One example is given by Hartley[26] who believes that PFI has diminished the conventional

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[20] NAO (2001) *Modernising Construction*. London: NAO.
[21] OGC (2003a) *Achieving Excellence in Construction, Procurement Guide: 01 Initiate into action*. London: OGC.
[22] OGC (2003b) *Achieving Excellence in Construction, Procurement Guide: 06 Procurement and contract Strategies*. London: OGC.
[23] Latham , M. (1994) *Constructing the Team*: The final report of the government/ industry review of procurement and contractual arrangements in the UK construction industry. London: HMSO. p.45.
[24] Ibid p.43.
[25] Egan, J. (1998) *Rethinking Construction: the Report of the construction task force*. London: DTI. p.27.
[26] Hartley, P. (2000) *Consulting Engineering: Consulting the future*. Hertfordshire: Research Studies Press.

role of engineering consultants to the point that they "*can simply be bought in on an ad-hoc basis*"[27]. This diminished roles is due to the greater life span focus that PFI requires, in comparison to the shorter front end design only process of traditional procurement.

3.3 Working together

In addition to alternative means for clients to select their project team, there has also been a concerted push towards integrated teams through methods such as supply-chain integration; long-term partnerships; term appointments or project partnering. A key driver for this is the push for the construction industry to develop long-term relationships, particularly involving the supply chain.

Critical to developing successful working relationships is the need for clear communication between parties. However communication by engineers is generally seen to be poor:

> *"engineers are notorious for their inability to communicate effectively… this has caused no end of damage to the profession within the UK ."*[28]

> *"being able to explain what we do has never been seen as a strength of the engineering sector… if you can't describe what you do, why should anyone be confident you could do it better? Why come and work for somebody who is confused? Why buy their shares?"*[29]

Through changing procurement routes and promoting teamwork, there is a move away from the adversarial approaches previously typical within the industry. However to adequately tackle this evolution that demands cooperation and collaboration, effective communication will the fundamental key.

3.4 A wider knowledge base

There is a common theme for the construction industry to have a greater awareness and in turn take appropriate action in aspects that may not be perceived as 'core' to the industry. Areas to be addressed as part of a continuing evolution include:

- **Sustainable development:** The current generation has been identified as being the first to have been *"resource constrained"*[30]. The need to ensure that

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[27] Ibid. p.76.
[28] Ibid. p.98.
[29] Clarke, L.A. (1998) Evolution or decay?. In *The Structural Engineer*, v76, n20, 20 Oct., p387. London: IStructE. p. 4.
[30] Luebkeman , C. (2006b) *Drivers of Change 2006*. Address at the Royal Academy of Engineering (RAEng) Visiting Professors workshop, Churchill College, University of Cambridge, 12-13 Sept. 2006.

future development occurs with due respect for resources is a new demand for the construction industry.

- **Technological development:** Technology can as play a major role in construction with the use of manufacturing techniques and advances in Information and Communication Technology (ICT) identified as key opportunities.
- **Global market place:** The role of the European Union and the reality of globalisation are creating both opportunities and threats for the UK construction industry. It is interesting to note that these have been broadly underpinned by advance in ICT.
- **Public image of construction:** Construction is a fundamental part of the economy but attracts a reputation for being a tough and dirty industry that is not accommodating towards females and is lowly paid when compared to other industries making it unattractive to school leavers. An increase in the quality of the working environment and appropriate remuneration will help to address this perception and in turn attract more to the industry mitigating against skill shortages.

4 INSTITUTIONAL RESPONSE

This chapter will discuss how the IStructE has responded to the evolving construction industry described in chapter 3. The topics are closely interrelated, and repetition between sections purely reinforces this interdependence.

4.1 IStructE Presidential Addresses and Publications

The IStructE member's journal, *The Structural Engineer*, has annually recorded the presidential addresses since 1923. Each address provides a convenient snapshot of the president's view at that time.

The IStructE council elects the president from a group of vice presidents, who are in turn elected by members. Following tenure as president, they may continue to serve on the council as a past president. This system of election should promote continuity in the council, and in the views of the Institution. It follows that the president's address should also reflect the general view of the IStructE. This assumption of continuity is tested in the review of president's address.

The presidential addresses, on a topic selected by the president, can thus be seen to be a barometer of the issues that the IStructE believed to be pertinent on a yearly basis, and in turn can be used to review how the IStructE is responding to external issues.

The IStructE prepares stand-alone publications, courses and workshops in addition to internal focus groups. The majority of these initiatives are technically focused, however some relate to changing work practices, and the future of structural engineering:

- *Rethinking Construction Toolkit*[31]
- *The Changing Role of Structural Engineers in Society*[32]
- *The Changing Roles of Structural Engineers in Society: Report of a Strategic Study*[33]
- *An Institution for 2010*[34]
- *A Strategy for Evolution*[35]

A review of the past 10 president's addresses, from 1997 to 2006, and the above publications has been undertaken and a summary is presented in Tables A1 and A2, located in Appendix A. The results of this review are presented in this chapter.

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[31] IStructE. (2004a) *Rethinking Construction Toolkit*. London: IStructE.
[32] Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.
[33] May, I.M., Talbot, R. and Owens, G. (2004) The changing roles of structural engineers in society: report of a strategic study. In *The Structural Engineer*, v82, n19, 5 Oct., pp. 27-30. London: IStructE.
[34] IStructE (2002) *An Institution of 2010*. London: IStructE.
[35] Stansfield, K. (Eds) (1999a) Strategy for evolution. In *The Structural Engineer*, v77, n6, 16 Mar., p.15. London: IStructE.

4.2 The project brief

Understanding and, in turn, defining a client's demands and aspirations is crucial for structural engineers in order to provide a service that is a suitable within a timely manner.

Prior to Blockley[36] there were no comments from the previous presidents on the client and their requirements, with the exception of a brief statement from Hill[37] that clients were starting to seek innovation. Whilst a changing client brief was not mentioned extensively in the Latham report of 1994, it was a primary driver in *Rethinking Construction* in 1998. This absence of comments from the presidents may be due to a changing client brief not yet filtering through industry in sufficient force to warrant the presidents to commentate upon it.

In 2001, Blockley[38] suggested that structural engineers often misunderstand the notion of adding value. Adding that real added value is not providing the solution to a technical problem, but understanding client's actual interest: how an asset can improve their business. This can be seen to be the first response from a president towards *Rethinking Construction*.

Dickson[39], in 2005, discusses a new measurement of quality, Design Quality Indicators (DQI's) and reinforces the importance of the structural engineer's input into architecture and thus influencing the attainment of such DQI's. His address further identifies that a future driver for engineering will be a focus on long term value.

Both Fordyce[40] and Harvey[41], in 2004 and 2006 respectively, both gave examples of how added value was realised from working closer with contractors. However, these examples are felt to differ from the drive of *Rethinking Construction* as reiterated by Blockley and Dickson. The added value described by Fordyce and Harvey related to a more efficient process during design and construction, 'added value' that may effect the client immediately, perhaps through a lower capital cost. The added value stemming from *Rethinking Construction* focuses design and construction providing a more efficient end product; one that would not only benefit the client, who may be only concerned with short term profitability, but also the long term views of the end user .

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[36] Blockley, D.I. (2001b) Thinking outside of the box with Phil's eight new maxims. In *The Structural Engineer*, v79, n20, 16 Oct., p.22. London: IStructE.
[37] Hill, J.A. (2000) Expanding horizons. In *The Structural Engineer*, v78, n20, 17 Oct., p.15. London: IStructE.
[38] Blockley, D.I. (2001b) Thinking outside of the box with Phil's eight new maxims. In *The Structural Engineer*, v79, n20, 16 Oct., p.22. London: IStructE.
[39] Dickson, M. (2005b) An Institution for the future – safety, sustainability and much more. In supplement to the *The Structural Engineer*, v83, n19, 4 Oct.. London: IStructE.
[40] Fordyce, M. (2004) Structural engineering – a passport to travel. In *The Structural Engineer*, v82, n19, 5 Oct., pp.22-6. London: IStructE.
[41] Harvey, D. (2006b) The value of the Institution – a new perspective. In *The Structural Engineer*, v85, n19, 3 Oct., pp.45-51. London: IStructE.

Process and product can not be easily separated as independent, as an efficient process must be reflected in the final product in some way, and vice versa. But the subtleties of this difference, and the subtlety of which party added value directly effect is, in the author's eyes, and important distinction.

The IStructE guide on *Rethinking Construction*[42], not surprisingly, pushes the *Rethinking Construction* message and advocates the importance of understanding clients needs, the end user and delivering value.
It is perhaps a little disappointing that only a few presidents discuss these aspects in any detail. The published guidance is clear in its message and the impact on structural engineers in their daily work appears to limited, but the benefits significant. The cause of this lack of recognition, particularly between 2002 to 2004, is due to the topics selected by these presidents, and is discussed in the following section.

4.3 Procurement

The impact of changing procurement strategies on the structural engineers, if any, has not been strongly reflected in the presidential addresses despite being a key recommendation from the Latham and Egan reports.

The first reference in a presidential address to changing procurement is in 2000 by Hill[43]. Hill acknowledged that the way of delivering structural engineering would change because of shifts in the industry. It appears that the changes proposed were a significant step as the measures presented: partnering, frameworks and KPI's (Key Performance Indicators), were felt by Hill to be sufficiently new to IStructE members that he presented a definition of these terms. Hill recommended that the IStructE should contribute to discussions about procurement and a task group formed to prepare guidance for members, although this guidance[44] was not published until 2004. These recommendations suggest that the changes to the industry were believed to have an effect on structural engineers.

This first reference is some six years after the Latham report and two years after *Rethinking Construction*. Given that this address makes recommendations for the IStructE to take greater awareness of changing procurement, one conclusion is that the impact on structural engineering takes many years to filter through following strategic direction from the UK government and that the IStructE is reacting to slow industry change rather than being a proactive driving force.

It is four years later in 2004, that the IStructE president again discusses procurement methods. The intervening years provide a mixed story of the debates within the construction industry. Whilst Blockley[45], in 2001, does not discuss procurement per se, he does actively promote the merits of *Rethinking Construction*.

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[42] IStructE. (2004a) *Rethinking Construction Toolkit*. London: IStructE.
[43] Hill, J.A. (2000) Expanding horizons. In *The Structural Engineer*, v78, n20, 17 Oct., p.15. London: IStructE.
[44] IStructE. (2004a) *Rethinking Construction Toolkit*. London: IStructE.
[45] Blockley, D.I. (2001b) Thinking outside of the box with Phil's eight new maxims. In *The Structural Engineer*, v79, n20, 16 Oct., p.22. London: IStructE.

However in 2002 & 2003, neither president makes any reference to the proposed changes in procurement, thus suggesting that were not seen as being of high importance. McKittrick's[46] 2002 address is primarily focused upon what may be described as traditional discussion points within structural engineering: public safety, professional conduct; engineering training; and the need for licensing of structural engineers. Whilst McKittrick does discuss the changing construction industry directly, he does recognize that society is rapidly changing and discusses its impacts on the traditional values of his address.

Nethercot[47], in 2003, also discusses traditional values; focussing on professional conduct, risk, ethics and fees; and similarly does not discuss *Rethinking Construction* in his address. In a separate interview, Nethercot explains that whilst he is aware of it and agrees with its ethos, he does not feel that *Rethinking Construction* can be converted into actions[48], consequently he chooses to discuss other topics in his address. It is notable that he makes no mention of *Acceleration Change*[49], the update to *Rethinking Construction*, despite it being published in 2002.

The silence of McKittrick and Nethercot is interesting for a number of reasons. Firstly, they highlight that the presidential addresses are a topic of choice, and consequently represent a very personal view. This is particularly clear in the comments from Nethercot regarding *Rethinking Construction*. More importantly, they indicate that the presidential addresses may not be a true representation of the IStructE activities or priorities at a given time.

Despite the lack of reference to *Rethinking Construction* or *Acceleration Change* by Nethercot in his address, the IStructE was responding to the changing industry during his term as president (Oct. 2003 – Sept. 2004). IStructE initiatives during this period included the commissioning of a study into the changing role of structural engineers[50] in October 2003; the preparation of a members' guide titled *Rethinking Construction Toolkit*[51] in January 2004 and a *Rethinking Construction Workshop* [52]in March 2004. The focus on *Rethinking Construction*, despite the more recent *Accelerating Change*, is again mirrored in these publications.

It is of further interest that in his year in review[53], Nethercot did not mention any of these initiatives, further emphasising a separation between the IStructE's activities and priorities and those of the president.

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[46] McKittrick, B. (2002) The institution – who cares?. In *The Structural Engineer*, v80, n20, 15 Oct., pp.25. London: IStructE.
[47] Nethercot, D. (2003) IStructE: I'm a Structural Engineer. in *The Structural Engineer*, v81, n19, 7 Oct., pp. 35-9. London: IStructE.
[48] Stansfield, K. (Eds) (2003) Educational values underlie new President's approach. In *The Structural Engineer*, v81, n18, 16 Sep., pp.17-18. London: IStructE.
[49] Egan, J. (2002) *Accelerating Change: A report by the Strategic Forum for Construction*. London: Rethinking Construction.
[50] May, I.M., Talbot, R. and Owens, G. (2004) The changing roles of structural engineers in society: report of a strategic study. In *The Structural Engineer*, v82, n19, 5 Oct., pp. 27-30. London: IStructE
[51] IStructE (2004a) *Rethinking Construction Toolkit*. London: IStructE.
[52] IStructE (2004b) *Rethinking Construction workshop - just one week to go*. [online] Accessed 18 Nov. 2006. [http://www.istructe.org/news/article.asp?NID=137].
[53] Nethercot, D. (2004) The President's year in perspective. In *The Structural Engineer*, v82, n18, 21 Sep., pp. 14-15. London: IStructE.

Both Fordyce in 2004, and the 2006 president Harvey, who are based overseas in Australia and Canada respectively, provide some useful perspective to what was, before their respective appointments as president, primarily a UK-based institution. As a consequence of their location, their input into changing procurement methods in the UK would naturally be limited.

Notwithstanding their distance from the UK, both presidential addresses make direct reference to project delivery methods, particularly those of Design and Build; PPP and framework style methods, and the added value gained through working together. Fordyce[54] reinforces the thoughts of Hill[55] that the position of the structural engineer in the team and thus the delivery of structural engineering is changing because of changing procurement.

In 2005, Dickson[56] identifies a conflict in the process demanded by modern procurement. He explains that to provide an efficient product, a linear procurement process is preferred, one that is free from any changes. This is in contrast to the development of the optimal design, which is the product of iterative and cyclical refinement. To satisfy the modern customer, Dickson advocates the separation of structural design into "*design for concept"* and "*design for procurement"* .

Notwithstanding this conflict of linear procurement and iterative design, Dickson asserts that structural engineers are capable of influencing the initial design phases whilst taking appropriate direction during the procurement stages. The importance of the structural engineer on procurement is strongly advocated by Dickson who assumes "*structural engineering is the backbone to the procurement process*"[57].

Only four presidents have discussed changing procurement strategies in their addresses, with only Hill and Dickson explicitly identifying changing procurement as a result of UK industry initiatives. Whilst Fordyce and Harvey actively address the merits of close integration with contractors, these views must be observed in the light of their offshore backgrounds. They are not a direct response to UK industry pressures.

As the presidents select their address topics individually, it can only be surmised that those that omitted procurement did so believing that there were no significant threats or opportunities for structural engineers, or that their impact was of lesser importance compared to their topics as chosen.

An alternative scenario is that the presidents were choosing to strengthen and maintain the IStructE's traditional standing as a learned society and that they believed

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[54] Fordyce, M. (2004) Structural engineering – a passport to travel. In *The Structural Engineer*, v82, n19, 5 Oct., pp.22-6. London: IStructE.
[55] Hill, J.A. (2001) John Hill's year. In *The Structural Engineer*, v79 n18, 18 Sep., p.17. London: IStructE.
[56] Dickson, M. (2005b) An Institution for the future – safety, sustainability and much more. In supplement to the *The Structural Engineer*, v83, n19, 4 Oct.. London: IStructE.
[57] Dickson, M. (2005a) Michael Dickson CBE: Shaping the world. In *The Structural Engineer*, v83, n18, 20 Sep., pp.28-32. London: IStructE. p31.

that changes in procurement were merely a change in the way that the business of structural engineering was 'bought' and thus was not 'worthy' of discussion.

In contrast to many presidential addresses, the *Rethinking Construction Toolkit*[58] actively brings changing procurement to the attention of structural engineers. The toolkit suggests that the benefits of working on a repeat business basis offer an improvement on how work is done (with a benefit to the structural engineer) and the delivery of better value to the client. It contrasts this with the situation of bidding for work and one-off commissions as being the "*less attractive end of the market*".

The toolkit asked structural engineers to assess their current position and to get actively involved in the changing process. The toolkits placed much significance on the move away from traditional tendering, stating that one must keep up to date to avoid missing out and that, if required, practices should actively employ those with partnering experience.

The toolkit clearly indicated to structural engineers that change is afoot and practices urgently need to get involved in the changes or risk missing out. The guidance given is much stronger in it message, and given earlier, than that from the presidential addresses. Given that it is a formal IStructE publication, it may be construed to have a greater influence than the yearly presidential addresses.

The need for a response from structural engineers due to changes in procurement is further highlighted in a strategic study titled *The Changing Role of Structural Engineers in Society*[59]. This document confirms that not only are changes to the procurement processes occurring, but these are in turn changing the relationships between the client and the structural engineer.

With regards to individual types of procurement, this study suggests that the use of traditional types of procurement is becoming limited, with design and build becoming the most dominant form for commercial and industrial-type buildings; notwithstanding the emergence of alternative methods it is appreciated that some methods, in particular PFI, need improvement[60].

It has been observed[61] that the larger consultancies have experienced the effect of changes in procurement, manifested in the team dynamic and the emergence of project teams consisting of client, design and construction teams. The clients within such project teams tend to be informed clients, who are focused on best value in lieu of tight costs. Such clients tend to be associated with larger, higher value or more prestigious projects. In many ways this mimics the *Rethinking Construction Toolkit*[62] message that resisting alternative procurement is likely to lead to work at the bottom end of the market.

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[58] IStructE (2004a) *Rethinking Construction Toolkit*. London: IStructE.
[59] Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.
[60] Ibid.
[61] Ibid.
[62] IStructE. (2004a) *Rethinking Construction Toolkit*. London: IStructE.

In the scenario described above, structural engineers are afforded direct client contact and influence that may not have existed under traditional methods. This has the positive secondary effect of raising the status of the structural engineer. In contrast, the clients of smaller consultancies tend to be cost and fee focused: often placing the structural engineer in a supply chain scenario led by the architect.

From these observations it may be inferred that smaller practices may find it difficult to move away from traditional methods unless they secure large or prestigious work. However, it is the existence of informed clients, and their pursuit of best value, that moves projects away from traditional methods. This education of clients forms one of the recommendations in the study, thus hoping to move clients away from traditional routes and in turn allowing structural engineers better client access.

This report[63] further identifies that modern procurement strategies require at least one party to have a holistic view of the overall construction process and recommends this as an opportunity for structural engineers. By accepting this challenge, the structural engineer will be able to not only provide greater value to the client, but be in a position to strengthen the image of structural engineering to clients and the public.

The reports prepared by the IStructE clearly indicate that procurement routes are changing and that they are creating opportunities for structural engineers. Many of the recommendation of these reports are echoed by later presidents, in particular Dickson, who would have had the benefit of their publication at the time of his address.

Of note is the timing of the IStructE publications, with the bulk published in 2004, but referencing the 1998 *Rethinking Construction*[64], despite an update in 2002 with *Accelerating Change*[65]. One explanation may be that it took the construction industry many years to digest and implement the recommendations from *Rethinking Construction* and that the IStructE publications were a reaction to a changing industry, ie it was waiting for changes on the ground prior to advising its members on how to react.

In contrast to this top down approach from industry, the IStructE could have actively embraced the recommendations of *Rethinking Construction* upon its publication and been part of the drive for its implementation. Such an active approach would suggest that IStructE members have sufficient respect and authority to effect such a change.

Furthermore, acting proactively, i.e. being a player in driving a commercial evolution within the construction industry, may be construed as being a step away from its traditional role as a learned technical institution. Consequently such an active approach was not pursued, and proposed industry changes were not discussed, in publications or presidential addresses, until evidence of its acceptance within industry had occurred.

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[63] Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.
[64] Egan, J. (1998) *Rethinking Construction: the Report of the construction task force*. London: DTI.
[65] Egan, J. (2002) *Accelerating Change: A report by the Strategic Forum for Construction*. London: Rethinking Construction.

4.4 Working Together

Alliances with other professions and bodies, collaborative working within project teams and increased communication from structural engineers are recurring themes in many of the IStructE addresses and publications.

The IStructE's report[66] on changing society identifies that the construction industry is moving from a discipline-orientated industry to a project-orientated industry. As the industry becomes more project focussed, the dynamics within projects team become increasingly more important.

The structural engineer has always been subjected to debates about its role in the design team, and this is reflected in the IStructE's literature dating back from the first IStructE journals[67] to current issues. The level of interaction has been discussed at both the individual or project level, and similarly at the institutional or profession level.

The majority of presidents note the importance of alliances with both government and within the construction industry. In particular, they often identify the Institution of Civil Engineers (ICE); the Royal Institute of British Architects (RIBA); and the Construction Industry Council (CIC) as being important allies.

Dickson[68] adds to these the Chartered Institution of Building Services (CIBSE) and the Chartered Institute of Building (CIOB). The choice of CIBSE mirrors the growing costs of building services in construction combined with the need to reduce the energy usage and the drive for sustainable development. The identification of CIOB may be seen as a response to the demands of construction practices on-site, and it is within this context Dickson specifically notes the need for collaboration in procurement, construction methods and health and safety. This can be seen as an example of trying to close the distance between designers and constructors, addressing Egan's "*fundamental malaise"*.[69]

At a project, or personal level, the importance of collaborative team working is discussed by many presidents[70]. Design is multi-disciplinary in nature, and structural engineers must ensure that they are not only aware of this, but that they address their working practices to ensure that collaboration is successful.

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[66] Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.
[67] Leverton, W.J.H. (1923) The Architect and Engineer. in *The Structural Engineer*, v1, n2, 1 Feb., pp. 37-42. London: IStructE.
[68] Dickson, M. (2005b) An Institution for the future – safety, sustainability and much more. In supplement to the *The Structural Engineer*, v83, n19, 4 Oct.. London: IStructE.
[69] Egan, J. (1998) *Rethinking Construction: the Report of the construction task force*. London: DTI. p.27.
[70] Roberts, J.R. (1999) Promoting the profession. in *The Structural Engineer*, v77, n20, 19 Oct., pp. 14–18. London: IStructE; Fordyce, M. (2004) Structural engineering – a passport to travel. In *The Structural Engineer*, v82, n19, 5 Oct., pp.22-6. London: IStructE;
Hill, J.A. (2000) Expanding horizons. In *The Structural Engineer*, v78, n20, 17 Oct., p.15. London: IStructE;
Harvey, D. (2006b) The value of the Institution – a new perspective. In *The Structural Engineer*, v85, n19, 3 Oct., pp.45-51. London: IStructE.

As team players, structural engineers must recognise their roles in finding win-win solutions through not necessarily working outside their competence, but being prepared to work to a wider purpose[71]. This wider purpose can be defined as the provision of value; to do this requires the recognition of the structural engineer's inter-dependence with others in the design team[72]. Structural engineers must share their knowledge and experiences, and at the same time expand their contribution to the project team.

The team players, typically identified as collaborators, mirror those of the professional institutions, particularly architects and M&E engineers. However it is only in the later addresses, in particular those by non-UK based presidents[73], that contractors were discussed as important collaborators.

As non-traditional procurement strategies are being developed, particularly those that place the contractor in a stronger position or as clients, such as design and build contracts, the degree of interaction with contractors will increase. However, this is not reflected in many of the addresses or documents. Where interaction and collaboration are discussed, it is primarily in reference to the traditional professions. This suggests a lack of recognition of the potential input from contractors.

Roberts[74] explains that structural engineers should take time to explain their designs as all the effort applied during design is wasted if it is not properly communicated to the construction team. This advice appears sensible, however it also suggests a view that the construction team is subservient to the structural engineer's design. One modern alternative is that the construction team may drive some of the structural decisions, such as the choice of material or use of prefabricated elements, to pursue wider efficiencies in construction.

The input from specialists, including subcontractors and contractors is a central theme of Latham's report[75] embodied within organisational frameworks such as supply-chain integration and partnering. Such frameworks require not only repeat orders, but also feedback or input to allow processes to evolve. This feedback includes input from those on site to the designers, and much of the IStructE's discussion appears to be focussed upon collaboration between designers only.

For successful collaboration to take place, effective communication is paramount. The need for stronger communication from structural engineers is a consistent theme, with many presidents identifying poor communication skills and stating the need for this to

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[71] Blockley, D.I. (2001b) Thinking outside of the box with Phil's eight new maxims. In *The Structural Engineer*, v79, n20, 16 Oct., p.22. London: IStructE.
[72] Ibid.
[73] Fordyce, M. (2004) Structural engineering – a passport to travel. In *The Structural Engineer*, v82, n19, 5 Oct., pp.22-6. London: IStructE;
Harvey, D. (2006b) The value of the Institution – a new perspective. In *The Structural Engineer*, v85, n19, 3 Oct., pp.45-51. London: IStructE.
[74] Roberts, J.R. (1999) Promoting the profession. in *The Structural Engineer*, v77, n20, 19 Oct., pp. 14–18. London: IStructE.
[75] Latham, M. (1994) *Constructing the Team*: The final report of the government/ industry review of procurement and contractual arrangements in the UK construction industry. London: HMSO.

be addressed. Given that this continues to be raised one can only suggest that structural engineers have not been adequately responding to this issue.

The cost of poor communication is perhaps well described by Clarke[76] who suggests that the cause of most errors is due to relationships and behaviours of people, not technical matters. If structural engineers wish to ensure that structures are safe, then clear communication is of similar importance to getting the calculations correct.

However, the construction industry is historically adversarial and open relationships are not common. Notwithstanding this, the encouragement from the IStructE's toolkit[77] is for problems to be shared with the team. Hill's[78] statement that knowledge should be shared, and Blockley's[79] belief that there is a duty of care to be open and communicate openly echo this encouragement from the toolkit. It can be considered that these encouragements are a proactive step in placing structural engineers at the leading edge of industry change.

Through these references the IStructE clearly advocates that structural engineers should not work in isolation from other professions, at either a personal/project or at institutional/profession levels. But the importance of input from contractors and others involved on-site is perhaps a little understated. The adage that *communication is key* continues to apply if structural engineers are to evolve under current demands.

4.5 A wider knowledge base

The wider brief that structural engineer may need to digest is wide reaching by definition. The incorporation of pure non-structural aspects into structural engineering is not new, for example the IStructE's 1999 internal strategy document[80] identified the growing importance of the environment, health and safety and technology to the role of the structural engineer. This increase in breadth may be loosely categorised as being technical in nature, and thus part of the natural evolution of a learned society.

However Blockley[81] discusses a larger role for the structural engineer. Blockley identifies an opportunity through engaging in wider societal issues and asserts that structural engineers must 'get out of the box'. A role is discussed where the structural engineer does not only have specialist knowledge within the team, but in parallel has a holistic view of the project and society. Dickson[82] later describes this broader

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[76] Clarke, L.A. (1998) Evolution or decay?. In *The Structural Engineer*, v76, n20, 20 Oct., p387. London: IStructE.
[77] IStructE (2004a) *Rethinking Construction Toolkit*. London: IStructE.
[78] Hill, J.A. (2001) John Hill's year. In *The Structural Engineer*, v79 n18, 18 Sep., p.17. London: IStructE.
[79] Blockley, D.I. (2001b) Thinking outside of the box with Phil's eight new maxims. In *The Structural Engineer*, v79, n20, 16 Oct., p.22. London: IStructE.
[80] Stansfield, K. (Eds) (1999a) Strategy for evolution. In *The Structural Engineer*, v77, n6, 16 Mar., p.15. London: IStructE.
[81] Blockley, D.I. (2001b) Thinking outside of the box with Phil's eight new maxims. In *The Structural Engineer*, v79, n20, 16 Oct., p.22. London: IStructE.
[82] Dickson, M. (2005b) An Institution for the future – safety, sustainability and much more. In supplement to the *The Structural Engineer*, v83, n19, 4 Oct.. London: IStructE.

understanding as a requirement for effective projects, although he is acknowledges that fulfilling such a broad role would be *"tough"*.

Thus over a period of four years there is an evolution from the aspiration of Blockley that a wider brief and understanding from structural engineers would be an asset, to that of Dickson who states that such a broad role is now a requirement, albeit a tough one.

Armed with a wider knowledge of the "*values, concerns and needs of others on the team*" Dickson[83] cites that the structural engineer can play a more influential role within project team. Rather than providing a reactive response, an increased understanding allows for a greater proactive role not only in design but also in the briefing, specification and procurement stages[84]. By playing a greater role at these stages, the structural engineer has the opportunity to provide added value.

The impact of technology and its demands on knowledge is perhaps best described by Thorburn[85] who draws an analogy similar to radioactive decay in suggesting that modern structural engineers have a technological "half life" of approximately seven years. Such a limited period, which can one assume is only becoming shorter, is placing greater demands on both initial education and ongoing professional development of core engineering skills, on top of which there is the digestion of a wider agenda. A considerable workload.

Sustainability has not been a theme noted in any of the presidential addresses until 2004, indeed the 2003 president stated that he believed that sustainability, whilst important, would not be presented in his address as it was not a 'core issue'[86].

The importance of sustainability to structural engineers is well documented in later addresses and subsequent IStructE initiatives, often with sustainability discussed as a discrete topic of it own. A number of IStructE documents[87] identify that sustainability is not merely a major pressure for structural engineers, but a major opportunity for structural engineers to play a larger role in the construction industry.

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[83] Ibid. p.10
[84] Ibid.
[85] Thorburn, S. (1997) The challenge of structural engineering: safety, with economy and harmony. In *The Structural Engineer*, v75, n20, 21 Oct., p.349. London: IStructE.
[86] Stansfield, K. (Eds) (2003) Educational values underlie new President's approach. In *The Structural Engineer*, v81, n18, 16 Sep., pp.17-18. London: IStructE.
[87] Dickson, M. (2005a) Michael Dickson CBE: Shaping the world. In *The Structural Engineer*, v83, n18, 20 Sep., pp.28-32. London: IStructE.;
Dickson, M. (2005b) An Institution for the future – safety, sustainability and much more. In supplement to the *The Structural Engineer*, v83, n19, 4 Oct.. London: IStructE.;
Dickson, M. (2006) A year of challenge. In *The Structural Engineer*, v84, n18, 19 Sep., pp.26-8. London: IStructE.;
May, I.M., Talbot, R. and Owens, G. (2004) The changing roles of structural engineers in society: report of a strategic study. In *The Structural Engineer*, v82, n19, 5 Oct., pp. 27-30. London: IStructE.;
Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.; IStructE (2004a) *Rethinking Construction Toolkit*. London: IStructE.

The identification and management of risk as a fundamental aspect is identified. In 1997 Thorburn states that "*Clients should be made aware of the technical risks and the consequence of uncertainty*"[88].

Four year later in 2001, Blockley[89] addresses risk in two of his eight maxims. In his first maxim *Look inside out and outside in*, Blockley believes that engineers need to think about "*how to justify the way we manage uncertainty and risk*"[90]. His fourth maxim, "*Look for unintended consequences*", is dedicated to risk management and the importance of practical rigour to engineering.

In the recent addresses of 2005 and 2006, both Dickson[91] and Harvey[92] have stated that the understanding of risk management is intrinsic to structural engineering. This is similarly supported in the IStructE publications[93].

Over the period reviewed, the identification and management of risk has become increasing more important and of greater detail. The earlier discussions, suggest that merely identifying the risk and consequences was sufficient, with later evidence suggesting that that risk management is now an intrinsic part of the non-technical requirements demanded from a structural engineer. The broader role for the structural engineer is possibly best defined by Harvey's comment:

> *"To be successful the modern structural engineer not only needs to be competent, but needs to understand risk management, teamwork and creating added value"*[94]

[88] Thorburn, S. (1997) The challenge of structural engineering: safety, with economy and harmony. In *The Structural Engineer*, v75, n20, 21 Oct., p.349. London: IStructE. p.349.
[89] Blockley, D.I. (2001b) Thinking outside of the box with Phil's eight new maxims. In *The Structural Engineer*, v79, n20, 16 Oct., p.22. London: IStructE.
[90] Ibid p.24.
[91] Dickson, M. (2005a) Michael Dickson CBE: Shaping the world. In *The Structural Engineer*, v83, n18, 20 Sep., pp.28-32. London: IStructE.
[92] Harvey, D. (2006b) The value of the Institution – a new perspective. In *The Structural Engineer*, v85, n19, 3 Oct., pp.45-51. London: IStructE.
[93] May, I.M., Talbot, R. and Owens, G. (2004) The changing roles of structural engineers in society: report of a strategic study. In *The Structural Engineer*, v82, n19, 5 Oct., pp. 27-30. London: IStructE.;
Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.;
IStructE (2004a) *Rethinking Construction Toolkit*. London: IStructE.
[94] Harvey, D. (2006b) The value of the Institution – a new perspective. In *The Structural Engineer*, v85, n19, 3 Oct., pp.45-51. London: IStructE. p.45.

5 THE CONSULTANT'S PERSPECTIVE

The chapter will explore how a changing industry, as described in chapter 3, is affecting structural engineering from the perspective of the consultancies who practice it.

5.1 Interview methodology

A series of qualitative interviews were held with consultants working within UK based structural engineering consultancies.

The individual consultants interviewed were selected as they are founders of established engineering practices based in the UK that have developed from structural engineering roots. Each is well respected within the industry for their views and achievements and are accordingly well represented in various industry publications and awards. The practices they established are regarded by many as being in the upper echelons of structural engineering consultancies in the UK. The four consultants interviewed were:

- Alan Baxter - *Alan Baxter Associates*
- Sam Price - *Price and Myers*
- Mark Whitby - *whitbybird*
- Chris Wise - *Expedition Engineering*

A brief biography of each is located in appendix B.

As a consequence of being at the forefront the industry, their views and beliefs may not be representative of the whole industry, but only of the leading practices. The author does not view this as weakness, for two reasons. Firstly, if they are of similar standing then their view of the industry should be similar. Secondly, as leaders, the balance of the industry will naturally want to migrate towards their models of working and understanding. Notwithstanding this, the author acknowledges that the current views for the majority of UK structural engineering consultants may not mirror all those as reported by the consultants interviewed.

The interviews were of a semi – structured format, with 13 consistent questions stemming from the outcomes of the research presented in chapters 3 and 4. A copy of the interview questions is located in Appendix B.

The interviews took place over a 3 week period from the end of January 2007, with each interview lasting approximately 60 minutes. The interviews were recorded on micro-cassette, with responses to each questions being recorded in Table B1, located in Appendix B.

From table B1, an analysis of the interviewee's answers has been undertaken. This analysis compares, firstly the individual thoughts of each interviewee, but also their collective beliefs against those of the IStructE in chapter 4.

5.2 The project brief

Questions on the client's business, the end user, innovation and added value were discussed with the consultants.

An understanding of the client's business was agreed by all consultants to be an important aspect, although Wise notes that this is not always forthcoming and Whitby adds that it is easier with repeat client's. The usefulness is in the ability to provide a better service: when the aims of the client's business are known and understood it is easier to tailor one's service to be supportive of their aspirations. The converse is that it is difficult to provide a tailored service to an unknown, or misunderstood, expectation.

Baxter places the importance of this understanding into the context of a professional service through suggesting that if you do not understand why you are providing a particular service, you are merely providing a commodity.

The consultant's views are found to be consistent with those of Blockley[95] as discussed in section 4.2 and within the recommendations of *Rethinking Construction*[96].

A critical driver of *Rethinking Construction* was a focus towards the end user. During the interview, the questions about end users required some clarification on what was meant by '*end user'*. When the difference between end user and client was elaborated upon, and in response to the actual question, all the consultants believed that they have always had the views of the end user in mind, and were not singularly client focused. Consequently, the interviewees saw that there has not been any change to the structural engineer's responsibilities or deliverables in this respect.

Notwithstanding their beliefs that they have always done so, Whitby acknowledges the influence of structural engineers directly on the end user is limited, although general discussion on the end user with clients has increased over the past 10 years.

From an architectural viewpoint, Whitby cited a traditional model for architects is that that they are designers for society, although they are paid by clients. In a similar vein, Baxter and Price individually made reference to Arup Associates whose ethos they believed encompassed a multi-disciplinary end user focus prior to *Rethinking Construction*.

From the above responses, the driver for an '*end user'* focus stemming from *Rethinking Construction* appears not to be directly applicable to structural engineers, and potentially nor to architects, but perhaps towards clients and constructors.

The role of the end user in the brief was met with consistent views from the consultants. Firstly, Baxter and Wise both expressed that briefs are often poorly

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[95] Blockley, D.I. (2001b) Thinking outside of the box with Phil's eight new maxims. In *The Structural Engineer*, v79, n20, 16 Oct., p.22. London: IStructE.
[96] Egan, J. (1998) *Rethinking Construction: the Report of the construction task force*. London: DTI.

defined and lag behind the design, with the design from one stage forming the brief for following stages.

When asked whether briefs included the DQI's, as proposed by Dickson[97], nearly all were not aware of DQI's and requested a definition. This clearly indicates that the use of DQI's has not yet made its way into main-stream consulting engineering.

All the consultants were familiar with whole-life costing, but many expressed the view that it was rarely implemented well, with capital costs tending to be the dominant driver.

Wise offered an explanation to this, citing one project where significant savings to maintenance costs could be realised for a small increase in capital cost. In this case the maintenance savings were not pursued due to the client not having an accounting mechanism to increase capital costs at the expense of maintenance budgets.

Criticisms of whole-life costing included Baxter suggesting it can miss some aspects of sustainability, such as designing loose-fit buildings for maximum re-use potential, through focusing on tangible benefits such as cost only. Whitby identifies PFI as a start to main-stream whole-life costing, although he was critical in other respect as he believed that PFI tended to "*dumb down design*".

Recent pushes for 'innovation' and 'added value' were also discussed. Added value was reported to be normal for these consultants and is embodied in working holistically. Wise reports that a reputation for added value can be a differentiator between practices. Some clients are now demanding added value and the ability to demonstrate how added value can be provided has become a decision point in successful commissions. It was a clear point from all the consultants that structural engineers must communicate their value clearly to clients.

The message on the importance of demonstrating added value to clients was far clearer from the consultants than from the IStructE evidence. An explanation for this may be simply that the consultants are closer to the commercial realities of competition and the demands of clients when compared to the more structured views of the IStructE.

Innovation was reported as no longer viewed negatively, with the consultants referring to the poor reputation of innovative 1960's structures and the legacy this reputation had on innovation in the following years. This reputation is no longer prevalent; innovation in design has now become a requisite for many clients, with clients seeing innovation as a means for added value.

Notwithstanding this new revolution for innovation, none of the consultants believed that innovation is new, as Price comments:

[97] Dickson, M. (2005b) An Institution for the future – safety, sustainability and much more. In supplement to the *The Structural Engineer*, v83, n19, 4 Oct.. London: IStructE.

> *"Innovation, or imaginative thought, has always been the business of the engineer. Thinking of ways to make things easier and cheaper to build is normal."*

Innovation did draw some criticism, particularly that it should not be pursued for its own sake. Furthermore, innovation will naturally generate greater risk that must be borne, often by the contractor and, ultimately by the client. Whitby succinctly explains this relationship as:

> *"Innovation has risk, but it must deliver added value".*

5.3 Procurement

The industry drive to move away from traditional methods of procurement to alternative methods was reported by all the consultants to be taking place with high proportions of current projects procured through alternative methods. The proportions were described to have been on the increase over the last 10 years. This is consistent with the industry objective noted in section 3.2 and the IStructE's recommendations in section in 4.3 and demonstrates a driver that has been successfully implemented by industry.

The predominant type of alternative procurement discussed was design and build. Other types of procurement methods were briefly discussed, such as PFI, construction management and framework agreements, but were not discussed at any length suggesting that their presence was not significant.

A common view of all the consultants is that alternative procurement methods are not a panacea to industry problems. Ensuring compatibility of the project with the proposed procurement method, in particular the design information available, the project's complexity and its size, is critical to the success of the project overall.

Whitby makes reference to the Holyrood Inquiry[98], regarding the recent Scottish Parliament project and the choice of construction management as a procurement strategy. Whitby believes that in this example a traditional type of contract would have led to better cost and programme control for the client in addition to less risk.

Similarly, Price gives an example that complicated refurbishments are not suited to design and build due to the inherent risks of working with existing buildings, but notes that they may be suitable for two-stage design and build in lieu of traditional procurement routes.

Price suggests that alternative methods of procurement can add another level of competition to tenders, and thus lower project costs. However, Price clarifies this in that the cost of a particular project is often finite and thus merely changing the procurement strategy is unlikely to affect the overall project cost. Interestingly Price

[98] http://www.holyroodinquiry.org/.

believes that one of the best methods to procure is via direct negotiation with a contractor.

When asked about the impact of alternative strategies on structural engineers, the consultants had mixed views.

Baxter believes that these alternative strategies are a detriment for structural engineers as they can "d*iminish the relationship to the client and society's long term interests*". Baxter gives the example of two-stage design and build contracts where the designers initially serve the client directly, then partway through the design process a contractor is appointed, with the designers then novated to the contractor. Subsequently a tension in the consultant's focus develops due to the interests of the contractor often not being strictly aligned with those of the client. This difference in alignment stems from the contractor tending to be more commercially focussed on the project alone and often having lesser concern for wider non-project specific issues such as sustainability.

Baxter further notes that procurement via competition-led design can itself act as a constraint, citing that the level of design often carried out for competitions tends to be limited due to the speculative nature of competitions. This limited design input may constrain a client to adopt a solution that may have been more developed, or even potentially dismissed entirely, had greater design iteration taken place.

In contrast, Price, Whitby and Wise all responded that alternative methods of contracts have allowed engineers to be closer to specialist contractors. The consequence is that, as Price comments *"for building designers to also be, or close to, building makers is a jolly good thing"*.

Other relationships have also matured, with Whitby stating that the client-engineer relationship is stronger now that the client and engineer can interact directly, traditionally the engineer was under the direction of the architect. Whitby's statement confirms the views of the IStructE[99] that increased client contact will stem from alternative procurement strategies.

Baxter and Wise, who both noted that their practices would often lead the design, a role traditionally held by the architect, similarly shared this view. The obvious tension from the above evolution is that the engineer-architect relationship is less comfortable.

Whitby and Price highlighted two specific aspects of how the day-to-day working has changed. Whitby notes that alternative strategies involving contractors early in the process require consultants to be better organised: in particular consultants are "*expected to be more thorough and with less room for late information"*. A consequence of this demand is the need to obtain information and coordinate with other members of the project team in a more proactive nature.

[99] Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.

Price observed that alternative routes sometimes demand a different approach to the responsibilities involved in providing information. An example is given where estimates of structural quantities, such as quantities of rebar, are provided to a client early in the design stage. The client often uses these quantities as the basis of tender when selecting a contractor. At a later stage, where the engineer is novated to the contractor, the previous structural quantities given to the client are viewed as fixed rigid quantities by the contractor, despite being prepared early in a design as 'estimates' only. Any requirements to amend the quantities, that would increase the cost for the contractor, may lead to the contractor looking to recoup costs from the consultant. This downstream pressure adds an extra dimension of foresight to how early information is provided to the client.

Interestingly, whilst Price acknowledges the tensions developed from a changing client when novation occurs as described by Baxter, he does not believe that this tension changes the responsibilities of the consultant, stating that the service provided is independent of the type of delivery.

Both Whitby and Wise disagree with the suggestion by Dickson[100] to separate design into "*design for procurement"* and "*design for concept"*. Whitby believes that structural design needs to be heavily focused upon how a structure is built, not how a structure is to be procured. He further adds that to hold discussions with the architect on the concept, and separately with the contractor regarding subcontractor buildability and interfaces is not fruitful. They must be addressed simultaneously.

Wise disagreed referring to some overseas (US and French) models, where the stages of concept, design and construction are actively separated and carried out by separate teams. In these models, Wise questions who maintains the overall understanding and responsibility for decisions made by the separate teams, and sees the potential for similar disengagement of process when separating concept from procurement.

5.4 Working Together

This section explores the structural engineering consultants working relationship with the wider industry. As previously noted in chapter 3, Egan stated that the

> *"…fundamental malaise in the industry – the separation of design from the rest of the project process… design needs to be properly integrated with construction and performance in use"*[101].

[100] Dickson, M. (2005b) An Institution for the future – safety, sustainability and much more. In supplement to the *The Structural Engineer*, v83, n19, 4 Oct.. London: IStructE.
[101] Egan, J. (1998) *Rethinking Construction: the Report of the construction task force*. London: DTI. p.27.

The consultants responded to this assertion with mixed views: Baxter, Price and Wise confirming that it generally does apply to structural engineers, whilst clarifying that they believed that their own practices were better, in contrast Whitby believed that it does not apply to structural engineers.

Notwithstanding this initial fundamental difference, the background to the replies were consistent. This initial inconsistency may be explained in that it was not always clear if they were answering with respect to their practice, or to the wider structural engineering industry.

Both Price and Whitby drew attention to the requirement for structural engineers to spend a minimum period of time on-site as part of their training to become chartered. This was described as crucial in ensuring a broader understanding of the construction process, in particular in gaining an understanding of the interfaces between trade contractors.

Price believes that such exposure to site and construction was fundamental and is critical of architects not being required to spend time on site:

> *"The single absolutely fundamental thing that would improve the building industry, far more than Egan or anything else would be for the RIBA to say that you can't become a member of the RIBA without [having] a year on site."*

Whitby holds a similar view that architects should be forced to spend time on site, but tempers this view acknowledging some architects fear that a rigorous understanding of the practicalities of construction may restrict their creativity.

All the consultants acknowledged a need for structural engineers to think of the design and construction process holistically. Price makes an analogy with product designers who require an understanding of the complete process of a product: concept, design, manufacturing, packaging, marketing, sale and ultimately profit. An innate understanding of all these elements is required prior to undertaking any detailed design. This holistic understanding is missing in the building process.

The existence of a large number of construction professionals exacerbates this problem with each profession focusing upon its own narrow responsibility only, and not taking a holistic view. Ultimately this has led to interface management being a critical role. The importance of this holistic approach and the importance of managing interface is explained by Wise:

> *"If you don't deal with the totality of a project from the beginning, you find out that you end up with a series of un-workable un-integrated systems, each one of which works perfectly on its own but has to be so fatally compromised to fit in with everything else that the whole system falls part and doesn't work very well."*

Baxter describes a *"culture of contractual complexity"* that makes it difficult to resolve interfaces, and interestingly states that most problems on site are not of the

conventional buildability or technical type, but often regard the contractual interfaces between subcontractors. This difficultly has led to a proliferation of managers, an effect that was also identified by Price. Project Managers and Construction Managers were identified as belonging to these additional tiers of managers.

A side effect of this additional tier of managers has been an increase in the distance between the parties involved, as Baxter explains "*They* [project and construction managers] *have got in the way of understanding the whole process from concept right through design, construction and handover*".

Price identifies an increase in the proportion of works undertaken by subcontractors, with some main contractors often carrying out little of the actual construction works and thus fulfilling primarily an administrative and managerial role. This in turn has led to high levels of ignorance amongst some main contractors as they lack the understanding of the whole process, and of the roles and responsibilities of the parties involved. Consequently Price describes many main contractors as *"paper pushers"* and questions their value.

Price further emphasises the problem by explaining that when direct consultation between the subcontractor and designer takes place, problems are resolved quickly and good feedback is provided to the design team.

Baxter also shares the view that the effect of extra managers combined with the involvement of contractors early, through alternative procurement routes, has diluted the ability to work in a multidisciplinary nature. As a consequence the quality of design is placed at risk.

It is interesting to note that both Baxter and Wise believed that Egan did not particularly understand the process of design citing his background in manufacturing. Therefore they believe that Egan may not have understood the impact of some of his objectives on the design process. In particular, Wise believes that Egan lacked a robust model to manage interfaces.

An increase in the poor management of interfaces, due to either poor understanding by members of the project team, the contractual complexities of subcontracting or the additional tier of management, has remarkably led to an opportunity for structural engineers. Both Whitby and Wise identified that managing interfaces is a role that structural engineers should take a greater responsibility for, due to their expertise in an area that has a direct interface with many elements within a building. This opportunity supports the IStructE[102] recommendation that structural engineers take a greater holistic responsibility for the construction process.

It appears that the problem of distance between designers and constructors is not being resolved well. Potentially it is being made worse with the increasing use of subcontractors, with attendant contractual complexities and additional management,

[102] Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.

in conjunction alternative procurement strategies, all serving to make effective communication and holistic understand increasingly difficult.

When collaboration was discussed all of the consultants were in general agreement. With respect to collaborating with the design team, all the consultants believed that their own practices already collaborated well with the design team, albeit admitting that as a profession there was some room for improvement.

The positive view from the consultants that plenty of collaboration is already occurring is interesting when compared to recommendations from the IStructE[103] that such collaboration needs to occur more. This is an example where the consultants interviewed are not representative of the wider profession. This is further emphasised in the consultants' remarks that the profession has some room for improvement regarding collaboration.

Whitby tempered any increase in collaboration with the existence of professional boundaries potentially restricting structural engineers from inputting too much into the work of other professions, unless the other professions were open to such intrusion stemming from the blurring of roles.

When discussing collaboration with contractors, three common elements were discussed:

- main contractors versus specialist subcontractors;
- contractors and the design process
- the timing of their input.

All consultants clarified the distinction between main contractors and specialist subcontractors, with the latter representing the party that physically carries out the work on site. Input from specialist subcontractors was agreed by all to be extremely useful. Both Baxter and Price were supportive of the understanding of structural engineers on buildability, remarking that it was generally good, if not better, than many specialist or main contractors.

Wise indicated the importance of constructor input through referring to the Japanese model of contractors where the constructors and designers were typically the same company. This model gives the excellent opportunity for collaboration during design, and for the designers to receive valuable feedback from the workers actually constructing.

In contrast, input from main contractors was found to be limited as their primary concern tended to focus upon contractual matters, subcontractor coordination and site

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[103] Roberts, J.R. (1999) Promoting the profession. in *The Structural Engineer*, v77, n20, 19 Oct., pp. 14–18. London: IStructE.;
Fordyce, M. (2004) Structural engineering – a passport to travel. In *The Structural Engineer*, v82, n19, 5 Oct., pp.22-6. London: IStructE.;
Hill, J.A. (2000) Expanding horizons. In *The Structural Engineer*, v78, n20, 17 Oct., p.15. London: IStructE.;
Harvey, D. (2006b) The value of the Institution – a new perspective. In *The Structural Engineer*, v85, n19, 3 Oct., pp.45-51. London: IStructE.

logistics, indeed Price comments "*talking to main contractors about buildability is just about always a waste of time*".

The ability of contractors to input into the design process was similarly met with a consistent view: most contractors do not understand the creative design process and can only respond to linear processes. Furthermore, Wise notes that contractors are often risk averse and prefer to use conventional solutions, preferably similar to one of which they have direct experience; consequently, this limits their design creativity. This limitation is sometimes imposed on the design team, limiting the overall design team's creativity.

All agreed that the timing of any contractor collaboration is of critical importance. Large amounts of input early in the design was felt would constrain the creative design process, and any work methods discussed were subject to change due to the final constructors not yet being in place contractually. Nevertheless, some limited constructor input was desirable very early to understand what was possible or viable. Whitby noted that in reality by the time that most contractors were onboard contractually, the majority of the primary structural decisions were made. Thus a tension exists that the constructor is often not engaged contractually at a time when the design decisions affecting them are taking place.

Whitby further identifies that subcontractors are primarily production orientated; subsequently they prefer working with information rich designs. By definition the design is heavily developed and the ability for the subcontractor to change the design is limited allowing them to focus upon production. This is in contrast to the creative design process, where there are relatively fewer constraints and iteration of design is common.

Relatively late subcontractor collaboration often suited the subcontractor as information rich designs were more likely to be available. Whitby suggests the ideal model would include the consultants taking a design to a stage from which the subcontractors would work most efficiently.

Whitby identifies an opportunity for structural engineers when collaborating with subcontractors through providing a clean interface of design information. An example is the use of electronic 3D models in lieu of paper drawings, with significant value added through reducing the number of site queries. This opportunity mirrors the sentiments of Blockley[104] where he believes that engineers must recognise the inter-dependence of others.

Given the above, there is some evidence to suggest that neither the designers or constructors want too much interaction from the constructors in the early design phases. This goes against some aspects of *Rethinking Construction*[105] and *Accelerating Change*[106].

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[104] Blockley, D.I. (2001b) Thinking outside of the box with Phil's eight new maxims. In *The Structural Engineer*, v79, n20, 16 Oct., p.22. London: IStructE.
[105] Egan, J. (1998) *Rethinking Construction: the Report of the construction task force*. London: DTI.
[106] Egan, J. (2002) *Accelerating Change: A report by the Strategic Forum for Construction*. London: Rethinking Construction.

Communication by structural engineers was found, not surprisingly, to be lacking by all consultants, or as Wise commented "*structural engineers do not communicate effectively – they are feeble*". Although interestingly, Baxter suggests that structural engineers communicate better, in general, when compared to project managers or building services engineers.

Both Price and Wise identified education as being the primary cause. Price refers to a culture of over-complicated language in lieu of simple explanations, making communication more difficult than required. Wise referred to the deferential training of engineers, where communication was not important. Wise believes that this may have been acceptable traditionally, but unless structural engineers can communicate the importance of their role they are likely to be seen as commodities and replaced by computer operators using prescriptive based designs.

5.5 A wider knowledge base

A future broader role for the structural engineer was explored with the consultants. Perhaps not surprisingly, and consistent with the views from the IStructE, the consultants were unanimous that structural engineers should expand their knowledge of societal issues, and bring such knowledge to the project team.

The background to this belief is that a greater understanding of society, and how one's role interacts with broader society, naturally leads to greater interest in one's work. Simplistically, the context of one's work becomes more clearly understood.

Baxter, Whitby and Wise all acknowledge that many artificial barriers stem from being 'pigeon holed' as structural engineers, and that breaking free from this "*artificial cage*", as described by Wise, is crucial. Such definition of roles is found by Whitby to be a direct consequence of traditional education systems citing that such "*narrowness stains them for life*". A broader approach to engineering is recommended by all.

In support of this broadening, both Baxter and Wise do not title, nor introduce, themselves as 'structural engineers'; that is reflected in their practice profiles and associated marketing material. Their titles as professionals are much broader along the lines of designers for the built environment, allowing them to work outside the traditional structural engineering mould.

Wise raises concerns that structural engineers must rapidly change the way that they work as their current roles are likely to be superseded and/or commoditised. The traditional remit of structural engineers is under scrutiny and they must adapt to suit current demands. In particular, that structural engineer must no longer wait to be asked for specific structural knowledge but offer broader understanding directly to clients. Such a change will require greater confidence and communication skills.

This proposed broadening of understanding and service mirrors the addresses by Blockley[107] and Dickson[108], and in particular affirms the evolution noted by Dickson that such a broad role is now a requirement, as opposed to the aspiration of Blockley.

The final discussion point with the consultants was to ask what three areas structural engineers should focus upon moving forward. This question was intentionally left open ended to remove any constraint on the level of where attention should be placed.

The areas identified were:

Alan Baxter
- Longevity of structures and their response to future generations.
- Use of existing structures in a creative way for the future
- Sustainability in an environmental sense, such as carbon footprint etc.

Sam Price
- Broadening of the understanding of society
- sustainability: in particular energy usage and embodied energy.
- Enthuse the builders about the design through explaining the design.

Mark Whitby
- Multi-disciplinary approach
- Knowledge management
- Manufacturing systems for construction

Chris Wise
- A broader education that includes contextual issues and judgement
- Multi-variable design across multiple disciplines.
- Decision making and judgements that are value based.

Out of a possible twelve different answers, there were nine distinct responses, with four responses falling under sustainability. Whilst this may suggest that sustainability is of greatest importance, it should be noted that all three of Baxter's responses were sustainability related, and that sustainability was only listed by two consultants, Baxter and Price.

Baxter's response of three sustainability items strongly suggests that structural engineers are in a good position to play a leading role in sustainability, an assertion also recommended by the IStructE[109]. Price's view is slightly less strong, stating that

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[107] Blockley, D.I. (2001b) Thinking outside of the box with Phil's eight new maxims. In *The Structural Engineer*, v79, n20, 16 Oct., p.22. London: IStructE.
[108] Dickson, M. (2005b) An Institution for the future – safety, sustainability and much more. In supplement to the *The Structural Engineer*, v83, n19, 4 Oct.. London: IStructE.
[109] Dickson, M. (2005a) Michael Dickson CBE: Shaping the world. In *The Structural Engineer*, v83, n18, 20 Sep., pp.28-32. London: IStructE.;
Dickson, M. (2005b) An Institution for the future – safety, sustainability and much more. In supplement to the *The Structural Engineer*, v83, n19, 4 Oct.. London: IStructE.;
Dickson, M. (2006) A year of challenge. In *The Structural Engineer*, v84, n18, 19 Sep., pp.26-8. London: IStructE.;

structural engineers are in a good position to influence the sustainability agenda, although not leading.

Further detail of their responses can be found in Table B1 located in Appendix B.

May, I.M., Talbot, R. and Owens, G. (2004) The changing roles of structural engineers in society: report of a strategic study. In *The Structural Engineer*, v82, n19, 5 Oct., pp. 27-30. London: IStructE.; Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.; IStructE (2004a) *Rethinking Construction Toolkit*. London: IStructE.; IStructE. (2004a) *Rethinking Construction Toolkit*. London: IStructE.

6 CONCLUSIONS

A review of how the construction industry is changing and the pressures these changes exhibit on structural engineers has been undertaken with two bodies of evidence used to assess the impacts on four industry led initiatives: the project brief, procurement, working together and a wider knowledge base.

The first body of evidence was presented in chapter 4 and utilised presidential addresses and publications from the IStructE. The second body of evidence was qualitative interviews with four UK engineering practice leaders.

A summary of the findings presented in chapters 3 – 5 is given in this chapter.

6.1 The project brief

From the evidence presented, the IStructE is found to have contributed little to raising awareness on initiatives to evolve the industry, until a number of years after the government initiatives were proposed and presented. Whilst some guidance was published in the *Rethinking Construction Toolkit*[110], the presidential addresses, with the exception of Dickson and Blockley, were not forthcoming in addressing the changes that clients may be demanding. Providing value and innovation was discussed in later addresses and publications, however it is the author's view that this was a reflection of industry requirements, as opposed to the IStructE recommending a proactive approach for their members.

The IStructE's approach, one that can be viewed as too little too late in terms of arming the structural engineer with strategic information on the future, is, in the author's opinion, disappointing from a professional body.

Potential motives for taking a less proactive approach may include that the IStructE was choosing to maintain its traditional role of a learned technical society. A manifestation of this choice could be that a changing industry or working environment would only effect how the services of structural engineering were bought, and is thus outside the traditional remit of a technical body.

The consultants provided a more positive view in context with the initiatives reviewed. They reported that understanding a client's wider purpose was inherently important in order to provide a quality service, but the client is not always their singular focus. Client requirements need to be tempered with the requirements of the final customer, or end user.

How client requirements are described in briefs was reported as often being not clear, with capital cost often remaining the primary focus with little reference to less tangible long-term aspects such as design quality or maintenance costs (which are hard to define during design, and are often funded separately to the capital cost).

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[110] IStructE. (2004a) *Rethinking Construction Toolkit*. London: IStructE.

Whilst added value and innovation were clearly identified as being requirements of the modern client, it was also clear that these were not new to the structural engineers, but greater focus is required to effectively communicate added value and innovation to the client.

The clearer explanations from the consultants on client's requirements may simply be reflective of the consultants' closer proximity to the commercial realities of competition and client demands when compared to the more structured, and potentially more established views of the IStructE.

6.2 Procurement

Whilst some presidential addresses acknowledged that changing procurement strategies would change the way structural engineers work, this was not a consistent message from the presidents, with some choosing not to deal with this pressure at all in the addresses. The non-UK based presidents gave useful insights into the impact of alternative procurement strategies, whilst Dickson strongly advocated input as he assumed that "*structural engineering is the backbone of the procurement process*"[111].

Published material from the IStructE gives strong messages on the need for structural engineers to evolve their working practices to suit the new demands, or risk being left behind. Benefits from these alternative methods of procurement were provided as being better client-engineer relationships and increasing input into the project team, with an attending increase in status for the structural engineer. At a project level, it was identified that better value and design-construction integration would be products of these alternative procurement methods.

The consultants all reported that alternative procurement methods are highly represented within their practices. This provides a strong indication that this industry initiative, moving away from traditional procurement to integrated models, has been successful. A common view of the consultants was that alternative methods had their merits, but were not a panacea to industry problems or would necessarily provide a lower cost. Examples of where traditional methods could remain valid were given.

With the exception of Baxter who believed that alternative methods diminished the input of structural engineers, Price, Whitby & Wise all stated that it had allowed the designers to get closer to the constructors. This was seen to be positive.

Some elements of day-to-day work that have evolved were discussed with examples including how design information is used and the need for structural engineers to be more proactive in getting information.

An interesting observation is that there appear signs that the construction industry has 'gone full circle'. Historically a client would engage a master-builder to design and construct on his behalf.

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[111] Dickson, M. (2005a) Michael Dickson CBE: Shaping the world. In *The Structural Engineer*, v83, n18, 20 Sep., pp.28-32. London: IStructE. p.31.

Following the division of labour, the establishment of 'professionals' and a greater complexity in construction, designers and constructors have been separated and indeed individually specialised further. This had led to a large number of specialists and the according need to coordinate between them, in addition to the attendant contractual difficulties.

In recent times, in particular the period reviewed (the last 10 years), there has been a greater drive towards engaging a party, the contractor, to lead the delivery process, i.e. design and build, and in some procurement methods, the entire project including design, i.e. PFI. Thus, the overall responsibility of a current day managing contractor draws parallels with the historic master-builder.

6.3 Working together

A shift towards a project-orientated industry from the traditional discipline-orientated one was a useful insight from the IStructE[112] and forms good background for the need for greater communication and collaboration.

The multidisciplinary nature of building design and need for collaboration was well documented by the IStructE presidents[113], although it was found that the majority of discussion on collaboration was design team focussed, with limited reference to collaboration with contractors.

Collaboration with contractors is a central theme in Latham's[114] report and was further noted by Egan in his reference to the distance between designers and constructors being the *"fundamental malaise*" [115] in the industry. The lack of recognition of the potential input from contractors in design from the IStructE appears to overlook this issue.

The consultants agreed that there was some distance between structural engineers and constructors, but noted that this was less so within their practices. Price and Whitby noted the requirement for structural engineers to spend a minimum amount of time on-site as part of their training, with Price further commenting that extending this to

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[112] Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.

[113] Roberts, J.R. (1999) Promoting the profession. in *The Structural Engineer*, v77, n20, 19 Oct., pp. 14–18. London: IStructE.;
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Harvey, D. (2006b) The value of the Institution – a new perspective. In *The Structural Engineer*, v85, n19, 3 Oct., pp.45-51. London: IStructE.

[114] Latham, M. (1994) *Constructing the Team*: The final report of the government/ industry review of procurement and contractual arrangements in the UK construction industry. London: HMSO.

[115] Egan, J. (1998) *Rethinking Construction: the Report of the construction task force*. London: DTI. p.27.

requirement to architects could be *"the single absolutely fundamental thing that would improve the building industry"*.

The increasingly complex nature of subcontractors and professionals has led to a key requirement on project being the management of interfaces. Whitby and Wise identified this as an opportunity for structural engineers to fulfil, and supported the IStructE recommendation[116] that structural engineers take a more holistic responsibility of the construction process.

Collaboration with the design team was reported by the consultants to be well developed within their practices, although admitting that the profession as a whole could improve.

Collaboration with contractors was discussed in three distinct streams: Firstly, input from specialist subcontractors was deemed more useful than that from main contractors. The former actually carrying out the works and the latter tending to be more contractually a commercially focused. Secondly, it was felt that contractors often did not understand the creative design process, preferring to work within the linear process of production.

The final stream regarded the timing of contractor input. The consultants believed that limited specialist contractor input early was invaluable, but too much input and the design may be constrained. Whitby noted the reality that by the time that many subcontractors are contractually in place, the majority of structural decision have been made. Whitby suggested that late subcontractor input was preferable for the subcontractor as it provided them with information rich design, and allowed them to focus upon their expertise, which is production.

Given the lack of IStructE discussion on contractor collaboration combined with the views of the consultants, it appears that the industry initiatives for greater contractor input may not strictly apply to structural engineering.

The adage that *communication is key* was a recurring theme with many presidents stating that structural engineers must ensure that they effectively communicate with all parties. The IStructE's recommendation[117] that structural engineers should open problems out to the project team is found to be a proactive recommendation.

Perhaps not surprisingly, the consultants found that communication skills of structural engineers were lacking or as Wise commented *"feeble"*. But there was some feeling that structural engineers did communicate better than other construction professionals. An education that narrows peoples viewpoints and places people within professional boundaries was suggested by Whitby and Wise to be key causes.

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[116] Jowitt, P., May, I.M., Talbot, R. & Beckmann, K. (2004*) The Changing Role of Structural Engineers in Society*. London: IStructE.
[117] IStructE (2004a) *Rethinking Construction Toolkit*. London: IStructE.

6.4 Wider knowledge base

The IStructE is shown to be promoting an understanding of the impacts of aspects outside construction on structural engineering; however this was felt to be a natural evolution on the technical aspects of structural engineers.

The growing requirement for effective communication and involvement in risk management was a clear statement from many IStructE presidents and publications. When discussed with the consultants, they described an increasing level of communication with clients, particularly in identifying risks. This confirms the growing importance of risk management and communication for the profession.

Blockley and Dickson both presented arguments for a wider societal role and understanding for structural engineers, Dickson stating that a broad understanding of society was now becoming a requirement for effective projects. A broader understanding was also identified as an opportunity to increase the status, and involvement, of the structural engineer in the project team.

The consultants agreed that structural engineers should develop a greater awareness and understanding of the society, and bring such knowledge to the project team. Baxter, Whitby and Wise expressed the damage that titles and roles, imposed during education, have on restricting people's abilities in participating in larger parts of their projects and society. Whitby succinctly commented that such *"narrowness stains them [people] for life*".

The IStructE in later evidence promotes the growing field of sustainability as a key opportunity for structural engineers, suggesting that structural engineers would be ideal leaders in this field. All the consultants were acutely aware of the opportunities for structural engineers, and their responses on future areas of focus had a strong sustainability flavour. However the potential role for structural engineers, compared to that promoted by the IStructE was tempered by Price's comments that structural engineers can influence the sustainability agenda, but were not in a strong position to lead.

7 BIBLIOGRAPHY

A list of abbreviations used within the Bibliography

CIRIA	Construction Industry Research and Information Association, UK
DTI	Department of Trade and Innovation, UK
HMSO	Her Majesty's Stationery Office, UK
ICE	Institution of Civil Engineers, UK
IEE	Institution of Electrical Engineers, UK
IMechE	Institution of Mechanical Engineers, UK
IStructE	Institution of Structural Engineers, UK
NAO	National Audit Office, UK
OGC	Office of Government Commerce
PMSU	Prime Ministers Strategy Unit, UK
RSA	Royal Society of Arts (The Royal Society for the Encouragement of Arts, Manufactures & Commerce)

Basalla, G. (1998) *The Evolution of Technology*. Cambridge: Cambridge University Press.

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APPENDIX A – TABLES OF ISTRUCTE RESPONSES

- Table A1 – Presidential Addresses
- Table A2 – IStructE Publications

Table A1 – IStructE Response: Presidents Addresses

Year	President / Title	The Project Brief	Procurement	Working Together	Wider Brief	Comments
2006	*Bridges across the world* (Harvey 2006a) *The Value of the Institution – a new perspective* (Harvey 2006b)	▪ No comments	▪ Refers to different delivery methods: D&B, PPP	▪ Examples of working closely with contractors to deliver value added projects ▪ Indicates that collaboration with contractors has been successful in Canada, particularly with bridges ▪ Valuable lesson is in adding value by involvement in design/build projects with close collaboration with contractors *"to be successful the modern structural engineer not only needs to be competent, but needs to understand risk management, teamwork and creating added value"*	▪ We live in a world where the only certainty is change, SE are naturally caught up in this ▪ A key driver for SE is sustainable construction ▪ Sustainable approach includes upgrading and increasing the service life of bridges instead of rebuilding ▪ States that SE need to react to changing world, but their training should place them in good position	▪ Not UK focused as an international president based in Canada ▪ No specific institution alliances noted, however this may be due to his international background
2005	*Michael Dickson CBE: Shaping the world* (Dickson 2005a) *An institution for the future – safety, sustainability and much more* (Dickson 2005b) *A year of challenge* (Dickson 2006)	▪ Improved communication of added value is central to success ▪ Satisfying the customer requires separation of "design for concept" from "design for procurement" ▪ SE need to be involved (to the clients benefit) in briefing, design, specification and procurement	▪ Makes reference to "design by procurement" ▪ Need SE to contribute to "design for concept" and "design by procurement" ▪ Discusses Rethinking construction; M4i; KPI's; DQI's; nCRISP ▪ Structural engineering should be the backbone to the procurement process ▪ Need for SE to be involved in whole process ▪ Increased productivity signalled by accelerating change is an opportunity for SE to get mover involved in an integrated design team ▪ Tensions between linear procurement to give maximum efficiency and the iterative / cyclic process of refinement / design	▪ SE need to address multi-disciplinarity, and improve they way they work with other designers/contractors/ specialists *"Effective engineered projects are the result of specific and different high level skills coming together to create holistic practical solutions. The job demands being a specialist in one's own field while having the wider education and knowledge to understand the values, concerns and needs of others on the team. Its tough!"*	▪ SE currently experiencing a resurgence ▪ Need to be specialist in one field but have wider education and knowledge including values and concerns of others ▪ Engineering education ▪ Discusses changes to the profession: assumption that computing has simplifies tasks ▪ Importance of design input into sustainability and Low carbon economy ▪ Public image of SE is increasing ▪ IStructE needs to define how Sustainable development is to be addressed by SE ▪ Criticisms of the professional institutions that they only test knowledge and ability at a time, and not wider issues such as H&S, and competency	▪ Very broad and holistic discussion; less technical detail of SE work ▪ Was member of CIC and involved in accelerating change ▪ Make references to manufacturing / prefabrications ▪ Need for SE to be involved in whole process ▪ Aware of different project delivery methods ▪ Aware of sustainability / low carbon ▪ Refers to two upcoming IStructE initiatives: ▪ "getting the best from your structural engineer – a clients tool kit" by Constructing Excellence ▪ "the clients guide to the appointment of a structural

Year	President / Title	The Project Brief	Procurement	Working Together	Wider Brief	Comments
			"enormous opportunities given by adopting the challenges of 'Rethinking Construction' and 'Accelerating change'" "optimum procurement of professional consultancy services should be by different means than that of buying products for which a clear performance specification and description is known"		through career ▪ Risk management is central to the work of the SE ▪ SE need to adapt their initial training to the opportunities of Rethinking construction ▪ Rethinking construction is a cultural change for SE (IStructE needs to stimulate this change) ▪ 3 drivers that the profession should benefit: process and market; technology and innovation and sustainability ▪ 3 drivers will allow SE to play a greater role in the built environment ▪ Sustainability is the overriding goal of govt policy in the UK ▪ Contributing to sustainable design is an opportunity for SE, to increase influence upwards and to shape the product downwards ▪ ITC systems allowing engineering visualisations and virtual prototyping are aiding multidisciplinary working leading to modularisation and prefabrication ▪ gap in the understanding of manufacturing / assembly within the IStructE. Members will need to gain advice else where. *"contributing to sustainable construction is a tremendous opportunity for structural engineers"* *"structural engineering can be a principle beneficiary of the ICT revolution and so play a central part in sustainable construction"*	engineer" (in response to OGC achieving excellence) ▪ IStructE preparing guides in response to Constructing Excellence and OGC 'Achieving Excellence' ▪ Profession should benefit from 3 drivers of process and market; technology and innovation and sustainability ▪ Great opportunities in ICT, sustainable construction, and collaboration for SE ▪ Large number of references to govt and industry bodies and initiatives ▪ See's many opportunities

Year	President / Title	The Project Brief	Procurement	Working Together	Wider Brief	Comments
2004	*Structural engineering – a passport to travel* (Fordyce 2004) *A dream realised* (Fordyce 2005)	▪ Poor documentation levels in Australia, due to poor fees, has led to an increase of 7-10% in construction cost	▪ Importance of the integration of design and construction ▪ Position of SE in project team in light of new delivery methods: not new that things change. ▪ D&C; BOOT and Alliance contracts common in Australia *"it is a profession that is about People, Places & Projects"*	▪ Essentials are: collaborative team working; awareness and response to different cultures; getting out of our silos; ▪ Gives examples of how close collaboration between engineers and contractors	▪ SE is international, but differences in social, cultural and environmental are important ▪ New report on "Changing role of structural engineers in society" ▪ Innovation is a 'hot ticket' item ▪ Sustainability (as a heading) ▪ IStructE seminar "Turning sustainability into Reality – two" has a low number of delegates ▪ Recruitment, education and training ▪ How to engage young people into the profession	▪ Not UK focused as an international president based in Australia ▪ Makes similar comments Egan and other presidents, in particular "getting out of our silos" and "integration of design and construction" ▪ Role of SE in new project delivery methods outlined in report ▪ Suggestion that alternative procurement routes are common in Australia ▪ Cites that Sustainability is not being well picked up by SE, with reference to poor attendance at seminar ▪ Good references to Australian papers. ▪ IStructE taking lead and giving guidance on the changing world in report
2003	*Educational Values underlie new President's approach* (Stansfield 2003) *IStructE: I'm a Structural Engineer* (Nethercot 2003) *The president's year in perspective* (Nethercot 2004)	▪ Best to stand back and look at the big picture rather than focus on local areas ▪ SE need to be 'persuasive sellers' and to promote 'receptive buyers' ▪ Discusses the tensions of providing expertise to clients at a fee and 'social good' ▪ Recommends that the added value given by Structural engineers is explicitly stated. ▪ By providing information on added value, the ability to use this as a differentiator in addition to fees is provided. ▪ Clients need to move away from the least costly solution is the best principle ▪	▪ No comments *"… does not see how the sort of philosophical discussions engendered [in Rethinking Construction] convert into actions"*	▪ Teamwork is a feature of structural engineering, very little is actually done individually.	▪ Cites that environmental issues were on the agenda prior to sustainability being a buzz word ▪ Challenges the 'Big Issues' of sustainability and rethinking construction ▪ Key aspects of structural engineering: Safety; Elegance and Economics ▪ Features of Structural engineering : Innovation; Balance; Team work ▪ Makes reference to RSA project "exploring professional values for the 21st century) ▪ Ethics and Conduct: primarily based upon providing warnings to preventable disasters	▪ His comments move against those made previously by presidents that SE need to have broader understanding and need to think differently ▪ Mixed messages from IStructE, particularly given that the Vice Presidents rotate into the President role. ▪ Makes direct reference to RSA project on the changing role of professionals ▪ Discusses the tensions between 'social good' and receiving a fee from clients ▪ No comment on environment ▪ Sustainability and Rethinking construction explicitly not in address as they are not core issues (Stansfield 2003)

Year	President / Title	The Project Brief	Procurement	Working Together	Wider Brief	Comments
					▪ Duty of care is not reduced by a lower fee ▪ Reference to 'An Institution for 2010' strategy document ▪ Broaden the role of SE, develop and extend competence but do not lose site of core skills.	▪ Little discussion on need for multi-discplinarity or on collaboration
2002	*The Institution – who cares?* (McKittrick 2002) *The last few miles…* (McKittrick 2003)	▪ No comments	▪ No comments	▪ No Comments	▪ Severe shortage of good structural and civil graduates is fast developing in the UK and else where ▪ Public safety is key role of SE ▪ Registration / licensing of SE ▪ Professional conduct and scandals (Shipman case; Enron; Bristol Infirmary), and the need for rules of conduct and complaints committee ▪ Corruption within construction	▪ Very focused on the IStructE ▪ Some broad comments on external drivers such as corruption and professional conduct ▪ Nothing on environment, sustainability ▪ Nothing on construction industry developments
2001	*Thinking outside the box with Phil's eight new maxims* (Blockley 2001) *Getting the message across* (Blockley 2002)	▪ Engineers should pay attention to clients; understand the clients business (not just provide a technical solution); ▪ Need to balance technical ability with an understanding of value; ▪ Asserts SE should look at the client's customer; and hence add value to the clients business ▪ Recommends the identification and communication of value ▪ Need to not only tell clients we add value – we must demonstrate that we have. *"… .focus on adding value to your clients and his customers in the value chain."*	▪ need to understand the perspective of others ▪ Refers to KPI's; ▪ Philosophies of how we think and perceive, making reference to Karl Popper and 3 worlds; ▪ SE must get out of the specialist silo *"in this modern world we need to be specialists and team players at the same time"* *"if we stay stuck in a specialist silo and refuse to engage in wider issues we shall be marginalised even more"*	▪ Engineers have an image of being narrowly technical and technically narrow, need to recognise and deal with this perception. ▪ Need to contribute to wider purpose within a situation; otherwise SE will continue to be marginalised as technical experts. ▪ As team players SE have a role in finding win-win situations for all.	▪ more philosophical discussion about the big picture ▪ Need better skills in getting involved in wider issues and communicating ▪ A key part of risk management is looking for unknowns, expect the unexpected ▪ Need to broaden expertise to relate to wider issues. ▪ Engineers need to think how: *"how to justify the way we manage uncertainty and risk"*	▪ Challenges the way that SE think ▪ Comments about Egan and need to 'get out the box' and think differently ▪ Notes the fragmented industry, and the new Strategic Forum chaired by Egan ▪ Recommends getting involved with Rethinking construction, and notes an IStructE task group ▪ Asserts SE should look at the client's customer; and hence add value to the clients business – i.e. Egan recommendation ▪ actively promotes the adoption of Rethinking construction and new strategic forum ▪ Must grasp the challenge of rethinking construction

Year	President / Title	The Project Brief	Procurement	Working Together	Wider Brief	Comments
2000	*Expanding Horizons* (Hill 2000) *John Hill's Year* (Hill 2001)	▪ Clients are asking for innovation	▪ IStructE to take greater profile in industry debate on new forms of procurement; team working. ▪ The way that SE is delivered will change ▪ Small task group to prepare guidance on partnering; frameworks; KPI's ▪ Needed to define partnering / frameworks and KPI's "*the way that Structural Engineering expertise is delivered may change*"	▪ Sharing of knowledge is important ▪ Helpful discussions with ICE; seeking greater collaboration ▪ Continue joint meetings with RIBA as initiated by Roberts ▪ The CIC is well developed in the concepts of inter-disciplinary understanding and cooperation across construction professionals. ▪ IStructE contributing to national debate in the construction industry "*engineering the built environment is indeed an inter-disciplinary activity, but that it is structured quite differently from manufacturing"*	▪ Chaired group that prepared IStructE 'Strategy for Evolution' ▪ Commercial pressures are not allowing members to have professional lives away from work ▪ Licensing of SE (at the time, SE did not need to be licensed to practice) ▪ Future of Licensing/registration of SE in the UK unknown ▪ Engineering and technology to be positioned centrally for future economic growth ▪	▪ Theme of expanding horizons: share optimistic view of SE and expand the horizons of SE. ▪ IStructE involved in construction industry debate ▪ The way SE will be delivered is changing due to procurement; partnering & KPI's. Reference to Egan? ▪ Needed to define / explain what partnering / frameworks / KPI's were! ▪ No discussion about environment, sustainability ▪
1999	*Promoting the profession* (Roberts 1999) *Promoting the profession* (Roberts 2000)	▪ No comments	▪ No comments	▪ Engineers need to describe and explain our work more clearly, not just rely on the results ▪ Communication of our design to the constructors is essential ▪ CDM legislation is a starting point for effective communication ▪ Structural engineers could directly brief site work force as a part of 'philosophies of teamwork and cooperation that have become such as current focus of the construction industry *"We should make a conscience effort to describe and explain our designs rather than just issuing drawings and calculations"* *"all the brainpower we apply to designing structures is of no avail whatsoever if it is not*	▪ Makes direct reference to CDM regulations requiring designers to give consideration to health and safety aspects of construction ▪ Strong theme of raising the profile of SE	▪ Makes direct reference to CDM ▪ Makes reference to team working and cooperation, possibly to Latham report ▪ Very centred on increasing the status of SE and the IStructE ▪ No references to environment or sustainability; global change. ▪ Little reference to other professionals

Year	President / Title	The Project Brief	Procurement	Working Together	Wider Brief	Comments
				communicated properly to the members of the construction team who actually build our creations"		
1998	*Evolution or decay* (Clark 1998) *Raising the profile* (Stansfield 1999)	▪ No comments	▪ Construction quality research was following Latham report. Research was undertaken with a sociologist *" the reasons that the required quality is not always achieved and we do not always get things 'right first time' are as much, of not more, to do with peoples behaviours and relationships as they are with technical matters"*	▪ No comments	▪ Theme is the need to evolve for to decay, at all levels (individual, company and IStructE) ▪ Education requirements ▪ Engineering graduates have sufficiently broad skills that they account for 10% of recruitment for financial services firms ▪ Contemporary areas of research and concern are sustainability and the environment ▪ Personally undertook Construction quality research was following Latham report. Research was undertaken with a sociologist ▪ Environment and Sustainability are issues for all engineers; structural engineers are used to taking into account environment and sustainability into account; but there is now a need to take into account the socio-economic issues ▪ Other influences such as 'information explosion'; speed of modern communication; erosion of the concept of professionalism; commodity style markets; world political and financial turmoil. ▪ influences such as 'information explosion'	▪ States that SE already take into account environment and sustainability, but need to also account for socio-economic effects ▪ Makes reference to Latham report following personal involvement in improving quality; experience included working with sociologist ▪ States that quality is often due to people, rather than technical criteria

Year	President / Title	The Project Brief	Procurement	Working Together	Wider Brief	Comments
1997	*The challenge of structural engineering: safety, with economy and harmony.* (Thorburn 1997) *Sam Thorburn's year – A safe pair of hands.* (Stansfield 1998)	*"Clients should be made aware of the of technical risks and the consequences of uncertainty"*	▪ No comments	▪ The need for SE to work together and with other professionals has been central ▪ Lists effective communication as being a must have	▪ Makes reference to the engineering climate as defined by Pugsley1 of (Political / Financial / Scientific / Professional / Industrial) which correlates loosely with the STEEP framework of external drivers and that structural Engineering is subject to external drivers. ▪ A profession engineer possesses the attributes of : leadership, good communication, knowledge of economic, commercial and legal issues, responsible and ethical approach. ▪ A broad range of engineering skills are required by the industry ▪ Structural engineers must confront a changing world. ▪ Social aspects of education, justice, communication, health and safety are recognised. As is the structural engineers role internationally. ▪ Social recognition will no longer be premised on "professional excellence and competence" ▪ Wider, non technical, education is required to cover law, economics, management and politics ▪ Technological change is apparent, to include computers for calculation and drawings. ▪ Rapid technological change give engineers a half life of 7yrs. Thus education will be a continuous process.	▪ Makes direct reference to a "world of rapid change" but whilst recognised social, political, economic and political drivers does NOT recognise environmental. ▪ Appreciates that structural engineers require a broader understanding including law, economics, management and politics ▪ No discussion of: other built environment professionals; comments on interdisciplinary working ; ▪ No discussion on environment or sustainability ▪ Nothing on Latham

[1] Pugsley, A.G. The engineering climatology of structural accidents. In *Int. Con. on Structural safety and reliability*, Washington, DC, 1969, pp335-340

Table A2 – IStructE Response: Publications

Year	Title	The client, end user and whole life costs	Procurement and working together	Technology	Wider Brief	Comments
2004	*The changing roles of structural engineers in society: report of a strategic study* May et al. (2004)	▪ Client education program needed to demonstrate that design quality adds value and reduces overall cost ▪ Clients role in sustainable design ▪ Design for deconstruction and decommissioning ▪ Need for flexible and adaptable buildings	▪ Structural engineers must respond to the increasingly multi-disciplinary nature of design. ▪ Relationships with CIC, CIBSE, ACE & RIBA ▪ When working together the SE & M&E engineer can deliver added value that could not be achieved by traditional working practices ▪ Collaboration with M&E and architects ▪ Benefits of integrated working, particularly with M&E ▪ Need to improve procurement methods, in particular *"perceived failings still associated with a significant proportion of PFI projects"* ▪ Importance of team work in increasing the "adoption of expert technical solutions".	▪ Knowledge management ▪ Developments in new materials ▪ Prefabrication / modular construction and standardisation ▪	▪ SE have a strong claim to have a leading role in sustainable construction ▪ Need for a sustainable construction panel ▪ Low carbon economy ▪ Risk management ▪ Licensing ▪ Graduate retention ▪ Globalisation ▪ Professional values ▪ Increase awareness of value from SE – promote SE. ▪ Attract young to SE ▪ Changing demographics ▪ Impacts of EU expansion ▪ Consideration to millennium development goals ▪ Engineering education	▪ Summary of recommendations from Jowitt et al. (2004) ▪ Multi-disciplinary nature design ▪ Work closely with other consultants, in particular M&E ▪ Impacts of sustainable construction and low carbon economy ▪ Need to improve procurement methods, in particular "perceived failings still associated with a significant proportion of PFI projects"
2004	*The Changing Role of Structural Engineers in Society* Jowitt et al. (2004)	▪ Must add value to projects as a whole ▪ ICT will allow simulations of performance ▪ Need for long design life and flexible usage of buildings ▪ Re-commissioning and refurbishment may be seen as more critical than demolition and de-constructing ▪ "*industry will be required, over time, to become more appreciative of customers and more thoughtful about their effects on third parties"* ▪ Clients seek value through reducing capital costs, improving quality, reduce	▪ Working with M&E + Arch to create intelligent structures ▪ SE working within project teams and must add value to projects as a whole ▪ SE need to understand the added value of input at the earliest stage. ▪ Alliance between SE & M&E offers great potential value ▪ Move away from *"discipline-orientated to a project-orientated industry*" ▪ Integration and cohesion should be an advantage to all. ▪ SE getting involved earlier in projects ▪ SE need to provide skills	▪ ICT is allowing for more readily outsourcing of increasingly skilled tasks. ▪ ICT will improve construction management, enable high standards simulations of both design and performance, and facilitate diversity in design ▪ Adoption of off-site manufacture will reduce costs and improve quality. ▪ Use of ICT to explore scenarios ▪ ICT and outsourcing allow "twenty four hour working" ▪ Knowledge management ▪ ICT for design ▪ ICT for management	▪ Little understanding of SE both amongst clients and the general public ▪ Shrinking skills base in the UK is augmented by work outsourced to other countries. ▪ SE must adopt leadership and risk management ▪ Ageing population ▪ Ageing building stock in the UK ▪ Restrictions on green field developments ▪ Demographics of developing nations ▪ *"Public will expect more sustainable and socially responsible practices*"	▪ 50 recommendations made.

Year	Title	The client, end user and whole life costs	Procurement and working together	Technology	Wider Brief	Comments
		running and maintenance costs ▪ More customer-centric thinking ▪ Improved design for of occupants health and wellbeing ▪ A holistic view of construction focusing on whole life impacts ▪ Sustainability requires a clear client lead ▪ SE should lead the process of showing the benefits of whole life costing ▪ SE to be client focused	within a team context, working towards team goals. ▪ SE need to respond to changes in the procurement processes and client/consultant relationships ▪ Working collaboratively with other professions and contractors.	▪ ICT in buildings	▪ Globalisation and huge new markets ▪ Implications of skilled task outsourcing via ICT ▪ EU enlargement ▪ Polarisation of firms into either large multi-disciplinary or small specialists. ▪ Large section on sustainable development ▪ Recruitment / Retention ▪ Education and skills base	
2004	Rethinking Construction Toolkit (IStructE 2004)	▪ Provide real value for the client ▪ Review cost plans ▪ Talk to clients about their needs ▪ Use of DQI's to meet objectives ▪ "competition on price does not give them what the want – best value" ▪ Must act and be seen to act in the interests of the client ▪ Talk to clients and understand what they really value ▪ If you bid for work and do one-off commissions , this is the less attractive end of the market ▪ Deliver whole life value ▪ Work as an integrated supply chain including end users and facilities management	▪ Rethinking construction is an opportunity to access what others are doing ▪ Integrated teams are essential: each player seeking to add value to the performance of the whole team ▪ Improve build-ability ▪ Seek view from others in the design team ▪ Good practice to meet with builders and other specialist prior to producing detailed drawings ▪ Improved teamwork will save money ▪ If you have a problem, share with the team ▪ Try to get whole team involved earlier to get buy in and build-ability ▪ Larger clients looking to use partnering and frameworks ▪ Supply-chain integration; long-term partnerships; term appointments or project partnering. ▪ Need to be getting involved in alternative methods of procurement, otherwise you will miss out	▪ Consider off-site pre-fabrication on the next project (requires collaborative design by the whole team) ▪ Use of IT to improve efficiency ▪ Is IT up to date and people trained	▪ Identify and manage risk proactively ▪ Sustain and protect the environment ▪ Use of CDM ▪ Sustainability : "SE are uniquely equipped to take the lead in this area" ▪ "be more proactive and help shape the architecture and design of a building that benefits our clients and also make clear what we do" ▪ Understand the detailed costs of your portion of works ▪ Design management, KPIs & DQI's ▪ Need for continuous improvement ▪ Invest in people ▪	▪ Focuses on delivering value client, not quality to end user ▪ End user and facilities management part of integrated design team ▪ Important to get involvement from all ▪ Long term relationships ▪ Lift profession through being 'more proactive' ▪ Strong teamwork focus, ie share problems

Year	Title	The client, end user and whole life costs	Procurement and working together	Technology	Wider Brief	Comments
2002	*An institution for 2010* (IStructE 2002)	▪ No comments	▪ Make 'non-members' welcome to IStructE ▪ Relationships with other institutions ▪ Support and participate with multidisciplinary bodies	▪ Use of IT to disseminate information	▪ Need for structural engineers to respond to Global issues ▪ Respond to sustainable development ▪ Aim to be a 'holistic and learned society' ▪ Promote the value of Structural Engineers ▪ Licensing ▪ Engineering education	▪ Strategic IStructE document and thus institutionally focussed. ▪ Little discussion about the end user ▪ Clear about the wider role responding to global issues and the need for multi-disciplinary input
1999	*A Strategy for evolution* (Stansfield 1999a)	▪ No comments	▪ Develop strategic relationships with other bodies ▪ Relationships with EC(UK), ICE, CIC,	▪ Use of IT for internal administration. ▪ Identifies that IT expertise should be recognise & promoted	▪ Greater breadth to SE to include environment, H&S, IT, management and communication ▪ Better public relations	▪ IStructE internal evolution & strategy document ▪ Many traditional aspects such as membership; ethics; standards and training discussed ▪

No notes taken on IStructE institutional matters such as membership etc.

APPENDIX B – INDUSTRY RESPONSES

- Brief Bio for each interviewed consultant
- Interview Briefing and Questions
- Table B1 – Interview Responses

BIOGRAPHIES OF CONSULTANTS INTERVIEWED

Alan Baxter[118]

Alan Baxter Associates

BSc Bristol University FIStructE MICE MCONSE

Alan Baxter founded the Practice of Alan Baxter & Associates in 1974. The firm has grown steadily and became a partnership in 1984.

As Senior Partner he coordinates the direction of the firm both in its technical evolution and in its overall management. He is involved in all the firm's projects. The wide range of projects is stimulating, especially those with demanding engineering or other special design aspects and major planning studies. New buildings of significance which he has engineered include Crown Reach and China Wharf on London's riverside and two control centres for the RAC at Walsall and Bristol. He is the Partner in charge of major projects such as the master planning and engineering of the new town of Poundbury, as well as the designer of small innovative projects. He is Consulting Engineer to the Dean and Chapter of St Paul's Cathedral.

Alan Baxter is closely involved with educational ventures, as well as with a number of organisations which advise and comment on aspects of conservation, urban design and the built environment. He serves on the London Advisory Committee of English Heritage and is a member of their Urban Panel. He is a member of the Heritage Lottery Expert Panel, and has been an assessor on several high-profile design competitions. He is a patron of the Urban Design Group and Art & Architecture, and a member of the Council of Architects and Engineers for Social Responsibility and is a Commissioner for both the Independent Transport Commission and the Royal Commission for the 1851 Exhibition.

Sam Price[119]

Price and Myers

MA FREng CEng FICE Hon FRIBA

After graduating from Trinity College, Cambridge, Sam worked for Ove Arup & Partners from 1960-67, which included two periods as a Resident Engineer; the first at Sussex University, the second for two bridges over the Volta river in Ghana.

He joined the multi-disciplinary practice of Arup Associates in 1967 as Project Engineer for a series of major schemes including the Central Depot for the Royal Borough of Kensington and Chelsea, and the Lloyds Administration Building at Chatham.

With Robert Myers he founded Price & Myers in 1978. Recent noteworthy projects include university college buildings at both Oxford and Cambridge with architects

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[118] CV provided by the practice of Alan Baxter and Associates.
[119] Price & Myers (2007) *Price and Myers – Structural Engineers* [online] Accessed 24th February 2007. [http://www.pricemyers.com/].

MacCormac Jamieson Prichard and van Heyningen and Haward; The Tricycle Theatre *(£2m, 1998)* with Tim Foster Architects; The Royal Court Theatre *(£13.5m 2000)*; a factory and new headquarters building for Dr Martens *(£1.5m, 1995)* and Coin Street Housing *(£11m 2001)* all with Haworth Tompkins; and Snape Maltings *(£2.8m 1999)* with Penoyre & Prasad. All of these won RIBA or Civic Trust awards.

He is chairman of the Steering Committee of the Interdisciplinary Design for the Built Environment Course at Cambridge; a trustee of the Interbuild Fund and he is a member of the editorial board of Architectural Research Quarterly.

He was a member of the jury for the RIBA Awards Eastern Region in 2001

Mark Whitby[120]
whitbybird

BSc FREng FICE Hon FRIBA

Mark Whitby is a founding Partner / Director of the practice.

Mark is a working Director, closely involved with clients and architects. He works on projects at concept stage and at stage reviews, focusing on the total design and establishing design criteria and quality objectives.

He has a reputation for imaginative design solutions that exploit the possibilities of materials and the latest construction methods. Vigorously champions a philosophy of sustainable design.

Mark seeks client and industry feedback on the role of engineers in the design and construction process. He works to extend the services that whitbybird provides to clients and to move the practice outside the confines of the traditional consultants' role.

Since his Presidency of the Institution of Civil Engineers, he remains committed to the process of restoring engineers to a position where they influence policy and practice at the highest level. Seeks to optimize engineering's contribution to sustainability and urban design.

2001 ... elected President of the Institution of Civil Engineers
2001 ... elected Chairman of the Urban Design Alliance
1999 ... appointed Honorary Fellow, RIBA
1998 ... led the development of industry standard computer-integrated techniques for structural steel design and fabrication (CIMsteel)
1997 ... elected Fellow of The Royal Academy of Engineering

[120] Whitbybird (2007) *whitbybird – Mark Whitby – Design Director* [online] Accessed 24th February 2007 [http://www.whitbybird.com/practice/cvs/markWhitby.asp.

Chris Wise[121]
Expedition Engineering
BSc RDI FREng MIStructE MIABSE FRSA

Chris joined Ove Arup and Partners in 1979, after working in UK, Australia and USA, he became Arup's youngest Director in 1992, later appointed one of five Board Directors responsible for a multi-disciplinary design office of over 500 engineers and support staff.

In November 1998 he was awarded the distinction of Royal Designer for Industry by the Royal Society of Arts, only the second structural engineer to be honoured in this way, and in 2002 was awarded an honorary fellowship of the Royal Institute of British Architects. In March 1998 he was appointed the first Professor of Creative Design at Imperial College, London.

In 1999, along with Sean Walsh and Chris Smith, he founded Expedition. In 2003 he was elected a fellow of the Royal Academy of Engineers.

He lectures, writes and broadcasts widely, to architectural and engineering students, and to architectural and engineering institutions in the UK, Europe and USA on creative design in projects and the role of the engineer in design.

[121] Expedition Engineering (2007) *expedition engineering* [online] Accessed 24th February 2007 [http://www.expedition-engineering.com/].

INTERVIEW QUESTIONS

Project Brief

1. Do you think it is important for structural engineers to understand a client business? Why?

2. Do you think that an end user focus has changed the responsibilities and deliverables of the structural engineer? If so, how?

3. How has the focus on the end user affected the project brief? I.e. use of DQI's; whole life costing; consultations; other consultants?

4. Do you think providing a client with 'innovation' and 'added value' are new requirements?

Procurement

5. What proportions of projects are being delivered through non-traditional procurement routes such as PFI, D&B, 2 Stage, frameworks? Has this proportion been increasing over the past, say, 10years?

6. Do you think that these alternative procurement routes have changed the responsibilities and deliverables of the structural engineer? If so, how? For example, design is iterative but procurement is linear. Dickson suggests the need to design for concept and design for procurement.

7. Do you think that alternative procurement strategies have been for the benefit or detriment of the structural engineering consultant? Why?

Working Together

8. Egan stated that the *"…fundamental malaise in the industry – the separation of design from the rest of the project process… design needs to be properly integrated with construction and performance in use*". Do you think this statement applies to Structural Engineers? Why?

9. Do you believe that structural engineers should collaborate more with other members of the project team? If so, who and why?

10. How important do you believe collaboration with the contractor is? When do you think an appropriate time is for this to take place?

11. Do you think that Structural Engineers communicate effectively as a profession?

Wider Knowledge base

12. Do you think that structural engineers must:
    a. expand their knowledge and understanding of larger societal issues?
    b. bring such knowledge to the project team?

13. What three areas do you believe that Structural Engineers should focus upon moving forward. Please explain each one.

Table B1 – Industry Interviews

Question	Alan Baxter	Sam Price	Mark Whitby	Chris Wise	Comments
	Project Brief				
1) Do you think it is important for structural engineers to understand a client business? Why?	Yes it is important, and is a fundamental part of being a professional. If you didn't you would be providing a commodity only.	Yes. Firstly it makes the job more interesting. Ideally, one should be committed to the aims of the client	Yes. It is easier with repeat clients who's businesses you learn. One off clients are more difficult, as they often do not understand the process and can only make changes after they see a result. Engineers can disengage from the commercial aspects. *"The more you engage the more likely you are to emphasise with what they are trying to achieve."*	Yes. Most capable engineers would be looking to understand the client business so that they determine what parts of the clients business they can offer other services. These services are not necessarily structurally related. A good structural engineer is well placed to do more for their clients than they are asked. Very helpful if structural engineers can understand the client's business case. Although this is not often shared. SE are traditionally subservient to architect, but their role has been eroded. Clients often do not know what structural engineers do. Important for clients to understand what structural engineers can do.	All agree. It is easier, and more interesting to carry out works if the context of the project is known.
2) Do you think that an end user focus has changed the responsibilities and deliverables of the structural engineer? If so, how?	Doesn't believe there has been change in his work. His practice has always focused upon the end user and long term. For the industry, there has been little change as many engineers only do what they have been asked. As his practice has a good reputation they can "*afford their ethics*".	Little change personally, has always seen this to be important. Believes this started when at Arup Associates where there was a strong element of cross disciplinary input. If the structural engineer is kept at arms length from the client or influencing the end user, it is difficult to get enthusiastic as you don't know what it is you are supposed to be focusing upon.	Cites one argument that architects don't design for a client, but design for society as a whole. You work for a client, and can influence them, but need to think about the end user as part of the process. Structural engineers are slightly disengaged from influencing on the basis of the end user, but are often aware of the clients commercial pressures. Believes architects are in the best position to impact the end user.	Deliveries are generally very similar, but recent methods of delivery have clouded the deliverables. Responsibilities should include bringing knowledge to the table but they are often trained to be subservient. Greater integration in design requires a greater level of involvement of other parties.	General agreement that there has been no change, but this view may be limited to the upper part of the industry. Some thoughts that the influence of structural engineers is limited due to both technical ability and training.

Question	Alan Baxter	Sam Price	Mark Whitby	Chris Wise	Comments
			Architects can provide an emotional value to design, whilst engineers often provide a more tangible value. Over the last 10 years, there has been more discussion with clients about the structural impacts on values, and in understanding risks. This is something that whitbybird have 'grown into'.		
3) How has the focus on the end user affected the project brief? I.e. use of DQI's; whole life costing; consultations; other consultants?	DQI's needed to be defined. Has little belief in any accounting type measures as these miss the point. Clients rarely define the brief very well. End user focus does not effect structural engineers greatly. With the exception of the poor quality buildings of the 1960's, structural frames should have extensive lives. Whole life costing can miss some larger sustainability issues such as buildings becoming redundant and how to reuse buildings. Egan and the box ticking has narrowed peoples mind and subsequently people are missing the point. *"The more you measure, the less value there is."*	Whole life costing is little used	DQI's needed to be defined. Much holistic about design, it is not always about creating the most economic structure or the largest space. Whole life costing is sometimes mentioned, but rarely actually implemented. Capital cost is still the primary driver. PFI has allowed for running costs to be included. A key problem is that running costs and how a building is managed are very subjective decisions. PFI is a more holistic approach although it also 'dumbs down design'.	A number of briefs put together with little understanding of their meaning. Briefs often lagged behind the design and costing information. Integration of the environmental aspirations into the financial aspects of briefs is often missing. A lot of talk about whole life costing. Solutions that engage whole life costing often require a greater level of design in the structure Projects may have aspiration statements about whole life costs, but capital costs nearly always govern. There is often no mechanism to take savings in maintenance downstream to increase capital expenditure.	The end user focus has not effected briefs greatly to date. DQI's needed explanation Whole life costing is rarely implemented.

Question	Alan Baxter	Sam Price	Mark Whitby	Chris Wise	Comments
4) Do you think providing a client with 'innovation' and 'added value' are new requirements?	No, not new. *"Some of the worst time for innovation was in the 1960's when people were trying to be too clever."*	A lot has been written recently about innovation. Innovation, or imaginative thought, has always been part of the business of the engineer. Thinking of ways to make things easier and cheaper to build is normal. Some of what is currently being called innovation, is producing designs, through new processes, that are creating increasingly risky projects. Much of this risk is being borne by the contractor and clients, with consultants only acknowledging modest amounts of risk. Believes some examples of innovation have placed too much risk on the contractor and were indefensible and immoral. An example being the Frank Gehry's Guggenheim in Bilbao.	No, not new. 20 years ago innovation was a bad word, nearly derogatory. Previously you were discouraged from innovating, and now you obliged to advise to clients how you provided innovation on their project. There is more innovation today. *"Innovation has risk, but it must deliver added value."* The risk is always carried by the client.	The feedback cycle is very important - clients will pay extra for good design. Gives two examples of American War Museum at Duxford and Commerzbank in Frankfurt where there is post completion monitoring of buildings energy usage. But believe this sort of monitoring is not normal. Added value is something all structural engineers do value and this should be better communicated. But clients expect added value when the appoint well regarded consultants. Very difficult to understand when you have provided value because the targets for cost are always moving. *"I don't think you should innovate for the sake of it."*	Generally not seen as new. Innovation is natural but shouldn't be forced.
	Procurement				
5) What proportions of projects are being delivered through non-traditional procurement routes such as PFI, D&B, 2 Stage, frameworks? Has this proportion been increasing over the past, say, 10years?	Very few traditional contracts in place. But there are too many contracts of different types that are causing their own problems. Proportion has increased over the last 10yrs.	More than 50% by non traditional. Majority is design and build, two-stage and frameworks. Proportion is increasing.	90% is via alternative methods.	Nearly all projects are alternative routes. 20yrs ago conventional JCT style contracts, 10yrs a large amount of construction management.	Very high proportions in all practices are now non-traditional.

Question	Alan Baxter	Sam Price	Mark Whitby	Chris Wise	Comments
6) Do you think that these alternative procurement routes have changed the responsibilities and deliverables of the structural engineer? If so, how? For example, design is iterative but procurement is linear. Dickson suggests the need to design for concept and design for procurement.	Under traditional routes always working for the client and has their interests at focus. Under alternatives your client and focus changes mid-process to the contractor. Contractors tend to have a very narrow commercial view and less of the broader issues. Believes PFI is "*a disaster*". Procurement through competitions can place a limit on the level of design depth in the entry. Subsequently this can act as a constraint on both the client and design team.	D&B does changes responsibilities, not always in an unhealthy way. *"For building designers to also be, or close to, building makers is a jolly good thing*." His practice often works for contractors and specialist contractors. Notes that architects often don't understand why working for the contractors can be interesting. Doesn't think there is change in responsibility when novated from a client to a contractor. The responsibility for the information provided pre-novation and how it is used post-novation, (after being interpreted during a tender process) is "quite an area to be thought about". [Sam cites the example of reinforcement estimates provided to the client early in the process, and can subsequently be used against you, although a number of processes have occurred in the interim that effects it]. [When asked about the tensions of when working for the clients, the client's interests are at heart. However when novated to the contractor, the contractor commercial interest can be different to what is best for the client]. Agrees that this change in focus does occur, and that this is a tension.	Expected to be more thorough, less room for late information. Need to be more demanding from fellow consultants in obtaining information required to prepare our designs. Disagrees, with Dickson's separation of design and procurement. You should start the design thinking about how you should build it, not around a procurement method. One should not have one meeting with an architect discussing concepts, and a separate one with a builder about buildability. They need to be addressed simultaneously.	Procurement is not necessarily linear: you need some input from specialists very early on in the design. This can work well in frameworks where cost-plus arrangements exist to allow for input from specialists. Doesn't believe you can split design and procurement. Disagrees with some overseas models (in US and France) where there are separate concepts, design and construction teams. Thus people are not responsible for the whole project.	

Question	Alan Baxter	Sam Price	Mark Whitby	Chris Wise	Comments
7) Do you think that alternative procurement strategies have been for the benefit or detriment of the structural engineering consultant? Why?	Yes, it is detrimental to Structural Engineers as it "*Diminishes the relationship to the client and societies long term interests*". Particularly when placed in the context of sustainability. "*Buildings are not commodities to be thrown away every generation*".	Difficult to answer, and is project dependent. Some projects are suitable for some types of contract, whilst others are not. Gives example that a complicated refurbishment is not suitable for D&B as it gives too much responsibility to a contractor. But a 2-stage process may be suitable. Different procurement strategies are seen as a way of increasing competition. Occasionally, a price during competitive tender comes in below the quantity surveyors budget. Everyone involved usually sees this as a saving and pursues it, however in the end the saving is usually paid back to the contractor for various reasons. But believes the ideal situation is to work with a contractor that you know well on a negotiated price. The quality of service provided is independent of the type of contract.	The relationship between client and structural engineers is better, and greater value given to the engineers contribution. If the structural frame goes well, i.e. integrates well, then many other aspects are more readily coordinated. The relationship between architect and engineers is less comfortable. The engineer is less subservient to the architect and has more engagement with the client.	Believes it is very helpful to sit with specialist manufacturer as a designer. There is willingness for contractors to engage with the design process. But this is not always represented in the final tender costs. Contractors don't have a great understanding of design	Mixed views. AB believes it diminishes access to the client. Other suggest that the increased discussion is generally positive, although not always efficient.
Working Together					
8) Egan stated that the *"…fundamental malaise in the industry – the separation of design from the rest of the project process… design needs to be properly*	Generally yes. Design and construction must be thought through as one operation. Design is a very different process that many people do not understand. Believes that Egan did not understand what design was. The culture of contractual complexity has made the	Yes it does apply, but less than it does compared to others. Building services engineers are in a difficult position, citing that they are often not paid to do detailed design (for very good reasons relating to specifying products). Structural and Building services engineers are generally quite close to construction.	Generally it doesn't apply. Site experience is crucial. Architects should be made to work on site, but fear that such knowledge may restrict their creativity. This has allows for gaps in the understanding of architect in how buildings are built to be filled by	This does apply to structural engineers. Has a fundamental disagreement with Egan due to his manufacturing background and lack of a model for dealing with interfaces. The structural engineers is well placed to manage the interfaces.	Does apply to SE, although SE are generally better than others. Architects and need to address this urgently. AB & SP both refer to additional managers required due to the separation of designers from construction. MW & CW cite opportunities for

Question	Alan Baxter	Sam Price	Mark Whitby	Chris Wise	Comments
integrated with construction and performance in use". Do you think this statement applies to Structural Engineers? Why?	interfaces between elements very 'awkward'. This has lading to more managers who 'get in the way Project managers and construction manager now proliferating and becoming very dominant, it is they that have to get their act together. "*They [project and construction managers] have got in the way of understanding the whole process from concept right through design, construction and handover.*" Problems on site are rarely on the conventional front of buildability. They are often on the contractual side between subcontractors and the interfaces. Buildings are very complicated, and they have got worse!	Agrees that for engineers to be qualified, they should spend a minimum of 1 yrs on site. This opens up the eyes of engineers as they can then understand the 'deals done on site' and impacts of late works of one subcontractor on other subcontractors. "*The single absolutely fundamental thing that would improve the building industry, far more than Egan or anything else would be for the RIBA to say that you can't become a member of the RIBA without [having] a year on site.*" Most good architects do understand how building go together onsite. Two main separations have recently been introduced between the designers and constructers: 1/ the increase of subcontracting of services by main contractors, with many contractors often not actually employing any site operatives. This leads to high level of ignorance amongst some main contractors. When there is direct consultation with the specialist sub-contractors, problems are resolved quickly and there is good feedback on buildability. Main contractors are described as paper pushers. 2/ Project managers. The techniques of management cannot be applied without a good understanding of the tasks being managed. Management is an important role, but must be done	the structural engineer. Structural engineers are now filling a role of construction consultant.	"*If you don't deal with the totality of a project from the beginning, you find out that you end up with a series of un-workable un-integrated systems, each one of which works perfectly on its own but has to be so fatally compromised to fit in with everything else that the whole system fall part and doesn't work very well.*" The structural engineer should take more responsibility for driving this process of interfaces.	SE to fulfil some roles.

Question	Alan Baxter	Sam Price	Mark Whitby	Chris Wise	Comments
		only by those who understand the business and the roles undertaken. There is a problem in having a huge swathe of paper pushers between the designers and the people that actually construct. Comparison with product designers who needs to understand the product holistically. Including the products final cost and how to manufacture for that cost. This understanding is missing in the building industry. The existence of different professions in the industry causes problems. Architects not concerned about construction, engineers not concerned about cost. Thus everyone is slightly irresponsible with everyone thinking that some elements always being someone else's problem.			
9) Do you believe that structural engineers should collaborate more with other members of the project team? If so, who and why?	Structural engineers have a good relationship with architects. Sometimes engineers are leading the team. Architects, like managers, have lost the plot as they are not in control of the projects anymore. Egan influence has brought in more managers, particularly project managers. Extra management and procurement methods have diluted design and multidisciplinary working.	At their best, his firm could not collaborate more with other members. Always encourages people to think about other peoples [within the project team's] jobs, and what their responsibilities are. Makes reference to Arup Associates as having a very good collaborative approach. As a profession, structural engineers should collaborate more.	If they can, they should do. One issue is that of professional boundaries, whether other parties want them to be move involved.	Yes they should collaborate more, but should not call themselves structural engineers. They are engineers for the built-environment with a structural specialism. Gives examples where his practice often leads the design, not the traditional model of the architect. This is seen as important change in how clients see his practice. "*They should collaborate inside their own heads first.*"	Generally yes, although most believe that their practices do this very well already. Professional boundaries is seen as potential constraint by MW.

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10) How important do you believe collaboration with the contractor is? When do you think an appropriate time is for this to take place?	The builder/ contractor as part of the creative design is rarely useful. Most managing contractors are concerned about contracts, subcontractors and site logistics. Whereas the creative team need to look at broader issues. Main contractor can provide some input into buildability, but often do not have the breadth of mind required for design. Project managers do not understand design and often believe that individual elements can simply be put together, but design of buildings is not a linear process. Structural engineers often cross many interfaces and thus understand the linearity of procurement, but also aware of the need for talking and thinking at the design stage. Structural engineers are generally good with buildability, often better than the contractor. Contractors are used to being told what to do, and are not used to a creative response to buildability. Rarely do they get useful input from contractors on buildability. Much of their input regards the packaging up of information to suit their internal subcontractor management. Contractors often do not understand the ramifications of choosing one type of construction on the rest of the design process. I.e. use of precast elements on design freeze.	Collaboration is absolutely crucial, should happen all the time. This is clarified to be with specialist subcontractors / builders and not with managing or main contractors. One problem when taking advice from a main contractors whose work methods are given by subcontractors, is if the main contractor uses a different subcontractor then the work method may not be valid. Thus it is sometimes better to speak directly to the subcontractor and elect them as specialist contractors. "*talking to main contractors about buildability is just about always a waste of time*" Sam gives an example of a concrete subcontractor who believed that structural engineers knew more about the buildability of concrete when compared to main contractors.	It is important. In many cases, by the time a contractor is fully engaged in a project many of the structural engineers decisions are made. Collaboration with trade contractors occurs quite late, but this suits trade contractors. The early involvement of trade contractors, for example to review design, is not necessarily in their interest. This is because takes them away from their normal work of production style working into a more design style. Ideal situation is to have consultants work to a point at which the trade contractor is at their most efficient. Trade contractor are primarily production orientated and require information rich design to do this. Being able to interface with subcontractor cleanly at this stage can provide significant value to the client in reducing site queries and RFI's. Believes that main contractors are aware about buildability, particularly as they carry such significant risks.	This is very important. Cite Japanese models where the contractors and design team are the same company. Contractors and developers are risk averse and can often limit design creativity. There is willingness for contractors to engage with the design process. But this is not always represented in the final tender costs. Contractors don't have a great understanding of design	Generally yes Difference between main contractor and specialist trade contractors. Difficulties in timing due to commercial pressures. Contractors not generally good with creative design and can constrain results.

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	Different contractors may wish to build differently, thus the timing of their input is important. Problems on site are rarely on the conventional front of buildability. They are often on the contractual side between subcontractors and the interfaces.				
11) Do you think that Structural Engineers communicate effectively as a profession?	Compared to services engineers and project managers very well. But never well enough. The top firms (i.e. those interviewed) are good but the majority of structural engineers are appalling.	No. Few engineers are taught English properly and make English over complicated and not straight forward. Over complicated language makes explanation more difficult. It is of fundamental importance of engineers to be able to explain what they are doing.	No	"*Structural engineers do not communicate effectively - they are feeble*" Need to explain in language that people understand. Trained to be deferential and subservient. This was ok traditionally when roles were better defined but is not suitable looking forward. Unless this is changed, structural engineering profession will die and will be overtaken by computer based design of the simple task.	Generally no, but better than others.
Wider Knowledge Base					
12) Do you think that structural engineers must: a. expand their knowledge and understanding of larger societal issues? b. bring such knowledge to	Yes. Alan Baxter don't call themselves structural engineers. How buildings form cities is extremely important. Yes. As structural engineers inform building design, and buildings have a long term value to society.	Yes. Yes. To be enthusiastic about your work you need to understand the background. Believes greater participation in general social activities such as theatre and movies, and discussion of such activities, would lead to better engineers.	Yes, absolutely. Believes peoples ideas of what their roles or abilities are, are narrowed through education and this "*narrowness stains them for life*". Engineers are citizens, and should engage in government and politics and feel like they can make a difference. Yes, they should be brought to the	Yes & Yes They are engineers for the built-environment with a structural specialism. "*They should collaborate inside their own heads first.*" There are 45 engineering institutions in the UK some of whom could provide some of the services of a structural engineer.	Yes Yes The more background the more interesting the work is and the context is understood.

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the project team?		Believes the traditional education method of separating arts from sciences is flawed in not providing rounded experiences.	project team. Particularly with regards to sustainability and managing the design team. Experience is the greatest education, and thus over time engineers can easily be competent architects or project managers. Over time there will be a greater blurring of boundaries between professions. Engineers are generally responding to this blurring and increasing their knowledge.	Unless structural engineers are aware of such technical competitors they may lose clients to other disciplines. UK structural engineers must also be aware of social competitors, for example engineers in China, India, South America. Darwinian approach: SE must understand and adapt. 1) their competitors 2) their environment 3) themselves They must change their service to suit current demands, i.e. no longer called structural engineers. As SE need greater confidence and understand their role in the project to allow them to offer their understand rather than wait to be asked. Gives examples where his practice often leads the design, not the traditional model of the architect. This is seen as important change in how clients see his practice.	
13) What three areas do you believe that Structural Engineers should focus upon moving forward. Please explain each one.	1) Longevity of structures and how they respond to future generations. 2) Use of existing structures in a creative way for the future 3) Sustainability in an environmental sense, such as carbon footprint etc. The challenge for structural engineers has changed dramatically	1) getting out into other parts of society (broadening knowledge, particularly into social areas) 2) sustainability: in particular energy usage and embodied energy. Structural Engineers are in a good position to influence, (maybe not lead). 3) Enthuse the builders about the design through	1) Multidisciplinarism [sic] 2) Knowledge management 3) Manufacturing system, i.e. streamlining construction and offsite construction. On Education: Disagrees with Chris Wise	1) Engineer education is flawed and represents engineering 20yrs ago. There is a significant mismatch between what is taught and studied and what is actually practiced. Broader education including teaching of contextual issues and importance of judgement. Thus placing	▪ Sustainability ▪ Broadening Horizons ▪ Communication of design ▪ Multi-disciplinary working ▪ Knowledge management ▪ Manufacturing systems ▪ Engineering education ▪ Multi-variable designs ▪ Judgement and values

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	from the traditionally technological focus, primarily due to the introduction of computers. Much of the focus of many engineering firms today is purely commercial, and they have become "dumb and boring". Consequently the engineering institutions have lost their clout. Challenges still exist, for example a the transformation of the urban form to create new sites. Some of the greatest challenges are in services engineering. In particular, how buildings behave and this relates to sustainability.	explaining the design.	regarding the need for more education on values, citing that there is insufficient time in universities for such education. Believes that the quality of education is good, although the area's of study is not perfect as this is set by institutions.	technical knowledge into a context. 2) Structural Engineering profession should no longer define themselves as structural only, they should evolve into built environment professionals. Particularly to develop design processes and tools to address multi-variable designs across multi-disciplines. I.e. true integrated design. 3) Learn more about decision making and judgement that is value based. Not necessarily reduce everything to money or other numerical measures.	
Other comments					
	Design is very broad and needs to include larger issues outside the site, in particular sustainability. Critical of increasing amount of managers, who often do not understand the processes of design and building. Increased management has disrupted the link between concept, design, construction and handover. Contractors are too focused upon site specific works and contractual matters to be helpful to the creative team.		Whitby was disappointed that Egan didn't discuss the role of computing. Given that Egan's background was in car manufacturing that used robotics, this was a missed opportunity to discuss the impact of technology to the construction industry. Believed Egan's input was important particularly in highlighting the importance of relationships, mutual respect for the contributors in a process and being accountably for one's decisions. Agrees with Chris Wise comments that one shouldn't rely upon a title or pigeon holing of one's abilities.	Believes the role of the IStructE is not well defined and needs an overhaul. The boundaries of structural engineering have been blurred. By defining oneself as a structural engineer, you are placing an artificial cage around your potential role.	