Client drivers for construction projects: implications for standardisation

Alistair G F Gibb & Frank Isack
Department of Civil & Building Engineering
Loughborough University

Accepted for publication in Engineering, Construction and Architectural Management

Abstract
This paper presents the results from interviews of fifty-nine senior personnel from major construction clients. There are two main themes: client drivers for construction projects and their implications for standardisation of processes and components.
The client sample is described and reasons for procuring construction projects are established along with the extent of their involvement in the construction process - and hence their ability to influence the outcomes. Their views on value for money, preconceptions of standardisation and their opinion on its future potential are explored.
Many clients recognise the need to involve constructors and manufacturers early, although fewer actually achieve this. Misconceptions about standardisation exist, but many clients are recognising the benefits possible from standardisation. However, very few actually measure benefits and so are unable to truly evaluate success. There is a future for increased standardisation, but only if the industry recognises the unique aspects of each client and responds positively to meet those needs.

INTRODUCTION

Getting close to the customer (Peters 1993) and recognising the needs of clients have come to the fore in construction management debate and practice over recent years (e.g. Egan 1998). The first aim of this paper is to review the client drivers and for construction projects and the extent to which they are involved in the process and hence the extent to which they can influence the outcomes. This information is important in its own right.

The second aim is to provide a brief introduction to standardisation in construction and then to consider the implications on standardisation from the client drivers. In other words, if standardisation is believed to be a good thing and clients are the main decision makers during the early phases of construction projects, then how do client's views impact on construction standardisation.

Standardisation is the extensive use of processes or procedures, products or components, in which there is regularity, repetition and a record of successful practice. However, very few things are generically standard. Most countries have standards that are controlled by legislation or common practice and some of these standards are becoming internationally recognised. Clients may have standard processes or corporate badging. Suppliers produce standard items or customised items with standard components through standard procedures. Some try to deny standardisation – but without doubt it exists in all organisations and all projects.

Standardisation has been used in construction for many years. There are some influential opponents. For example HRH The Prince of Wales has endorsed Landscapes of Change (Spiller et al 1999) which claims that computer-aided manufacture will spell the end of standardised building systems and instead usher in affordable, one-off components (Fairs 1999). Notwithstanding, standardisation remains an important part of construction best practice forming one of the tenets of Sir John Egan's (1998) report challenging the construction industry towards renewal for the new millennium. Standardisation has changed over the years with efforts now being made to meet clients needs and produce customised individual buildings, yet still using standard components and employing standard processes to ensure success. A full discussion of the historical development is outside of the scope of this paper, but has been published elsewhere (e.g. White 1965, Russell 1981, Herbert 1984, Groák 1992, Gann 1996, Gibb 1999, Gibb 2000a). Over recent years there has been increased interest in the topic with a number of research projects and related publications (e.g. Bottom et al 1994, Sarja 1998, CIRIA 1997 & 1999, Gibb 2000b)

This paper summarises the results from interviews of fifty-nine construction client representatives conducted between September and November 1998. These interviews formed part of a project for the Construction Industry Research and Information Association (CIRIA). The research contractor was Loughborough University and Laing Technology Group. The project deliverable is a clients' guide and tool kit for standardisation and pre-assembly. The interview proforma was developed following an extensive literature review

and drawing upon previous work by the research team (CIRIA 1999). The full literature review is outside the scope of this paper and has been published previously (Gibb 1999; CIRIA 1999). The proforma was field tested on the CIRIA project steering group set up to guide the overall project. This paper concentrates on clients' main drivers for construction projects and on whether standardisation can help meet those needs. Pre-assembly aspects of the research have been published separately by the authors (Gibb & Isack 2000). Full attributed results are held by the research team to ensure validity and retain confidentiality.

SIGNIFICANCE AND CHARACTERISTICS OF THE INTERVIEW SAMPLE

Fifty-nine senior personnel responsible for construction developments were interviewed. They represented forty-two of the largest, or most frequent construction client organisations (Figure 1). In 1997/98, these companies and organisations invested some £8.7bn in new tangible assets and around £2.7bn on repair and maintenance. Assuming that only 60% of new tangible asset investment is construction related, the construction element of this new investment was a minimum of £5.2bn. Therefore, the total aggregated construction-related investment by the companies interviewed in this study was over £8bn, almost 15% of total 1997 construction output, as measured by the DETR. The residential and engineering construction sectors did not form part of the CIRIA project.

Except for the industrial sector, the percentage breakdown of interviews based on their number by sector is a good match with the percentage breakdown of new construction output data by sector, based on data from the DETR. The match is less good based on the actual investment in new assets because a few of the companies had very large capital programmes. This also meant that infrastructure investment accounted for a high share of total new investment in this sample of companies. Conversely, the reported investment by organisations in the health sector was lower than actual because of two Private Finance Initiative (PFI) hospitals that were not included in the capital expenditure data. In addition, several companies capitalise some of their repair and maintenance investment, particularly for infrastructure investment in the rail and water sectors where it is reported as repair and maintenance. Figure 1 also provides a revised breakdown of the companies based on an adjusted capital investment by deducting capitalised repair and maintenance expenditure. This adjustment improves the match with the DETR data for new work output by sector but the industrial sector is still under represented.

More than half of the interviewees had specific individual responsibility for over 100 projects in the past five years and more than a third of these were worth over £5 million each (Figures 2 & 3). Where interviewees had managed few projects, say less than 10, this was generally because these projects had a very high average value, over £20m each. This clearly establishes the credibility of the interviewees.

The research team wanted to see if responses were different from different client types. The forty-two firms were broken down into three broad groups, private companies (21), regulated private companies (9) and public organisations (12). Private companies included retailers, property developers, industrial firms and companies in the leisure sector. Regulated private companies included companies in the water, gas, communications, rail, electricity and air sectors and which have their investment programmes influenced by government. Public organisations included local authorities, government departments, health trusts, a university and a local transport body.

The team also wanted to compare the influence of project type and location. The spread of projects by location was evenly distributed across each of the three types of location, town centre, edge of town centre and out-of-town. In terms of the type of project, 47% of all projects were new build, 42% renovation/refurbishment and understandably only 11% were a hybrid (e.g. new build with a retained façade). This hybrid option was included because it presented significantly different opportunities for standardisation.

Figure 1 Breakdown of companies interviewed by construction market

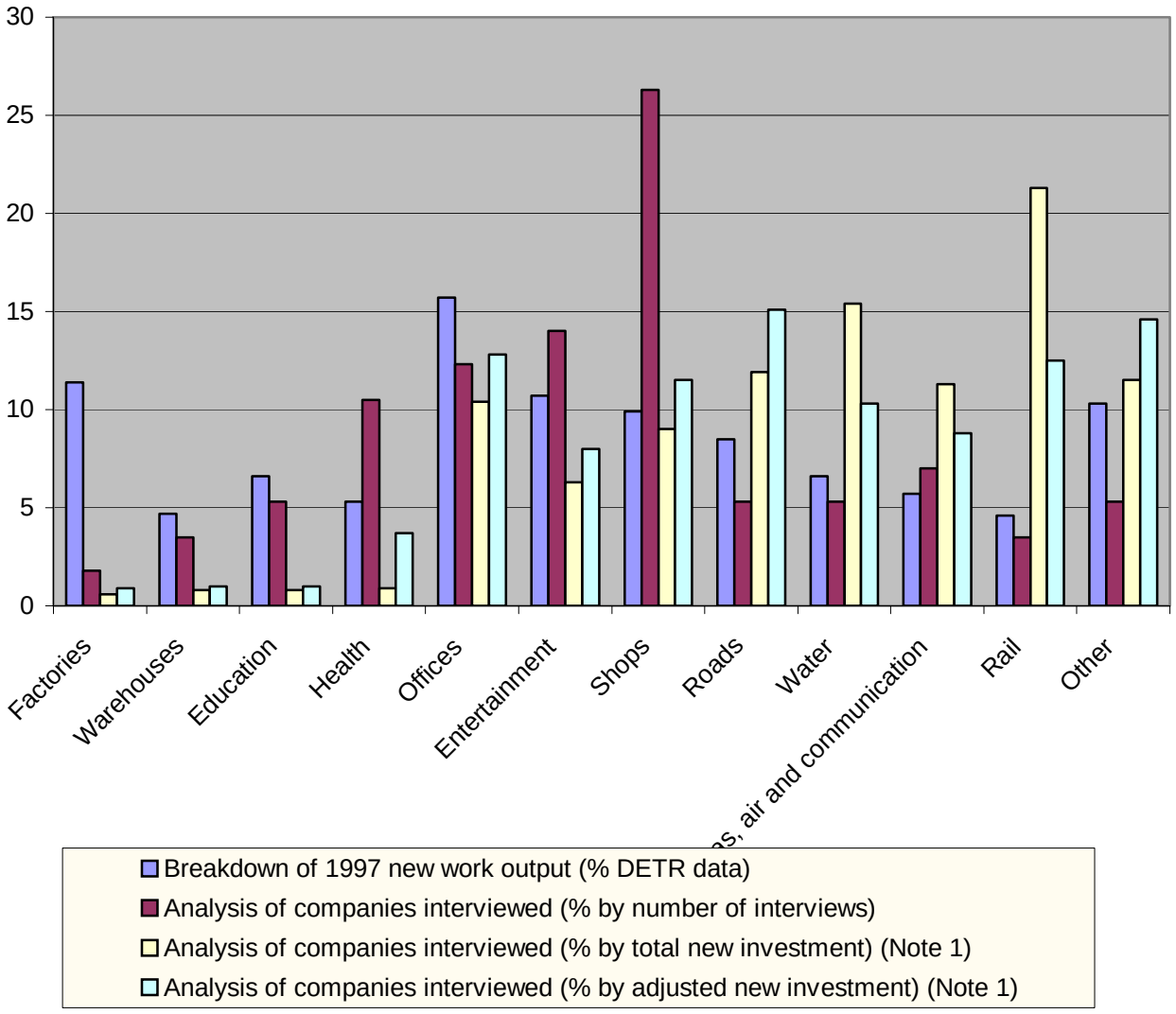


Figure 2 No of projects managed by interviewees in the last 5 years (%)

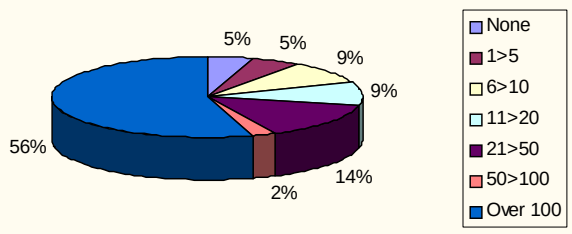
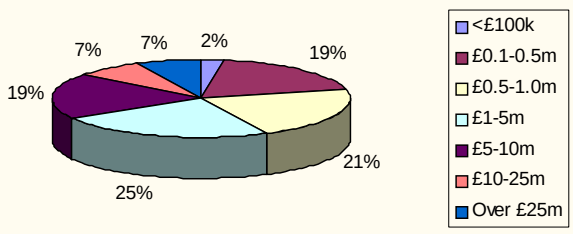


Figure 3 Average value of construction projects managed by interviwees (%)



CLIENT DRIVERS FOR CONSTRUCTION PROJECTS

Interviewees were asked why they commissioned projects. In accordance with accepted practice for qualitative data (Fellows & Lui 1997), their unprompted responses were grouped into three categories: corporate, government policy and financial. The largest group were the corporate drivers including increasing capacity, upgrading buildings and other assets, meeting business and strategic objectives and expanding into new markets. The second largest group related to government policy. These included investment programmes agreed with government or arising from new legislation. This 'government' driver was expected to be high as many of the organisations are regulated in one form or another with the investment programmes of the water, gas, rail and electricity industries agreed with their respective regulators. Construction activity in the health sector has also been affected by government actions, for example the PFI care in the community legislation. Profit-related financial drivers were the next largest motivators for investment mainly for property developers.

Interviewees were also asked for their views on a pre-determined list of drivers for construction work. This indicates that upgrading facilities, reducing operating costs and adding capacity are the main drivers. Table 1 details these drivers broken down by the location and type of project.

Client views of value for money

The term value for money is often quoted as one of the main client requirements and it is important to understand what clients perceive when they use the term. Figure 4 shows that lowest whole-life cost, lowest cost for a given quality, satisfied end users, highest quality for a given cost and consistent quality are the preferred definitions. It is significant that costs feature highly in three of these definitions. However, some clients considered other issues, such as finishing on time, as more important than the construction cost.

Although lowest whole-life cost was ranked the highest factor, several respondents admitted that that their organisation did not necessarily use this measure when they were looking for value for money. When asked to redefine their ranking in the light of this comment, several people said that lowest initial cost or highest quality for a given cost would be their organisation's key determinant for value for money.

Client's views on what value for money means are important because they differ from client to client. Therefore, it is essential that advisors and suppliers ensure that they explore this issue in more detail with each particular client in order to be able to respond appropriately.

DECISION MAKERS IN THE CONSTRUCTION PROCESS

Client's involvement

Looking at client drivers, or views on value for money is unproductive unless the clients are going to influence the outcomes of their projects, so interviewees were asked about their involvement in construction projects. More than 80% of organisations took a hands-on approach in their construction activities where they were the main drivers, employing consultants and contractors and managing them themselves. This was to be expected as the sample was taken from the larger clients. This figure was over 90% of the private and regulated private companies, but only 67% for the public sector. It is acknowledged that many smaller, 'one-off' clients rely much more heavily on the advice and guidance of advisors.

To establish the clients' role at times when key decisions are made, interviewees were also asked how their involvement varied through the duration of the project (Figure 5), based on the Process Protocol (Salford 1998) which describes a construction project in terms of the following stages:

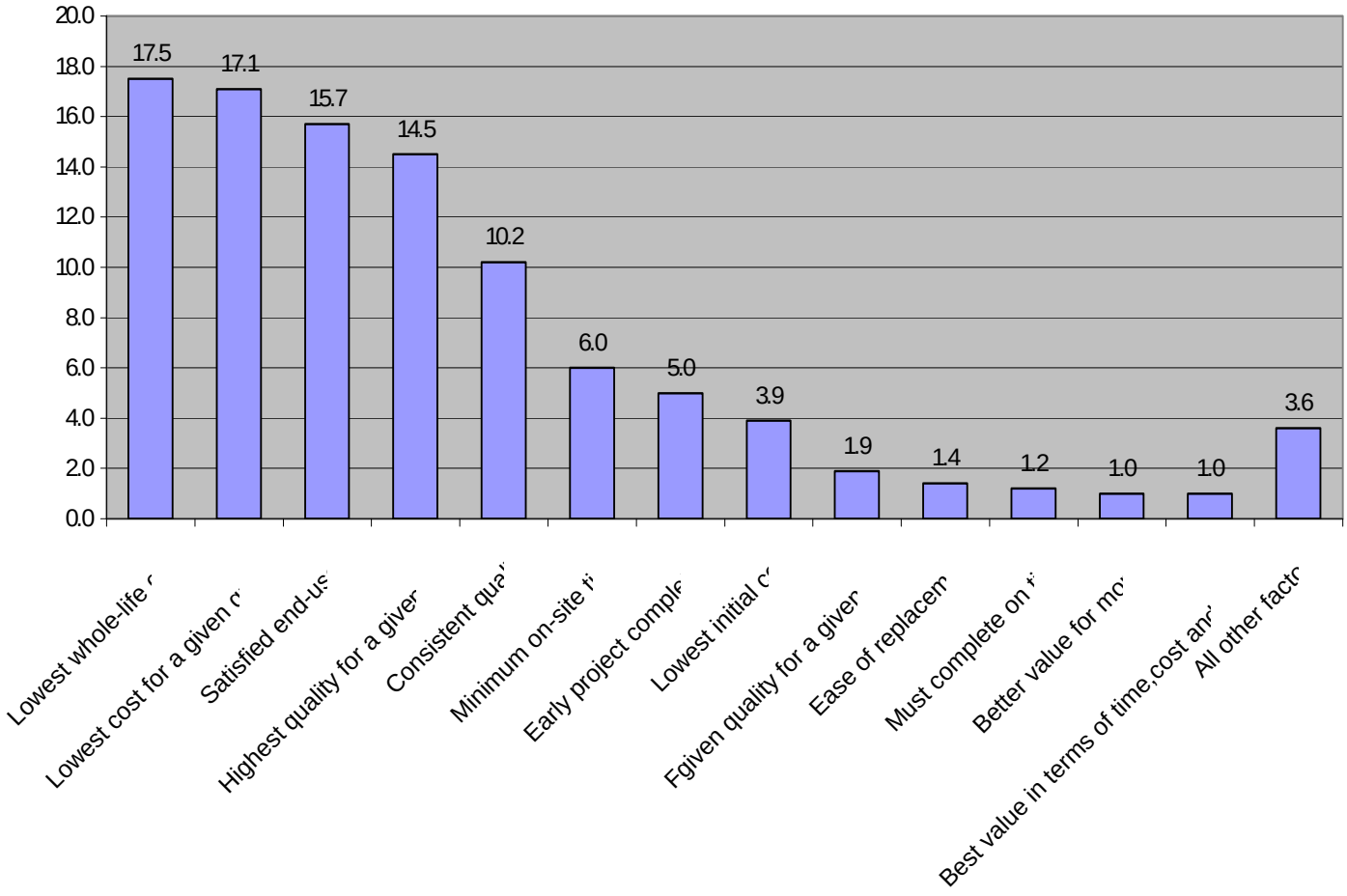
Demonstrating the need	phase 0
Conception of need	phase 1
Outline feasibility	phase 2
Substantive feasibility	phase 3
Outline conceptual design	phase 4
Full conceptual design	phase 5
Co-ordinated design	phase 6
Production information	phase 7
Construction	phase 8

Around a third of clients are still 'hands-on' all the way through the process, with others gradually handing over responsibility to their advisors. Other work (CIRIA 2000) has shown that to maximise the benefits from standardisation key decisions must be made early in the construction process, largely before conceptual design (Phase 4). At this stage, more than 60% of clients are still 'hands-on' and therefore have the opportunity to influence these decisions

	Investment Driver	Town Centre (32%)			Edge of town (34%)			Out of town (34%)			Totals	Variation
		New build	Hybrid	Refurbish	New build	Hybrid	Refurbish	New build	Hybrid	Refurbish	%	from mean
		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*j*	*k*	*l*
1	Upgrade facilities	1.6	0.4	3.6	2.5	0.5	2.9	2.3	0.4	3.4	17.4	4.9
2	Reducing operating costs	2.1	0.7	3.0	2.5	0.4	2.7	2.7	0.4	2.7	17.1	4.6
3	Add capacity	2.1	0.4	2.5	2.9	0.5	2.5	3.0	0.4	2.7	16.9	4.4
4	Health & safety	1.4	0.2	2.5	2.1	0.0	2.5	2.0	0.0	2.0	12.6	0.1
5	Expand by geographic region	2.1	0.5	0.9	2.3	0.4	1.1	2.7	0.4	1.1	11.4	-1.1
6	Legislation	1.4	0.2	1.8	1.8	0.0	2.0	1.8	0.0	1.6	10.5	-2.0
7	Expand into new markets	1.1	0.4	1.3	1.6	0.2	0.9	1.6	0.2	0.9	8.0	-4.5
8	Other reasons (Note 1)	1.1	0.3	0.5	1.2	0.4	0.7	0.9	0.3	0.5	6.0	-6.5
	Totals	13.0	3.0	16.0	16.9	2.3	15.1	16.9	2.0	14.8	100.0	

Table 1 Client drivers for construction projects (Prompted responses) % of all
Note 1: Other reasons included making a profit, balancing the property portfolio, relocating facilities and facilitating new technology (eg IT)

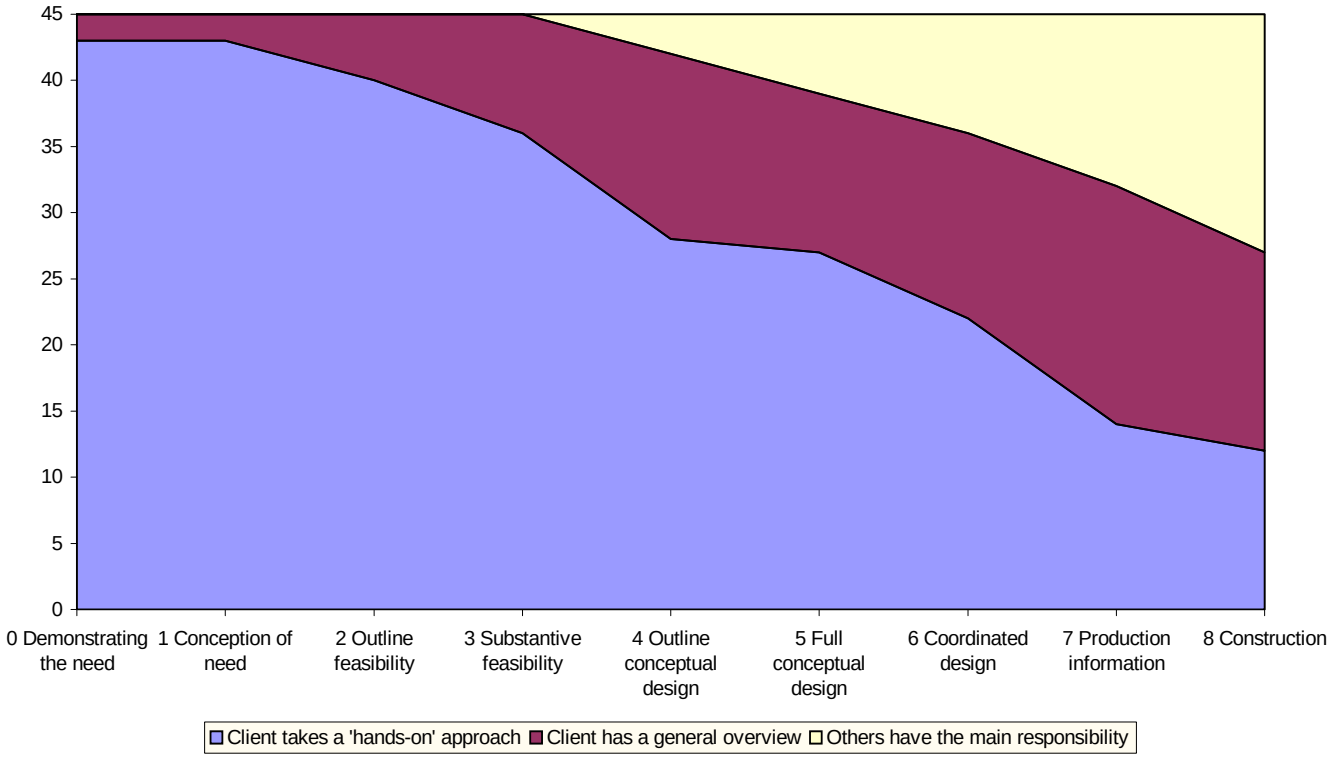
Figure 4 Ranked factors in clients definition of value for money
(% of responses)



Note 1: Interviewees were asked to rank their top four factors. Their top factor was awarded four points, the second three, third two and fourth one point. The aggregate points awarded to each factor were then divided by the total number of points and the ratio expressed as a per cent.

Note 2: Other factors include functional efficiency, least disruption to customers, optimum combination of capital and operating costs, ease of conversion and shortest development time.

Figure 5 Client involvement in the construction process
(No. of responses)



Note 1: The total number of replies was 45 as some companies varied their involvement depending on the size of the project. In these instances two inputs were recorded. Two respondents did not reply to this question as their systems were changing

Appointing advisors, contractors and suppliers
Having established the extent of client involvement it is important to consider who are the main advisors and when they are appointed. Depending on the project, firms first approach was to an architect, quantity surveyor, engineering organisation or a project manager.

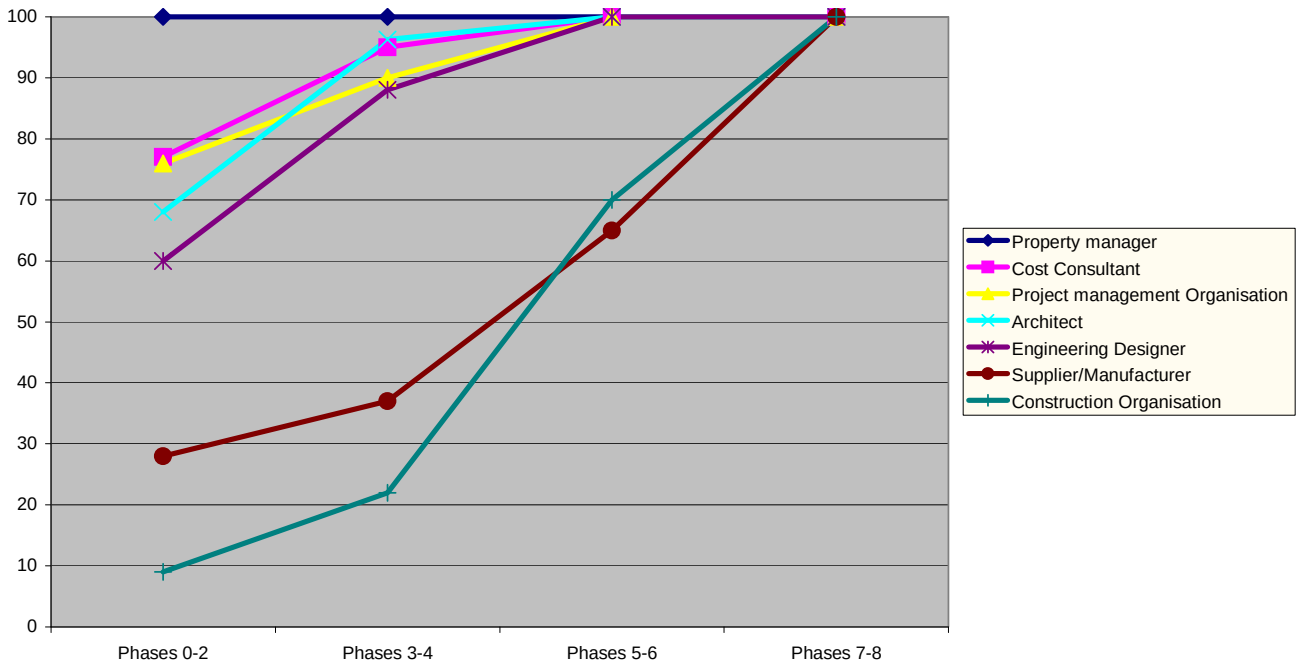
However, more than 40% of the private sector interviewees (25% of the total) sought advice first from a property manager (estate agent, property agent, commercial agent or town planner) when considering projects. Five of the forty-two organisations involve a team of people in their first review of a project, usually comprising architects, engineers, suppliers and contractors. However, nobody cited suppliers or manufacturers as their first contacts, unless they were part of their initial project team.

Figure 6 shows the timing of the appointment and briefing of consultants, contractors and suppliers. Where property managers were involved they were all appointed by outline feasibility (Phase 2). Although most consultants were appointed by Phase 4, only a quarter of respondents had taken on their construction organisation and suppliers by then even though, almost without exception, respondents felt that the earlier suppliers of a component or product were appointed the better. The few clients that did involve contractors and suppliers at an earlier stage were those which had framework agreements or corporate supply agreements.

Some clients, mostly from the public sector (58% of all public sector clients interviewed), were not involved in appointing their own suppliers, leaving this entirely to the contractor. By contrast, 85% of the private companies played a part in the appointment of their suppliers. All the regulated private companies had close relationships with their suppliers and several operated term contracts with them.

Comparing these replies suggests that although the benefit of early supplier involvement is acknowledged there are still large sections of the industry where it is not practised. Furthermore, comparing Figures 5 and 6 shows that as the hands on role of the client diminishes, the influence shifts to the consultants. Whilst this is unsurprising, it is worthy of note that project managers and cost consultants seem to be as involved as architects during the key decision making phases. Therefore, if there are benefits to be realised from standardisation, then all of these groups must be aware of how to facilitate effective implementation and this includes property management advisors, who are not typically considered in the briefing and dissemination by groups such as the Movement for Innovation.

Figure 6 Timing of briefing and appointment of key advisors
(% at each phase)



IMPLICATIONS FOR STANDARDISATION

A full discussion on the typology for standardisation is outside the scope of this paper. However, standardisation is taken to be the extensive use of processes or procedures, products or components, in which there is regularity, repetition and a record of successful practice.

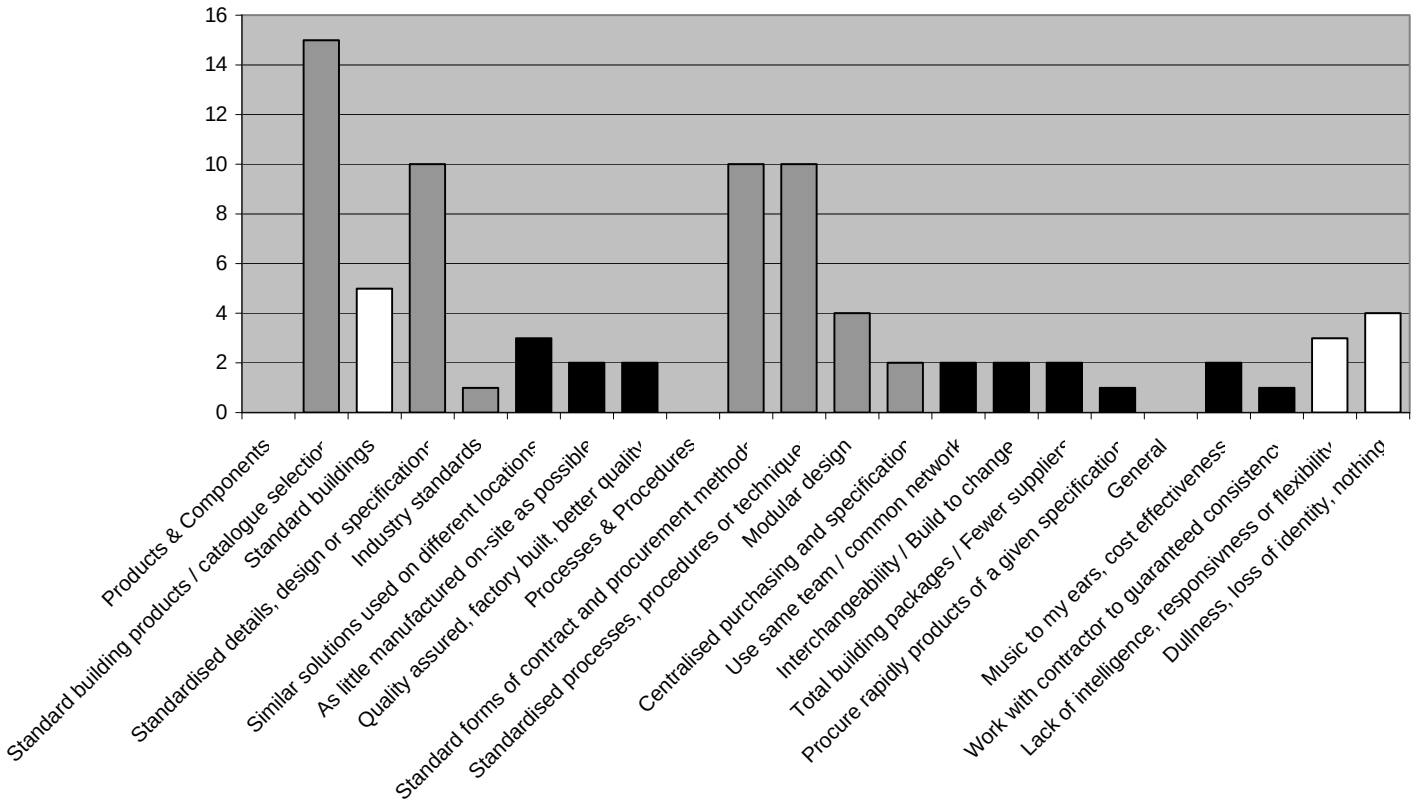
Process standardisation may vary from absolutely standard documentation and procedures at the detailed level, to a more strategic approach of a standard framework or approach. The contemporary preference appears to be the higher level framework. An analogy can be drawn from health and safety legislation, which has moved away from a prescriptive approach (you shall do this - you shall not do that) to a framework approach (you shall demonstrate that you have assessed and addressed the risks), typified in the Construction (Design and Management) Regulations.

Fox and Cockerham (2000) have recently tried to categorise component standardisation in buildings as follows:
Standard buildings that are completely off-the-shelf, made to stock, chosen from a catalogue and made in large numbers.
Customised buildings that use standard components & systems, pre-assembled into standard units, with standard interfaces but flexible floor plates etc.
Hybrid buildings that use standard components, standard sub-assemblies but bespoke interfaces.
Bespoke buildings with some standard components or project-specific standards, but no standard systems or sub-assemblies and no standard interfaces
However, these categories do not address the contemporary issue of mass customisation that uses innovative manufacturing techniques to gain the benefits of mass production with a batch size of one. This issue is developed further elsewhere (Gann 1996, Gibb 2000).

Clients' views on standardisation

Before any definition of standardisation was discussed, interviewees were asked to say what came to mind when the word standardisation was mentioned (Figure 7). This was done to establish what likely influence the clients would exert towards, or against standardisation. Most of these 'first thoughts' were merely descriptive (64%), for example: standard building products, catalogue selection or standardised processes. Some were supportive of standardisation, for example: procure rapidly or guaranteed consistency (21%).
However, some were clearly negative, criticising standardisation for a lack of responsiveness or flexibility and for creating dull standard buildings (15%).

Figure 7 Clients' first thoughts on standardisation (No. of unprompted responses)



Standard processes and procedures

Without prompting, interviewees were asked how standardising construction processes could help them meet their business needs. Figure 8 shows that the most frequent response related to cost issues with process-related factors, people issues, quality and design all being noted. This indicates that the client sample was able to make some link between standardisation of processes and their main business, which includes the drivers for the construction projects. It is significant that cost issues feature highly in the drivers list (Table 1), in the value for money definitions (Figure 4) and in the process standardisation figure (Figure 8).

Besides the cost issue, many respondents felt that having a standard process allowed all parties, both in the company and outside, to understand what is needed, from whom and by when. Several people said that this led to fewer claims and hence, less unplanned cost.

Contractual relationships and procedures were then discussed. The type of contracts used by the interviewees included strategic partnering agreement, construction management, management contracting, design & build and JCT80/lump sum type contracts. The most common forms of contract were JCT80/lump sum and design & build contracts. However, there was some evidence that more firms are looking to use some form of partnering agreement.

Half the respondents use their own form of contract for all projects, often based on a JCT form of contract. Just over 10% had their own standard contract for some projects and the remainder (40%) did not have their own standard form of contract. In these latter cases, the form of contract was based more often on Fixed price/JCT80 or some form of public sector contract, for example Minor Works contracts. In terms of contracts for consultants, responses were varied. Some clients had developed their own form of contract, often based on RIBA or RICS standard contracts. All respondents in the health sector said that they used the NHS Blue Book for consultants' contracts.

The 26 respondents who had their own standard form of contract were shown six statements and asked which best described their standard form of contract. Figure 9 shows that there is considerable variation of the extent of document standardisation with most clients using identical clauses on key points with some variable clauses. This aspect was verified by viewing examples of the documents.

Figure 8 How standard processes and components help meet clients' business needs
(No of responses - 109 Processes - 132 Components)

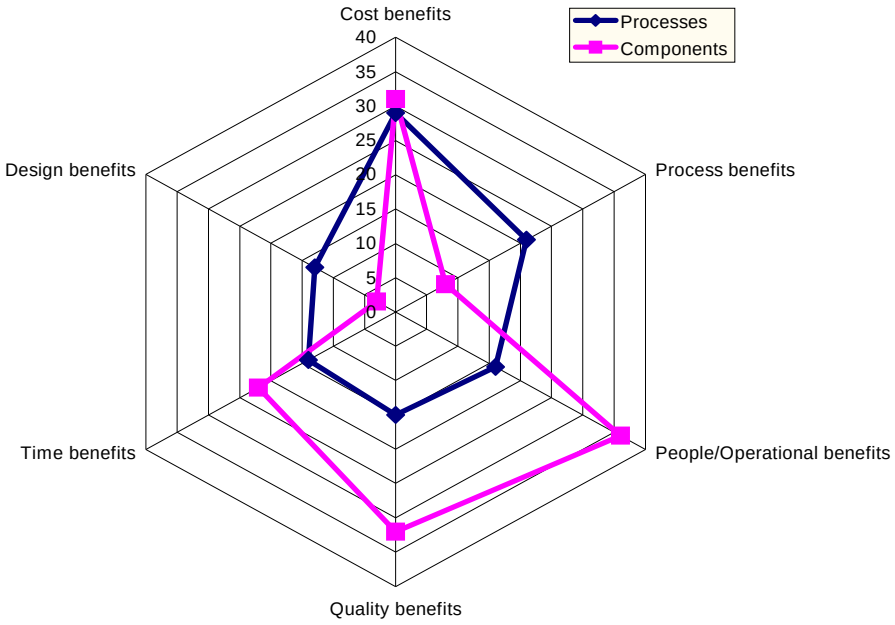
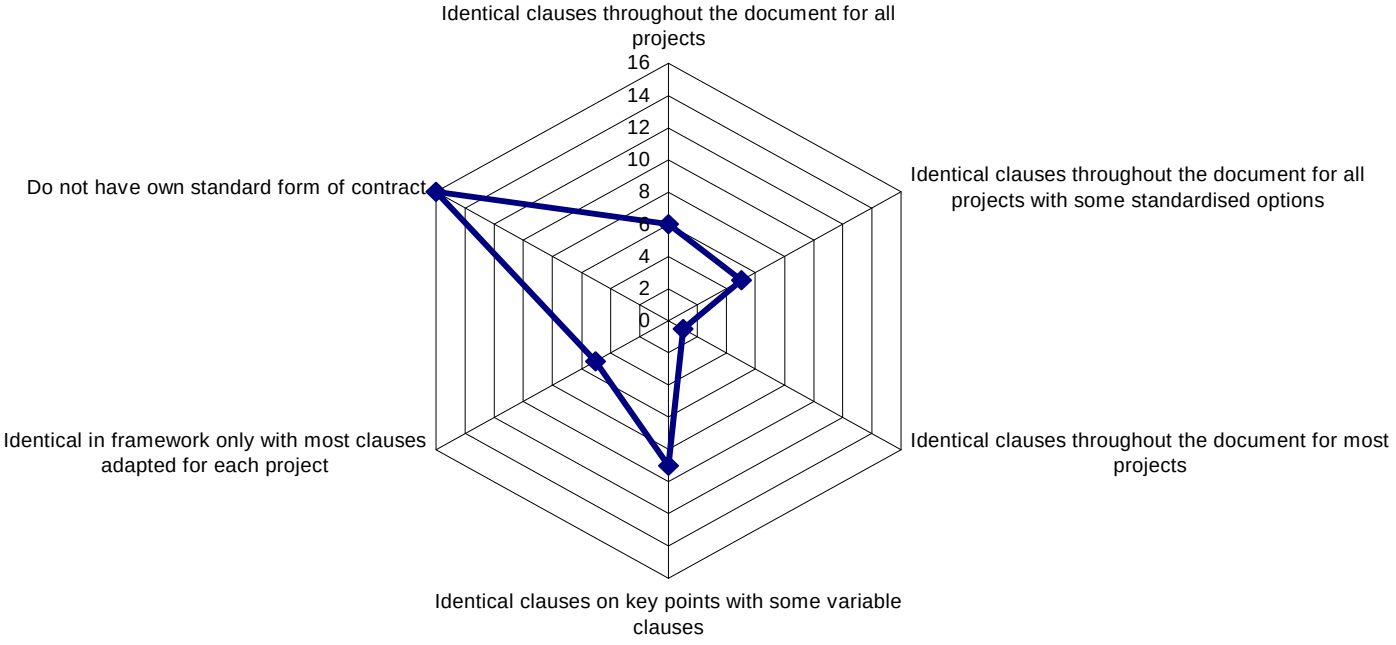


Figure 9 Extent of standardisation in contractual documentation
(No. of responses - total 42)



To establish whether a culture of process standardisation existed in the sample organisations, respondents were asked what other procedures they standardised in their construction process. Most respondents had some form of standardised project management and financial appraisal procedures. Many had standard procedures for holding project meetings, for paper systems and for how aspects of a project can be changed, for example who can authorise changes. Several companies had manuals on, for example, health and safety issues, procurement procedures, quality plans and the handling of hazardous materials.

Standard products and components
Before considering product and component standardisation it was essential to establish the extent of client product knowledge and expertise. Although subjective, almost 80% of clients considered that they at least had a reasonable knowledge (Figure 10). The regulated infrastructure clients seemed to be more knowledgeable about components than private or public clients.

134 responses were given to the question asking how the standardisation of construction components and products could help them meet respondents' business needs. Figure 8 compares these responses to those for standard processes. There were more time, quality and operational benefits cited for component standardisation whereas process benefits were biased towards cost issues. The most frequent comments were that standard components had lower costs, were of a given or proven quality and people knew how to use them. Repeatability and predictability were also mentioned many times but these were often in relation to, say, quality, cost or delivery of the product on site. An important issue, particularly for the civil engineering sector, was the fact that having standard components meant the construction users and the end-user understood what they were getting and how to use the product. For example, how tight to fasten nuts and bolts, quicker time to repair a broken pump or flange, less time spent on having to re-train operators to use a new design of component or machinery. This factor relates well to the second highest driver for construction projects, namely reducing operating costs (Table 1).

Respondents have used a very wide range of standard components with some examples being lifts, escalators, heating and ventilation equipment, cladding, fire alarms, sanitation goods as well as complete modular buildings of various types. More than 40% of respondents use some standard products which are unique to them, with examples being baggage-handling systems, security locks, vanity basins, light fittings and window and radiator guards.

More than 70% of respondents felt that there should be an increase in future component standardisation (More: 71%, less: 2%, the same: 24%, no opinion 2%).

Impact of contract conditions, project location and project type on standardisation
65% of respondents stated that the type and location of the project did not affect their approach to the standardisation of the construction process. The reasons given by those who felt their approach changed were:

- the need to meet local planning conditions
- take on board other local conditions, for example views of local inhabitants
- new build, especially out of town, is more straight-forward than other projects

Companies also tended not to vary forms of contract by type and location of work (63%), with most of the remainder varying their contact type depending on type, not location, for example new build or R&M.

Similar to processes, 63% stated that component standardisation did not vary by type and location of project. However, the reasons given for not using standard components included planning constraints, the fact that it was more difficult to use standard products on refurbishment and renovation projects and that it was easier to use standard products on new build, out-of-town projects.

The form of contract rarely affected the use of standardised components (93% said ‘no’). However, three people did feel that the choice of contract could affect their use of standard components. Their reasons were that the final choice of which component to use lay with others, for example in a turn-key contract the contractor, not the client would choose what to use, and that the details might change depending on which supplier was used. For example, some companies have group or framework contracts with some suppliers and might use other contracts for other suppliers.

Quantifying whether standardisation was a success or failure
The need to measure performance is becoming more of an issue in contemporary construction, for example in the UK’s Movement for Innovation initiative following Egan’s report (1998). In this survey most of the clients did not operate systems that could measure the success or failure of their projects with respect to either standardised processes or components (Figure 11).

Figure 10 Clients product knowledge and expertise
(No. of responses)

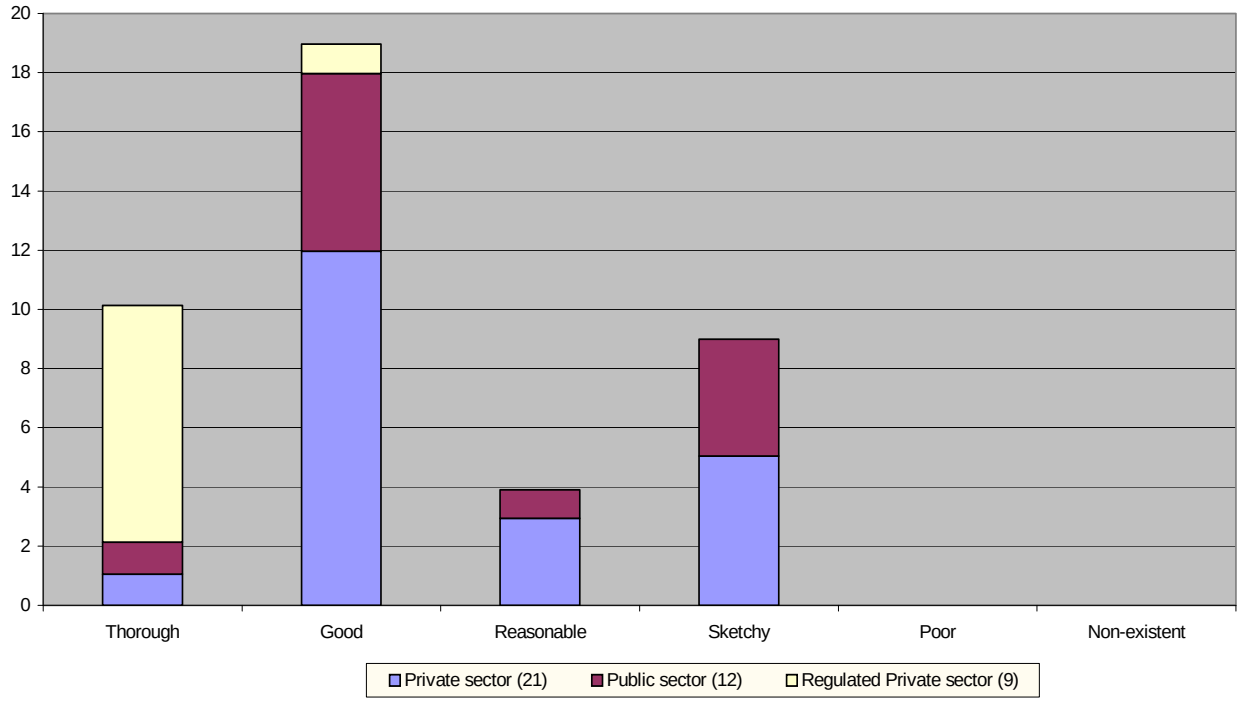
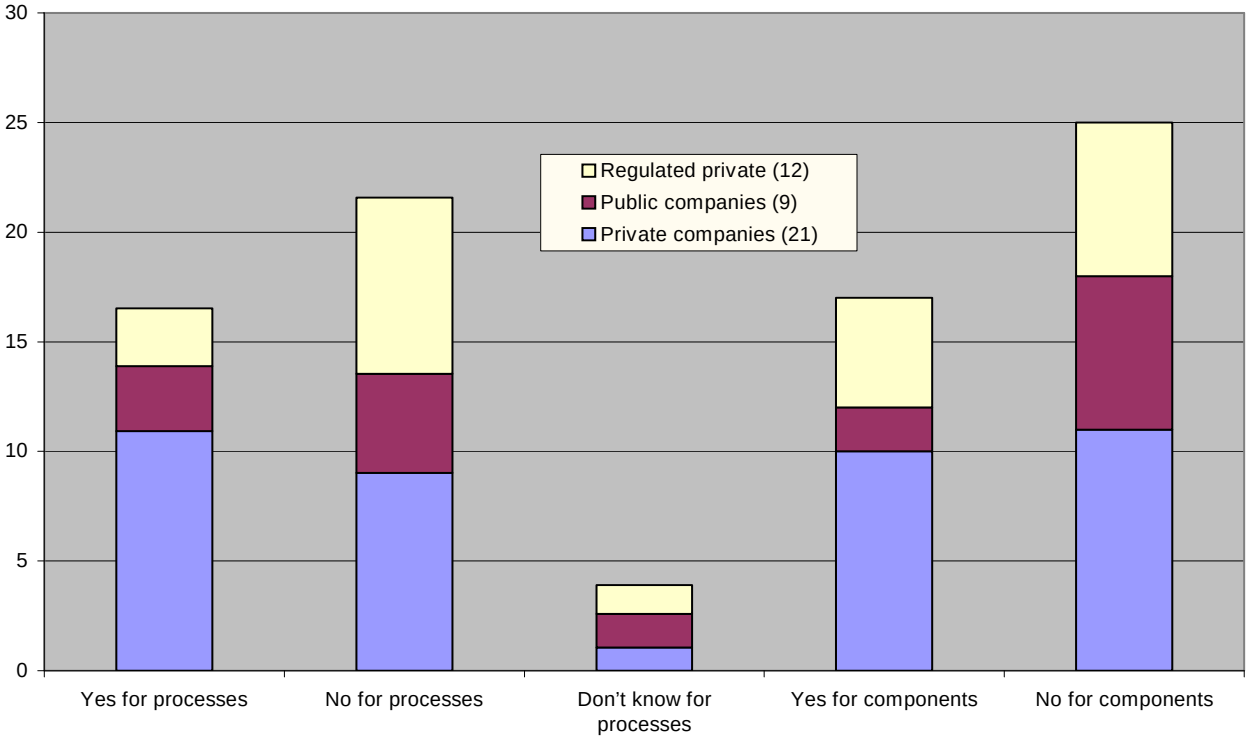


Figure 11 Do clients measure success or failure of their projects - particularly for standardisation?
(No. of responses)



The private sector was ahead in this area with almost half using some measurement scheme. Also, many of those who claimed to measure, did not have any meaningful metrics in place at the time of the interview. For instance, although some 40% of respondents stated that having a standardised process did help them to achieve a better project, this was often a qualitative response such as:

- The project finished on time
- I let more contracts with fewer in-house people
- My internal costs are much lower
- Projects are meeting time, quality and cost objectives

Most of these comments could not be substantiated by the respondents. Some of the quantifiable responses related to the fact that cost overruns had been reduced, from 10% of project costs to 2%, that fewer people were needed, in one case a reduction of staffing of 20%, and that construction times had been reduced, from 14 weeks to 10 weeks. Several respondents noted that their construction costs and times had been reduced but this improvement also entailed the use of pre-assembly (Gibb & Isack 1999).

Overall, it is very difficult to differentiate process savings from those derived from using standardised components and pre-assembly, or a combination of both. However, one person did state that changing their procurement process and using pre-assemblies had led to a 12% cost reduction over the past year (1997 versus 1996). Of this saving, only 1% was due to material savings, in this case the use of timber frames for retail outlets. The rest of the saving had been achieved by changing procedures and reducing the number of contractors from over 135 to 30.

The companies that have measured the savings from using standard components looked at lower cost, shorter delivery times, faster construction times and fewer quality problems. However, this information was very limited.

Of the 42 responses to whether organisations measured the success of standard components, 26 people said that they either did not measure this factor or had no details. Of the 16 who did, only 8 were able to give a quantifiable measure. Several of these responses related to reduced costs of components and products, anything up to 30% over two years, and others concerned reduced construction times, such as a six-week programme reduced to four weeks and a 16-week programme reduced to 14 weeks. Other benefits cited were reduced whole-life costs, reduced training needs for operatives and that having standard parts meant that fewer spares would have to be kept and that this too was a saving.

Overall, quantifiable data on the benefits of using standardised components is very poor. In many cases, it appears that it is the client who has to devote resources to developing products to meet business needs which could mean that these might become 'bespoke' items. Several respondents thought that suppliers should be doing more.

Clients' expectations for the future of standardisation

Respondents were asked if they believed that their company should be looking to use, or increase the use of standardised processes or products. Just over 70% of interviewees would definitely use, or increase the use, of standardised processes and products. With only around 20% probably not or definitely not intending to increase their use of standardisation.

In an attempt to ascertain the extent of the desire for increased standardisation not being met by suppliers, interviewees were asked if there were any products they would like to use as standard, but could not because they were not available. Again, around 60% replied no to this answer. Some examples of what people are looking for include a standard design for hospital care wards and station canopies.

In terms of products or aspects that the interviewees believed could not be standardised, the most frequent response was the footprint of the site. Since renovation and refurbishment work accounts for around 40% of all the work undertaken by firms in this survey, the location, shape and size of the building will often restrict them as to what can be installed in it. Clients often have to use products that match those already present in the building.

CONCLUSIONS

This paper has presented the results from interviews of fifty-nine senior personnel from major construction clients investigating project drivers and implications for process and component standardisation.

These clients commission construction projects for various reasons. They all want value for money, which to them means: lowest whole-life cost, lowest cost for a given quality, satisfied end users, highest quality for a given cost and consistent quality. Clients had some knowledge of standard processes and components although some of their preconceptions were mixed. This suggests that

more work must be done to ensure, and clearly demonstrate to clients, that standardisation in process and components need not stifle creativity nor lead to boring buildings.

They saw mainly cost-related benefits from standard processes but also time, quality and operational benefits from standard components. There was some link between the initial drivers for the projects and the perceived benefits from standardisation.

Some clients retain hands on involvement throughout the construction process, however at the key decision making phases other advisors are also influential. These include architects, cost consultants, engineers and project managers but also property managers. All of these groups must be lobbied if there are to be any changes in the way the construction projects are delivered and more work must be done to understand the factors driving these advisors. Many clients recognise the need to involve construction and manufacturing experts early, although fewer actually achieve this, which remains a major barrier to implementing change.

One weakness identified is that few clients have any meaningful way of measuring success of their projects. Therefore, decisions on future strategy, including standardisation, are most likely to be strongly influenced by the preconceptions of the clients and their advisors. Due to the inherent inertia in construction, unless effective measurement is implemented soon it is unlikely that much change will be effected.

Clients believe that there is a future for increased standardisation, but only if the industry recognises and responds to the drivers of clients and their teams. This paper has attempted to inform and facilitate this action.

REFERENCES

Bottom, D, Gann, D., Groak, S. & Meikle, J. (1994*) Innovation in Japanese prefabricated house-building industries.* Construction Industry Research and Information Association, London, 65pp.

BSRIA (1999) *Prefabrication and pre-assembly – applying the techniques to building engineering services.* Compiled by Wilson, D.G.; Smith, D.H. & Deal, J. The Building Services Research and Information Association, Bracknell, ACT 1/99, ISBN 0 86022 505 4

CIRIA (1997) *Snapshot – Standardisation and Pre-assembly.* Compiled by Gibb, A.G.F.; Groák, S. & Sparksman, W.G., Construction Industry Research and Information Association, London, pp. 1-8.

CIRIA (1999) *Adding value to construction projects through standardisation and pre-assembly.* Compiled by Gibb, A.G.F.; Groák , S.; Neale, R.H. & Sparksman, W.G., Construction Industry Research and Information Association, London, Report R176, . ISBN 0-86017-498-0.

Egan, J. (1998), *Re-thinking construction*. DETR, London

Fairs, M. (1999) Charles turns techno. *Building Design.* Miller Freeman, London, **1400**, 18/6, 6.

Fellows, R. & Lui, A. (1997) *Research methods for construction.* Blackwell Science, Oxford, ISBN 0 632 04244 3, 214 pp.

Fox, S. & Cockerham, G. (2000) Matching design and production. *The Architects' Journal,* Emap, London, 9 March, 50-51, ISSN 0003 8466.

Gann, D.M. (1996) Construction as a manufacturing process? – Similarities and differences between industrialised housing and car production in Japan, *Construction Management and Economics*, **14**, 437-450.

Gibb, A.G.F. (1999) *Off-site fabrication - Pre-assembly, prefabrication & modularisation.* Whittles Publishing Services, Caithness, 320pp., ISBN 1 870325 77 X.

Gibb, A.G.F. (2000a) Standardisation and pre-assembly – distinguishing myth from reality. Invited Paper *Construction Management & Economics*, E&FN Spon, In press.

Gibb, A.G.F. (2000b) *Client's Guide and Tool Kit for Standardisation and pre-assembly.* Construction Industry Research and Information Association (CIRIA), Report CP/75, 70 pp.

Gibb, A. G. F. & Isack, F. (2000) Client expectations from pre-assembly: results from major client interviews, *Proceedings of the Institution of Civil Engineers.* awaiting publication.

Groák, S. (1992) *The idea of building.* E & FN Spon / Routledge, London, ISBN 0 419 17830 9.

Herbert, G (1984) *The dream of the factory-made house: Walter Gropius and Konrad Wachsmann.* MIT Press, Cambridge, Mass, ISBN 026 208 1407

Russell, B (1981) *Building systems, industrialisation and architecture.* Wiley, New York, ISBN 0471 279 528.

Salford (1998) *Process Protocol – Generic Design and Construction Process.* University of Salford, Manchester, UK.

Sarja, A. (ed) (1998) *Open and industrialised building.* E & FN Spon / Routledge, London, ISBN 0 419 23840 9

Spiller, N. (1999) *Landscapes of change.* Bartlett School of Architecture, London.

White, R. (1965) *Prefabrication: A history of its development in Great Britain.* National Building Studies Special Report 36, HMSO, London.