THE IMPACT OF PROCUREMENT METHODS ON DELIVERING ENVIRONMENTALLY SENSITIVE BUILDINGS

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In the UK, new building regulations ('Part L2006') to reduce energy consumption and carbon dioxide emissions within the built environment came into force in 2006. It is now mandatory that all new built and refurbished buildings demonstrate compliance with 'Target Carbon Emissions Rates' in the design phase. This has prompted some interesting questions concerning their procurement. Under traditional UK procurement arrangements, designs are, in theory, completed before the contractor becomes involved. However, there has been a significant increase in the use of Design-and-Build procurement: a system which actively supports concurrency in design, procurement and construction. Under such arrangements, the design of environmentally sensitive buildings may be seen as a challenging task, as the iterations required are at odds with the contractor's incentive to avoid delays and extra cost. This has prompted a preliminary investigation into the opportunities and limitations afforded by different procurement methods for delivering environmentally sensitive buildings. Although these issues are fairly ubiquitous throughout the various building elements, the particular focus was on façade design and construction. Data collection was by structured questionnaire and interviews carried out with large construction companies, architectural practices and building performance consultants. There was a consensus that Part L2006 has major implications for procurement and that compliance is a major step change. A new and indispensable bidding document, the 'Building Energy Model', will emerge and in its absence most contractors would decline invitations to bid. There will be an impact on procurement, probably in the form of an extension of the use of 'novation'. Design-and-Build contractors will 'freeze' designs earlier, and forgo the potential for later value engineering in order to avoid risks, which they see as significant. Finally, despite the industry's 'fear' of Part L2006, the regulation has already created a welcome by-product in the form of a clear increase in collaborative work among design and construction teams.

Keywords: energy-efficient design, Part L, performance-based regulation, procurement methods.

INTRODUCTION

To meet the Kyoto target of reducing carbon dioxide emissions by 20% by 2010 the UK government has introduced a number of measures to achieve energy conscious buildings and promote sustainability within the built environment. In April 2006, *Building Regulations Part L: Conservation of Fuel and Power* was introduced. The response of the industry was, according to Lane (2006) one of 'blind panic'. The reaction of the Department of Communities and Local Government was that stakeholders perceive building regulations to be driven by reactions to current hot topics and as 'being increasingly politically, rather than practically, driven'. The

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Hamza, N and Greenwood, D (2007) The impact of procurement methods on delivering environmentally sensitive buildings. *In:* Boyd, D (Ed) *Procs 23rd Annual ARCOM Conference*, 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management, 723-732

impetus was ‘getting a tick in the box for Kyoto’ which was accomplished with ‘the usual political rush to be seen to be doing something without sufficient regard for implications’ (DCLG, 2007).

Building regulation revisions are normally incremental but Part L (2006) is significantly more radical. For the first time in the history of such legislation there is a need to comply with a building regulation *before* applying for planning permission. This is because the ‘building energy model’ depends on five main variables; façade configuration, occupancy levels, building services systems, local climate and orientation of building. Among these variables the building envelope and the building orientation are design variables that are the main components in submitting the building for planning approval. The major impact of regulating energy consciousness and environmental sensibility will fall upon many parties, for example, architects, building services engineers, main contractors and specialist engineering contractors. The degree of responsibility and risk, and where they fall, will depend in part on the project’s particular procurement and contractual arrangements. The research sought the views of representatives of the key parties involved in these issues and particular care was taken to select respondents who had already some knowledge or experience of the new regulations.

REGULATORY CONTEXT

Building regulations are introduced to protect the health and safety of people as well as limiting the environmental impact of the built environment on natural resources. As the built environment consumes 50% of the energy within the UK, the construction industry has a significant contributions and responsibility to reduce energy consumption and carbon dioxide emissions by designing and constructing buildings that contribute to human well-being while reducing energy consumption during the course of their use. Building regulations to reduce energy consumption by good design and detailing date back to 1965 in the UK, in the form of prescriptive regulations in which a certain U-value is achieved for individual components of the fabric or the overall building envelope. These prescriptive regulations were tightened over the years in response to repeated energy crises and concerns regarding the increases in carbon dioxide emissions, reducing the U-value for exposed walls progressively from 1.7 W/m2.K in 1965 to 0.35 W/m2.K in 2002. The regulations were satisfied by increasing insulation thickness and limiting glazed areas on facades; a response that was considered by some to restrict innovation in architectural design, construction materials, building services and control systems (Gann, 1998). This led many countries to a move away from prescriptive regulations to standards where compliance is achieved by the performance of the end product (the finished building). The merits and disadvantages of performance based regulations are discussed in (Hamza, 1999) and Beller (2001).

Energy efficiency in the built environment is regarded as a key area to influence reductions in carbon dioxide emissions and avoid climate change consequences. Performance-based regulations for conservation of energy and power in buildings in the UK (Part L of the Building Regulations) came into effect on the 6th of April 2006, and is based on the need to comply with the European ‘Energy Performance in Building’ Directive introduced into all European states in 1991. The new performance based Part L 2006, differs from any previous regulations concerning reduction of energy consumption in the built environment in the UK. There are to be four approved

guidance documents which will deal with work to *new dwellings, existing dwellings, new buildings other than dwellings,* and *existing buildings other than dwellings.*

Compliance with this regulation is extended from the design phase, to completion and operation of the building. Measures for compliance can be divided according to the stages of the project into (i) the *design stage,* (ii) *as built,* and (iii) *as operated.*

In the *design phase* designers must ensure:

1. Building envelope design limits heat loss or gain through the building fabric ;
2. Performance of the whole building is based on target annual carbon dioxide emission rates (TER) ;
3. Solar gain and heating gains are considered in an attempt to remove reliance on air conditioning systems where natural ventilation can be used;
4. Availability of passive ventilation systems is ensured where air-conditioning is not used;
5. Energy efficient building services systems and insulated duct work are specified;
6. Energy efficient building services controls are specified;
7. Attention is paid to decreasing thermal bridging and uncontrolled air infiltration;
8. The intended design should deliver reductions in the TER of between 20-27% from a notional building based on the prescriptive Part L(2002).

The *as-built* requirements are:

1. Evidence of improving the quality of construction to deliver air tightness;
2. Air pressure testing for buildings more than 1000 m2;
3. Separate energy metering systems (separate meters by end use and fuel type, and renewable energy source if used on site);
4. Certification of testing and commissioning of heating and ventilation systems;
5. The building model to prove that the ‘as built’ design has an accepted *building emission rate* (BER) that does not exceed the intended TER.

In operation, the building must

1. Provide reliable and detailed information to the owner to allow efficient use of the building and services;
2. Record energy consumption by end use to ensure building runs as per the design intentions.

From the foregoing it should be evident that the new regulation is radical and far-reaching in its effect. The current research is concerned with its effect on the procurement and contractual arrangements in the industry. In order to limit the complexity and extent of the investigation, particular attention was paid to the implications of these changes on one element, namely the envelope or façade of the building. The key issue is that any changes to the façade configuration after it gains planning approval will lead to a need for complete re-submission of the project for approval.

PROCUREMENT CONTEXT

A number of recent reports have highlighted changes in the way buildings are being procured in the UK. According to the Consultants' Performance Indicator Report (ACE, 2003:48) Design-and-Build as a procurement route increased between the year 2002-2003 from 12% to 30% of contracts (by value) while traditional, 'lump sum with quantities' contracts decreased from 35%-29% from 2002-2003. The RICS survey of building contracts in use during 2004 reported a decline in what could be described as 'traditional' methods, with Design-and-Build accounting for just over 40% of total workload value, and partnering agreements featuring much more heavily (RICS, 2006). Data provided by Hughes *et al.* (2006), based on a more extensive survey, support this and indicate that together 'pure' (20%) and 'novated' (26%) Design-and-Build procurement, account for nearly half the value of proposed construction projects. In an earlier work, the same authors also refer to 'the increasing use of collaborative working methods' (Hughes *et al.*, 2005) stating that proponents of collaborative working point to the reduction in the costs of striking deals. A further advantage of integrative procurement practice is cited by Greenwood (2006) who notes that the approach has been considered (by Latham and Egan, for example) as fundamental to a more productive and innovative industry.

In traditional procurement, it is the architect's responsibility to gain building control approval on all drawings before the bidding process starts. This process is criticized in the Latham report (1998) as leading to the production of costly prescriptive specifications and detailed construction information that limits the flexibility of contractors to involve their own supply chains. It is against this context that the move to potentially more integrative forms of procurement – specifically Design-and-Build – has taken place. A further development in procurement approaches has seen an industry-wide departure from the obsession with least-cost bidding, and the adoption of more flexible selection criteria. This is exemplified, in the public sector, by the move from Compulsory Competitive Tendering to Best Value Procurement occasioned by the Local Government Act of 1999 (Hughes *et al.*, 2006).

As pointed out by Greenwood and Walker (2004), both of these developments – a move to more integrative procurement structures, and a more relaxed approach to selection criteria - have had significant impacts on the dynamics of the design process. Removal of the traditional barriers of *independent design* and *lump-sum tendering*, has enabled clients (potentially, at least) to involve contractors and their supply chains at a much earlier stage. Furthermore, given the prospect of a high level of control over all aspects of a project - from design to commissioning - contractors can feel justified in offering a guaranteed price 'at risk'. This risk is offset by a corresponding contractual right (afforded to them by the Design-and-Build system) to 'value engineer' designs.

PART 'L' AND THE PROBLEM OF INTERVENTION

Under the 'traditional' procurement system it is customary that the architect, on behalf of the client, is responsible for gaining building control approval. By contrast, in Design-and-Build projects, the contractor is the single point of responsibility for delivering the project, including dealing with building control approval. Contractors identify *compliance with regulations* as a risk factor in projects, and this is accounted for in their bid prices. Before the introduction of Part L (2006), it was customary, under Design-and-Build arrangements, for the work to start on site based on staged building control approval. As well as being quicker, this allowed more flexibility in

the design of facades and systems while construction is being carried out. Contractors had the choice of employing the client's M&E consultants, their own, or allocate the complete package to a specialist contractor under subcontract. An attractive aspect of this was the potential for designs to be concurrently 'value engineered'. However, the introduction of Part L has appeared to have had an impact on this. Specifications that meet the new Part L requirements focus on what the completed facility enables the client to do (for example, to provide a standard office environment for fifty staff). They do not necessarily specify the detail (number of doors and windows etc) on the basis that the supplier will be better placed to decide on how the requirement will be met. Where an output specification is not well developed, there is a risk that the quality, design and performance of the completed facility may be compromised. Careful attention to the output specification is essential to achieve the required outcome.

It was already known that contractors were anxious about the new Part L. In a survey by DCLG (2007) of 200 firms, 73% expressed concern over the new regulations. And although the regulatory changes included Part B (Fire), Part M (Accessibility) and Part P (Electrical Safety), Part L was cited as the a major area of concern. There is a perception of 'no joining up of the construction cycle from design, through build and operate'; of a 'gaps emerging' between the development process and the new regulations, especially in the 'newer areas of interest such as the environment'. All this is adding to 'complexity and increased frustrations' (DCLG, 2007: 74). In particular, the complexities of ensuring *design phase* compliance, together with the new requirement that the *as-built* BER meets the *designed* TER, have a potentially massive impact on the timing and nature of the design; of contractor intervention; and of the contractual and working relationships of those involved. It was these considerations that prompted the current research.

METHOD

To explore these matters, semi-structured interviews were carried out with a number of organizations that have had experience of working with the new regulations. The context of the enquiry was limited to large-scale commercial buildings that had been let on a Design-and-Build basis. Three large main contractors were approached: each was a large 'player' in the construction market. In addition, four architectural design offices, working at a national level on commercial projects and with experience of Design-and –Build, and novation. Finally, four building energy performance Consultants (also referred to as M&E consultants) took part.

The four areas of exploration with respondents were:

1. Their experience with how Part L had an impact on design and decision making in design and construction projects;
2. The impact of Part L on bidding documents in different procurement routes;
3. Whether compliance with Part L had led to an in increase in the factoring-in of risk margins anywhere in the design and construction process;
4. Contactors' control measures to reduce risk of non-compliance of the *as built* energy model.

At the end of each interview, interviewees were asked to comment on previous interview outcomes in the same four topic areas. All transcribed interviews were sent via e-mail to the interviewees for further comment and to reduce subjectivity in

interpretations of interview outcomes. Comments on the responses were invited from a major national construction law firm and from a local building control authority. All interviews were carried out in April 2007.

RESULTS AND ANALYSIS

The results presented here are restricted to those issues upon which there appeared to be a clear consensus within groups or a consistency in their answers. The groups were coded as shown in Table 1, below.

Table 1: Coding of respondents' groups

Group	Code
Architectural design offices	A
Main contractors	C
Building energy performance (or M&E) consultants	M
Construction Law firm (legal commentator)	D

The comments included in the section are referenced accordingly, with a quotation from one of the Architectural group referenced as 'A', a main contractor as 'C', and an M&E consultant as 'M'. Respondents' general impressions of Part L were that it represented a major challenge. There was anxiety amongst designers (Groups A and M) in particular about the expertise needed for energy modelling, and the untested and incomplete nature of the related monitoring software. Contractors (Group C) questioned the level of understanding (other than a basic one) amongst building control officers, and doubted the system's ability to properly police compliance.

Impact on design and decision making

Compliance with the new Part L has increased iterations between the architectural design team and the M&E consultants. The commercial concerns of clients were seen as a major barrier to this.

- Clients 'need to change their attitude... [and] …understand that need to bring in the ME consultants earlier'… despite the extra cost (A).
- It is still the client's perception 'that sustainable building costs more… but the difference of constructing sustainable buildings and non sustainable buildings is decreasing' (C).
- With the old regulations 'there was still reluctance from developers to involve consultants at an early stage, as there was the issue of modelling fees. The new version (Part L 2006) forces this on all the design teams as they have to work together at a very early stage' (A).

Within the design team, Part L is seen to further erode the architect's status.

- 'The role of the architect as the design leader is slightly eroded' (C).
- 'Architects do not have the skill in house to deal with Part L, specialists have to come on board earlier on in the scheme as compliance with part L is related to the orientation of the building, façade materials , glazing ratios and the M&E strategy' (M).
- The building services engineer becomes a more critical partner in the building design…It is all about collaboration.' (M)

Despite the recognition that Contractors should be involved earlier in the design process, Part L (2006) limits their flexibility to change certain aspects of the building design after a certain point (planning permission)

- 'You get one chance to change for free, after that even with minor changes to glazing means re-submission for planning……What is happening is that architects would draft up very rough scheme of the building, its orientation and then asks the modellers to assess the amount of glazing they are allowed to use. There is a lot of iteration and this is time consuming …and it is not cheap'(M).
- 'When the job goes to planning we would make sure that we have frozen the envelope design and specification so we are ensured that the quality is delivered. This is the only way to defend quality by doing more work upfront. It is dangerous to define what quality is later on in the project where cost becomes a critical factor' (A).
- 'We take it up to planning in terms of the M&E the rest of the team will be novated to the contractors, but a lot of clients retain the M&E consultants on their side to assure quality. The contractor will appoint a different M&E consultant to do the detailed design and installation. With the new Part L set up to get you through planning, the performance specification and major design elements are already fixed for the sub-contractors on the performance, so the plant efficiency are fixed, the ventilation strategies are fixed.' (M)

Impact on bidding documents in different procurement routes

There was a general assumption amongst respondents that Design-and-Build was the procurement arrangement most likely to be encountered. Novation (by the client to the contractor) of lead designers (i.e. architects) was taken for granted but the prospect was raised of the novation of the client's M&E consultant (to the main contractor, or even to a specialist sub-contractor) in order to preserve continuity (and responsibility) in running the 'Building Energy Model' for final compliance with Part L2006 in the form of the *as built model*. A preference was expressed by some for a two-stage tender approach. The 'Building Energy Model' has become an integral part of tender documentation.

- 'Two-stage tendering is the best where the contractors are brought on earlier and all the design team is novated. There are advantages as the project would be taken up to Stage D, up to planning permission phase, then the contractors get bidding for the project. As the contractors participate in the rest of the process, the reason this works best is because the client wants to control the cost and the contractors are capable of delivering a project on cost and time, but the collaboration between designers, consultants and contractors can deliver quality'(A).
- The 'Building Energy Model' is a major part of the bidding contractual documents. Contractors will reject to bid for a project if the 'building energy model' was not constructed and proven to comply with Part L performance based requirements.
- 'The consultant specification and tender drawings form the contract and the contractor implements the contract by interpreting the contract They are not making big decisions or strategies. If a contractor wants to propose an alternative because the onus of compliance is on them then they will have to demonstrate compliance with Part L' (M).

- 'We insist on a Building Energy Model at tender stage' (C).

Change in risk and measures to reduce the risk of non-compliance

Compliance with building regulations is an item that now appears on all Design-and-Build contractors' risk matrices. Compliance with Part L2006, in particular, is seen as a critical and sometimes unacceptable risk. Contractors will price for this risk, and in some cases even decline to tender.

- If a Building Energy Model is not provided [at tender stage] then we would insist on stating that we have priced the project as per information provided and if we are successful in being appointed, the client will have to fund running the energy model and any changes due to non compliance with part L will have to be priced (for example changing the building services systems). We would not take that risk' (C).
- 'Before we approve novation we seek evidence of compliance with part L. You then do not allow changes to happen to the project once the contract is signed or be put in extra money to manage the risk of non-compliance with part L. So in a way it forces the client to produce the thermal model or a large amount of money will be built in as a risk. As this will add consequential improvements to specified equipment and materials in the building' (C).
- Compliance with all building regulations is on the risk matrix and we put a percentage to this. But it is back to choosing a competent design and sub contract team. Part L2 is an expectation, the industry is not experienced enough to take decisions on changing façade elements without running the energy model and we would not like to take the risk of implications, therefore there is a conservative approach to handling this risk. Because without running the energy model even the consultants would not know the answer if the building is compliant or not (C)
- 'I haven't seen a contractor turn down a bid for non-compliance with Part L. Everyone accepts it is a genuine risk, who wants to take on a fixed price for a project when a large piece of the design is still at large. The first thing they would want to do is to quantify the risk and deal with it quickly' (A).

Because of the sensitive nature of the energy calculations required for the *designed* TER and the requirement for a compliant *as-built* BER, contractors are reluctant to alter certain key elements of the pre-start design. For example, there is a strong link between final façade design and detailing and how it contributes to the building energy consumption. Contractors indicated that they would freeze the façade design and specifications rather than take on the risk of non-compliance with the *as-built* model later on in the project. This defies the normal rationale behind Design-and-Build, where flexibility to value engineer changes in specifications and detailing during construction affords them important commercial advantages. In the case of façades, an alternative would be for the contractor to intervene at an early stage with its own selection of preferred system.

- The façade design should be freezed [sic] in its design once it complies with part L but once it is costed' (C).
- We would rather give the client a number of choices of façade systems that are constructed off site that we have tested and know that they meet with Part L. But there is no contractual obligation to comply with part L before planning stage' (C).

Responsibility and liability

In the case of the completed building failing to comply with Part L contractors would attempt to rectify the problem (particularly if it is concerned with workmanship). If, upon investigation, there was a major design problem attention would turn to designers and specialist subcontractors. It was interesting that all three contractors interviewed professed a reluctance to litigate, or even claim, under such circumstances. In the current procurement environment, where contractors regularly alternate between 'traditional' and design-and-build arrangements, the relationship between designers and contractors is seen as a 'political' issue. Contractors would rather absorb problems than sour their relationships with designers (who effectively lead to clients and more project work for contractors). This point was confirmed in discussions with legal commentators (D).

- 'If the building does not comply after construction we need to establish why it failed. In a D&B project we try to put the problem right first then investigate the reason so we can get the completion certificate' (C).
- 'It is a political issue to sue designers in case there is a design failure. The contractor would try to protect the designer. Acoustic and air testing must be carried earlier on rather than waiting till the completion date' (C).
- 'We had problems with running SAP calculations *as built* and finding out it failed but we managed it by improving the heating systems so the problem is absorbed. The calculations *as built* need to be done as soon as the design and services are built not nearer to the completion date' (C).
- There are also several quality insurance procedures in place to minimize problems occurring at the end of the project due to design defects or workmanship. We are aware that any risks with detailing needs to be managed at bid stage' (C).

CONCLUSIONS

Unlike many revisions to the Building Regulations, which have been incremental, the new Part L2006 is a major step change and represents a steep learning curve for all of those involved. Compliance is a complex procedure that depends on conceiving a 'Building Energy Model' for the building. This model is now a major part of bidding documents and contractors will tend to reject invitations to bid for a project if the model is not present, or fails to demonstrate compliance with Part L, as non-compliance appears on the contractor's risk matrix as a particularly unacceptable risk.

The production of the 'Building Energy Model' requires several iterations at the design stage and, more than ever before, invites close collaboration between the various professionals involved. If, in line with present procurement trends, projects are commissioned on a Design-and-Build basis, it is imperative that the contractors are fully involved at the design stage if they wish to exercise 'value engineering': the opportunity to do so after the acceptance of the bid is severely limited by the technical complexities surrounding environmental compliance. It is more likely that designs would be 'frozen' early to avoid the risk of a non-compliant of 'as built' energy model.

The common practice of 'novating' designers to Design-and-Build contractors is not only compatible with the regulatory developments, but is likely to be extended. Interviews indicated a preference for, and increased tendency to novate energy performance assessors, such as M&E consultants, to the relevant specialist

subcontractors. This is considered necessary to ensure continuity of responsibility for the 'Building Energy Model' in its as-built form for final compliance with Part L2006.

For some years the construction industry has been keen on promoting collaborative work among the design and construction team. These interviews clearly indicate that this has increased since the new Part L was introduced in April 2006. This represents an incidental, but very welcome effect of the legislation. Overall, it appears likely that the legislation is already having a profound effect on the contractual and procurement arrangements of UK construction projects.

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