

ECONOMICS

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Procurement Building services

The design and installation of building services needs careful management if a project's M&E is to be delivered successfully. **Simon Rawlinson** together with **Barry Nugent** and **Andy Dedman** of Davis Langdon Mott Green Wall look at best practice in this specialist area of procurement

01 Introduction

Building services typically account for 25-35% of the capital value of a large commercial scheme and their design and installation often sit directly on its critical path. On some specialist projects, such as collocation centres or clean rooms, the value of the services component can exceed 75% and requirements for total system reliability place huge demands

on the ability of the services team to deliver.

Irrespective of the scale and complexity of the installation, good-quality design and installation work, effective co-ordination and thorough commissioning are essential for the long-term, efficient operation of the asset.

However, most players in the construction industry will recognise that building services installations could often be designed and

constructed in a more efficient way, and that the procurement arrangements adopted could also protect the client's interests more effectively. This latest article in Davis Langdon's procurement series examines where some of these difficulties come from and outlines some of the steps that can be taken to secure cost-effective and co-ordinated design and construction.

02 The role of the client

Owing to the interrelated nature of the design and construction of building services, the decisions made by clients in determining the procurement strategy have a substantial effect on project organisation and project outcomes.

The client needs to consider a number of key issues, which include:

- Who will be responsible for design at the stages of the project: the consulting engineer, principal services contractor or the specialist contractor?
- Who will co-ordinate the design and installation of the elements of the works?

■ How will design responsibility be transferred to the supply chain?

■ How will requirements for single-point responsibility for building services be reconciled with the main contract works?

■ What degree of control over the selection of specialist contractors is required by the client? And what impact will this requirement have on programme and tendering?

■ To what extent is price competition required by the client in the appointment of the services supply chain?

Although many of these issues are common to general procurement, the extra requirement

for a substantive completion of building services design by the contractors combined with the requirement to co-ordinate the works of specialist trades is often incompatible with the objectives of conventional lump-sum contracting, which is usually based on sequential design transferred from the design team to the contractor at a single point.

Informed clients, who understand the overall contribution that services contractors are required to make, and who can create the conditions where designers and contractors can work together effectively, will get the best out of the services components of the project.

03 Why services can be difficult to procure

Building services installations present a particular challenge to the project team, in that although designers and the supply chain work together more closely than in many other elements of construction, they are often treated as if they were no different to other building works.

As already described, much of the difference

is concerned with the allocation of design work and responsibility for the design, and the way in which this is spread across a disaggregated supply chain consisting of principal contractors, subcontractors and specialists.

Furthermore, the fixed sequence of how design is developed, from the initial

calculation of loads, through the selection of equipment, the sizing and routing of ducts and cables, and the co-ordination of systems, generally requires the input of contractors, as the design cannot be completed ahead of tender. This can create problems on lump-sum, sequentially designed projects.



Cladding delays on the Willis building meant the top five plant room floors had to be temporarily wrapped in plastic to keep the job on programme

Given the supply chain's high level of design involvement, the effect of decisions by contractors on detailed design, and split responsibilities for co-ordination, there is plenty of opportunity for ambiguity, error, and confused contractual responsibilities. A managed approach to the procurement of building services should seek to address this. The principal issues that need to be resolved in dealing with these problems include:

- Achieving clarity in defining the scope of the consultant's appointment. This requirement goes beyond having a clear statement of what the consulting engineer's duties are, to also having an understanding of which parties will undertake the outstanding duties together with clarity as

to the extent of the consulting engineer's role in responding to design by others.

- Clearly communicating the extent of the design and co-ordination role within the supply chain's scope of work, together with requirements for obtaining approvals from the consulting engineer and regulatory bodies. Often these duties are inferred, which can lead to misunderstanding and poor performance by both the consultant and contractors.

The definitions of contractors' design roles should also identify constraints that might affect the completion of design work, such as pre-selected plant and equipment, spatial constraints and so on. A detailed schedule of drawings, schedules of equipment, cause-and-effect matrixes and other outputs

defining the extent of work required by the parties can be valuable in this respect, but need to be made available early to meet the demands of the design and co-ordination programme.

- Programming the design and construction sequence. The programme must make provision for design activities required after the contractor's appointment, so that there is sufficient time for the completion of detailed design, design co-ordination and testing and commissioning activities. As many of the parties responsible for providing these services will not be appointed when the initial programme is drawn up, the skill of the programmer in anticipating the sequence and duration of activities required is critical.

04 Setting the foundations: the consultant's appointment

As a result of the extended and sequential nature of building services design, much of which cannot be finalised before plant and specialist systems have been selected, the scope of services of the consulting engineers vary to take into account the extent of work that will be passed to a contractor.

These differing levels of service can introduce inconsistency into the overall development of the design, particularly when other consultants are employed to work up detailed production information. Different consultants have differing interpretations of

the work required to meet a particular set of duties, and the client often has to read between the lines to understand the exact deliverables that they will receive from the consultant team. Further ambiguity can also be associated with defining the extent of consulting engineer's role in checking and responding to design development by others.

As a result, it can at times be very difficult for clients, particularly those with limited experience, to be able to determine the scope of service they require at the outset of a project, or to understand the implications

of the terms of engagement they have signed up to. A case in point is co-ordination duties, which are not included within the engineer's normal duties under the current standard scope of services published by the Association of Consulting Engineers. If these additional services were not included in the scope, it could leave the client wholly dependent on the contractor for co-ordination input, a responsibility that may not necessarily be established in the construction contract if the implications of the appointment are not properly understood by the project team.

05 Sources of problems on a building services project

Building services subcontracts face all the challenges that one would expect on a project, and are delivered in ways that can add complexity and uncertainty. Common problems experienced on projects include:

Drawing standards

Even if the consultant's and contractor's design duties and co-ordination responsibilities are defined and agreed, there can be problems with the completion of drawings by parties to the contract, there being no fixed definition of the content of drawings required at a particular stage.

Physical constraints

As the design progresses to detailing plant rooms, duct layouts and such like, problems to do with the physical constraints of the building may come into play. Although a co-ordinated project team will generally devise a solution that provides sufficient plant space and duct allocations for likely plant combinations, constraints on space may limit the options for equipment selection. In these circumstances, if a contractor wishes to introduce alternative plant solutions, performance improvements and cost savings identified will have to offset redesign and review costs, as well as providing a cost and/or performance benefit to the client.

Impacts are greater if problems are not discovered until late in the design, fabrication and installation programme. The late discovery of sizing or co-ordination problems is more likely where there is a lack of clarity over responsibility for checking the design.

Co-ordination

Problems associated with design co-ordination include dimensional clashes, requirements for on-site rework, poorly executed system interfaces and the use of less than optimal design solutions to work around physical constraints. Innovations such as 3D modelling can go a long way to solving many of the dimensional issues.

Another area where co-ordination difficulties can arise relates to the involvement of system specialists, particularly where their design work has knock-on effects on other systems.

The co-ordination of the systems relies on the painstakingly detailed scheduling of all connections between components, M&E control systems and so on. The aim is to make sure that responsibility for co-ordination is clearly identified. The preparation of such a co-ordination matrix is not included in standard duties and the requirement has to be introduced by the client.



Arup designed the M&E services at Moor House in the City of London

Design management

Co-ordination depends on the quality of the overall design and construction programme, the contractor's own design resources and (possibly most importantly) the principal services contractor's design management skills. These are vital as the contractor must ensure that design work by equipment manufacturers and specialist subcontractors is completed and co-ordinated in accordance with the overall programme for approvals, design freeze, procurement and construction.

Management resource

A further challenge for some specialists relates to the calibre and extent of their management resource and the principal contractor's ability to manage the completion of all aspects of the subcontracted works. This can be a problem for some packages, such as building management systems, which are usually on the critical path.

Many services specialists prefer to work on package-based contracts as they give direct access to the designers and client. How the client manages these specialists depends on its procurement strategy. Typically, the choice is between a lump-sum approach, with management and commercial risk held by a principal contractor, or a package route that has greater transparency but also more risk exposure on cost, scope and performance. Where a package route is adopted, specialists are an area of particular risk in terms of performance and co-ordination. The client may need to invest effort in programming, design management and monitoring.

Effective contractor involvement

It is considered beneficial to involve contractors at the earliest opportunity, so they can contribute to buildability reviews, the selection of plant and equipment and co-ordination of the design. Unfortunately, early involvement only generates benefits if

the design work is sufficiently fixed to enable the contractor to develop the detailed design without the risk of abortive work.

Programming of works

According to BSRIA, UK building services contractors achieve comparatively low levels of efficiency once on site. Much of this is related to issues with site labour, but the way in which site works are programmed often contributes to inefficiency too.

On many projects, the contractor is motivated to commence services installations as early as possible. However, the risk is that the services contractor will not be given clear access to the workface. As a result, progress can be delayed. It can be beneficial for services contractors to start at a later date, when they can get free access to work areas.

Commissioning

Provision for commissioning must be made in system design. The witnessing of commissioning and testing by consultants, licensing authorities and so on must be properly resourced, and the programme for commissioning must be ringfenced to ensure the building is ready for this key activity.

Coming up ...

- 25 May The tracker;
Country focus: France
- 01 June Mini cost model

Data toolkit

Building's extensive database of cost data is an essential resource for anyone in the business of procuring buildings. Gain instant access to this valuable information at www.building.co.uk/datatoolkit

06 Effective building services procurement

Faced with the risk of uncontrolled change associated with the delegation of design work, and requirements for co-ordination between systems specialists, how should a client procure building services?

The procurement strategy should be determined by the client's priorities - its experience and willingness to accept risk exposure, its preferences for working with certain firms and its favoured contract forms.

Irrespective of the approach chosen, many clients want to increase their involvement in subcontractor procurement at the second stage so they have more influence over the selection of subcontractors and the basis on which they are appointed. In the current marketplace, negotiation rather than tendering is increasingly common, requiring greater post-contract discipline to ensure that the contractor cannot recover costs through claims for rework and disruption.

In finalising the strategy, the client should also consider the following broader issues:

■ Securing cost certainty

A quantified schedule of rates from all appointed M&E contractors is essential for post-contract management and must be obtained before orders are placed.

■ Documenting design responsibility

A full range of warranties that reflect the duties of each player must be obtained from all consultants, specialists and so on.

■ Packaging

In agreeing a package strategy for services,

a balance has to be struck between the size of the subcontracts. Large packages offer a diversified risk and efficient use of a contractor's resource, whereas a larger number of small ones will give the client direct access to the resources that deliver the work.

Unfortunately, use of a lot of smaller subcontracts may expose the client to a reliance on businesses with less robust management, together with costs associated with multiple layers of management and a larger number of interfaces to co-ordinate. In most cases, it is preferable to use a small number of larger subcontracts, splitting mechanical works, for example, into water-based and air-based packages. Smaller specialist contracts should only be let separately where contractor performance is judged to be critical to project completion.

■ The role of the consulting engineer

Where consulting engineers are appointed on relatively limited duties, it is good practice to appoint a lead services contractor with overall responsibility for the co-ordination of the full installation. An approach based on minimal contractual subdivision will provide the client with a degree of single-point responsibility, together with a reduced requirement for co-ordination and management input by the consultants.

Lump-sum contracts, let on the basis of a scope-and-performance specification, are a good example of this, although second-tier subcontractors may be let on a two-stage

basis, as the design work is completed by the principal services contractor.

■ Programming of the works

The programming of the completion of the design and the sequence of construction is another key factor. In lump-sum contracts, programming is the main contractor's responsibility. Its performance may represent a significant risk to project delivery.

Where the transparency of programming, sequencing of packages and the performance of trades are important to the client, and if the risks associated with taking an active role are seen as acceptable, a package-based approach may be an appropriate response.

Modern building services procurement exemplifies many of the trends associated with current thinking on project management: encouraging collaboration and the use of specialist skills. Unfortunately, procurement practice has not evolved sufficiently to avoid some of the complications that come from the sharing of design roles, the co-ordination of complex systems and the exploitation of ambiguous contract documentation.

To get the best out of designers and supply chains, clients must understand the reasons for current systems and the implications for the project if they do not address sources of weakness. Clients that proceed without this understanding risk poor-value solutions and are unlikely to get full benefit from their specialists. In the case of building services, forewarned is definitely forearmed.

a Indicative costs of building services installations

Indicative specification Indicative cost (£/m² gifa)

Commercial offices for selling on to the investment market

Building completed to shell and core with category A fit-out.	
Naturally ventilated with LTHW heating	270-285
Extra for enhancements for owner occupier or investor/developer	30
Building completed to shell and core with category A fit-out.	
Mechanically ventilated with two-pipe fan-coil and LTHW heating	455-470
Extra for enhancements for owner-occupier or investor/developer	75-85

Healthcare buildings

District general hospital, including medical gases, standby generation and nurse call systems; LTHW perimeter heating; extent of mechanical ventilation and cooling varies	450-640
Private hospital. Including medical gases, standby generation and nurse call systems; Air-conditioning	645-715

Arts buildings

Museums and galleries. Naturally ventilated with LTHW heating	330-370
Extra for air-conditioning	190-210
Performing arts buildings. Naturally ventilated with LTHW heating	580-640
Extra for air-conditioning	120-145

Retail buildings

Shopping centre; naturally ventilated open arcade, rate based on floor area of landlord's accommodation	295-325
Shopping centre; air-conditioned, enclosed mall, rate based on floor area of landlord's accommodation	515-565
Department store shell; air-conditioned	370-410

Hotels and residential

Four and five-star hotels; air-conditioned with four-pipe fan-coil units; life safety standby generation	750-840
City-centre apartments; LTHW heating	430-540
High-quality city-centre apartments; LTHW heating; localised cooling; centralised kitchen and bathroom extract	600-700

The above are costs for building services installations, suitable for estimates produced at RIBA stages A and B. Costs include services contractors' on-costs, overheads and profit and builders' work but exclude: specialist installations such as catering equipment, exhibition and show lighting; lift and conveyor installations; external services and services connections; main contractor overhead and profit, preliminaries and contingencies; professional fees; VAT; inflation beyond 2nd quarter 2007. Costs are based on an outer London location in 2nd quarter 2007, for a large-scale competitively procured project.