BSRIA

A BSRIA Guide

www.bsria.co.uk

Choosing building services

A practical guide to system selection

By John Langmaid

BG 9/2004

PREFACE

This publication and decision support tool provide information to help clients obtain an understanding of building services in order to satisfy functional needs in buildings. The guide will enable a client to specify the type of environment it wants rather than a particular building services solution. They do not provide in-depth technical information as this is readily available elsewhere and is unlikely to be needed by the client in making essential business-related decisions.

The two publications help the client and the professional design team to ask the right questions, and arrive at reasoned answers, in order to identify the most appropriate and cost-effective solutions to clients' business needs. They are therefore of greatest value to clients during the design process.

Both the decision support tool and the publication will also be of use to experienced professionals in architecture, design and construction in that they provide information on building services in straightforward, non-technical language. They will also enable an audit trail to be established which directly links the original needs of the business to the actual operation of the building services.

Of the multitude of services generically aggregated under the term building services, this publication concentrates on mechanical and electrical services.

The publication contains many questions. The most important two that the client can ask when presented with a technical proposal are why and how:

- Why that solution and not another one?
- why those functions?
- why are those functions missing?
- why does this compromise my use of the space?
- why do I need such high maintenance equipment?
- why do I need this level of complexity?
- how will this affect my business?
- how will users operate this?
- how do I maintain this?
- how can I increase the value?
- how can I achieve the same function with less complexity?

The main aim of this publication is to avoid unmanageable complexity and an excessive dependency on technology and management. It helps give control tasks to the occupants and to cut waste, especially energy.

CONTENTS

1 BACKGROUND 1

2 USING THE DOCUMENT 3

3 BEING A CLIENT 7

4 FUNCTIONAL SPACE 9

4.1 The concept 9
4.2 Descriptions 9

5 BUILDING SERVICES 11

6 PROCUREMENT, DESIGN AND HANDOVER 13

6.1 Health and safety 13
6.2 Comfortable environment 13
6.3 Power requirements 16
6.4 Domestic hot water 18
6.5 Fundamentals of energy and resource efficient design 19
6.6 Access and risers 21
6.7 Plant rooms 22
6.8 Spatial co-ordination 22
6.9 Commissioning 23
6.10 Lease agreements 24

7 OPERATING THE BUILDING 26

7.1 Environment 26
7.2 Flexibility and adaptability 28
7.3 Operation 31

8 MAINTAINING THE BUILDING 34

8.1 Equipment life 34
8.2 Maintenance 37

9 REFURBISHMENT AND DECOMMISSIONING 43

9.1 Refurbishment 43
9.2 Decommissioning 44
9.3 Legislation 44

REFERENCES 47

TABLES

Table 1: Functional spaces 10
Table 2: Office power requirements 16
Table 3: Conference room power requirements 17
Table 4: Power outlet requirements 17
Table 5: Expected economic life of various types of mechanical and electrical services 36

FIGURES

Figure 1: The introductory page of the decision tool 4
Figure 2: Example of a functional space table in the decision tool 4
Figure 3: A filled in example from part of the decision table 5
Figure 4: The professional response form 6
Figure 5: Relation to well-known process maps 8
Figure 6: Comparison of calculated internal gains to composite guidance values 20
Figure 7: Building life-cycle flow 26
Figure 8: Achievable level of operational savings 32
Figure 9: Achievable levels of carbon emissions 32
Figure 10: A maintenance logic tree 39

Building services engineers provide the internal environmental conditions that enable business processes to function at an optimum level while providing comfort conditions for occupants to achieve their maximum performance potential. [1]

This quote from a CIBSE publication contains several truths. Unfortunately, these truths tend to become forgotten in the rush for project start and completion, the smoke-screen of technology, and the unswerving aim to keep to budget. However, added value comes from increasing the functionality required by the client and not necessarily from reducing costs.[2]

Providing an internal environment which enhances the business process requires that all aspects of the system provided are linked to that process. Unless the system designer acquires an in-depth understanding of what the client needs to support and augment the business process, any proposed solution may prove to be invalid.

Providing what the client needs (and only what the client needs) is the key to providing value and satisfaction. Unfortunately, from a supplier's viewpoint, defining client value can be a stumbling block and something more often avoided rather than overcome.

From the client's viewpoint, trying to ensure that the technical proposal meets business needs can be a daunting task. Clients are forced to rely on advisors to avoid spending a great deal of time and effort in penetrating what can, at times, seem to be an arcane art. With the best will in the world, these advisors do not fully recognise that what they have successfully provided to others may not be the best answer for other clients.

Clients must also accept that, for an advisor to gain the necessary in-depth understanding of what the client's business is about and how the proposed project will enhance that business, time and money must be expended at the outset of the project. This is often time and money which the client is unwilling to commit.

The quality of the air (and other environmental factors) provided for the workforce has been shown by many researchers to be fundamental to good productivity, especially in commercial or service environments. For example, ASHRAE[3] has reported relationships between air quality and the following factors:

- Absence from work
- sick leave, accidents and injuries
- interruptions to work
- controlled independent judgements of work quality
- self assessments of productivity
- speed and accuracy of work
- output from pre-existing work groups
- cost of the product or service
- exchanging output in response to graded reward
- volunteer overtime
- cycle time from initiation to completion of process

- multiple measures at all organisational levels
- visual measures of performance, health and well-being at work
- development of measures and patterns of change over time.

The *ASHRAE Journal*[4] also quotes that operational productivity may be influenced by up to 17% by addressing factors such as noise, temperature fluctuation, lighting and glare, comfort, relocation frequency, layout and the users' perception and level of control.

A study by Dorgan and Dorgan[5] concluded that the American economy could be improved by US$55 bn per annum for a one-time investment of US$120 bn to improve poor air quality in all buildings.

This benefit is achieved because people work better (and therefore more productively) as a direct result of good air quality.

This does not mean that all buildings require full air-conditioning. They do not. What it does emphasise very strongly is that, given the 1:5:200 ratio[6] (where 1 represents the cost of construction of a facility, 5 the cost of operating and maintaining that facility, and 200 the cost of the business process being undertaken in the facility) there is a convincing argument that the money needed to fully and properly define and plan the M&E services in a facility is easily recoverable within a short period of occupation.

CRISP Report 00/04[7] states that 87% of survey responders (representing companies who commission building projects) said that they received what they expected – but this was not necessarily what they wanted. It should not be surprising, then, to find that no facilities managers were involved in the development of the client statement of requirements (often called the client brief).

In an attempt to ensure client satisfaction without understanding what that client's adjudication will be based upon, it would seem, that architects, designers, and development surveyors specify the highest level of implementation achievable within the budget that can be forced from the client, irrespective of whether the functionality thus provided is required or not. If this is the case, the level of unwanted function and therefore unnecessary cost, must be considered excessively high.

The primary objective of the rules of thumb contained in this publication is not to provide prescriptive or quantative answers. Rather, they are designed to assist the client and the clients advisors towards asking – and getting answers to – the questions that are fundamental to understanding the business needs and thus the available generic solutions.

The identification and definition of business needs, which are the drivers in most construction projects, are two important factors in achieving a high client perception of value for money.

USING THE DOCUMENT 2

The document is split into two parts.

Part 1 discusses many of the issues surrounding the whole-life of the proposed installation and guides clients towards the questions which must be addressed during the early stages of the project. Part 1 also lists further reading and useful web addresses.

Part 2 (the decision support tool) deals with the definitions of building services and functional spaces. It provides look-up tables for matching functional space (see example in Figure 2) to building services (useful for new construction) it also matches building service to functional space (useful when dealing with refurbishment and existing facilities).

The decision support tool includes a fill-in decision table primarily designed for client use. The data collected via this table (see example extract in Figure 3) is to be used by the professional team in the development of alternate options for meeting the client's business needs.

A professional response form is available for use by a professional team (see Figure 4). As a first pass, the form should be used to identify contentions within the client's functional requirements and to propose solutions to those contentions. Once the contentions have been successfully resolved, the form should be used to formalise the professional teams recommended solution for the named functional space.

The objective is to guide the client towards an understanding of the issues and topics which need to be addressed to ensure that the client's requirements are met.

The guide provides background information to enable a client and a professional team to engage in useful and value-adding dialogue.

The publication cannot provide definitive or quantative data. This would not be possible given the scope of building services and the innumerable variables within the construction and business environments.

Clients should not feel that the decision table must be completed in isolation. The reverse applies – a professional team should be consulted regarding the meaning that the client is placing on each statement of requirement and the reasons behind the client's responses.

By completing the decision table, a client can provide a professional team with a concise, non-technical statement of the functions required to be performed by the building service. This will provide the team with the scope to recommend alternative and innovative solutions while still ensuring that no functionality is lost and no unwanted functions (and thus unnecessary cost) remain.

Figure 1: The introductory page of the decision tool.

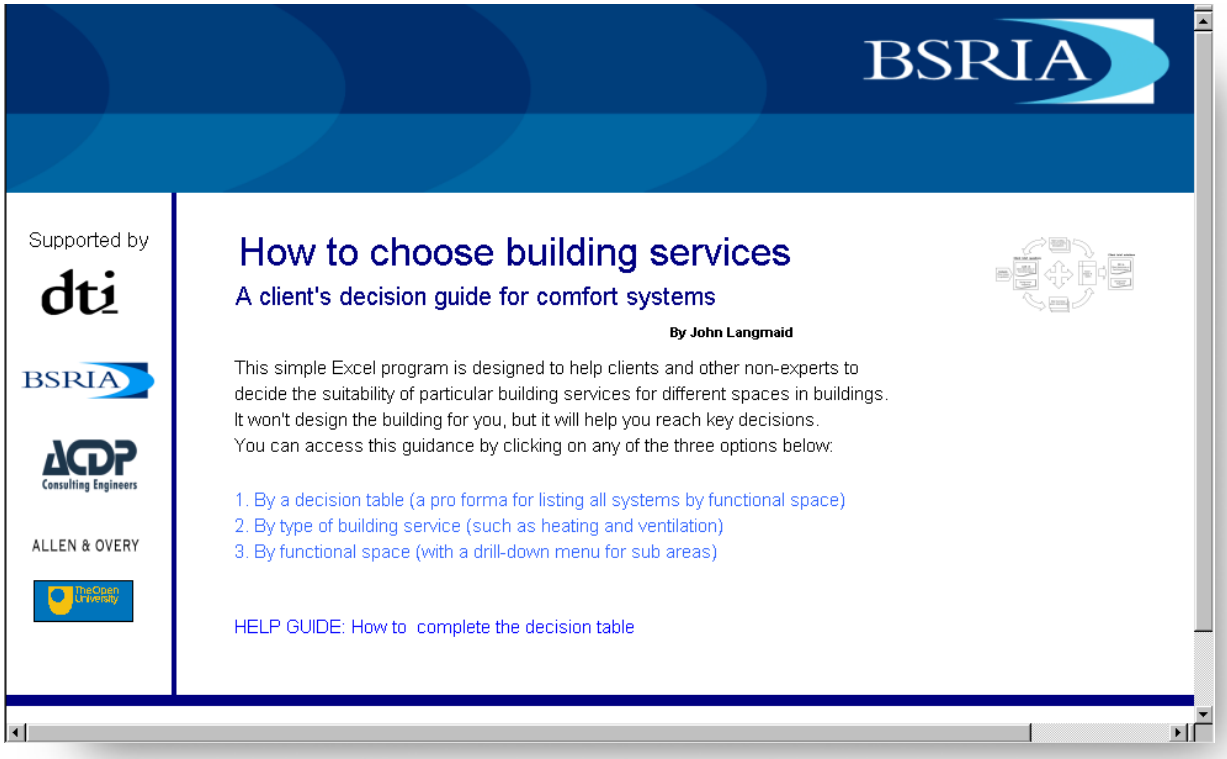
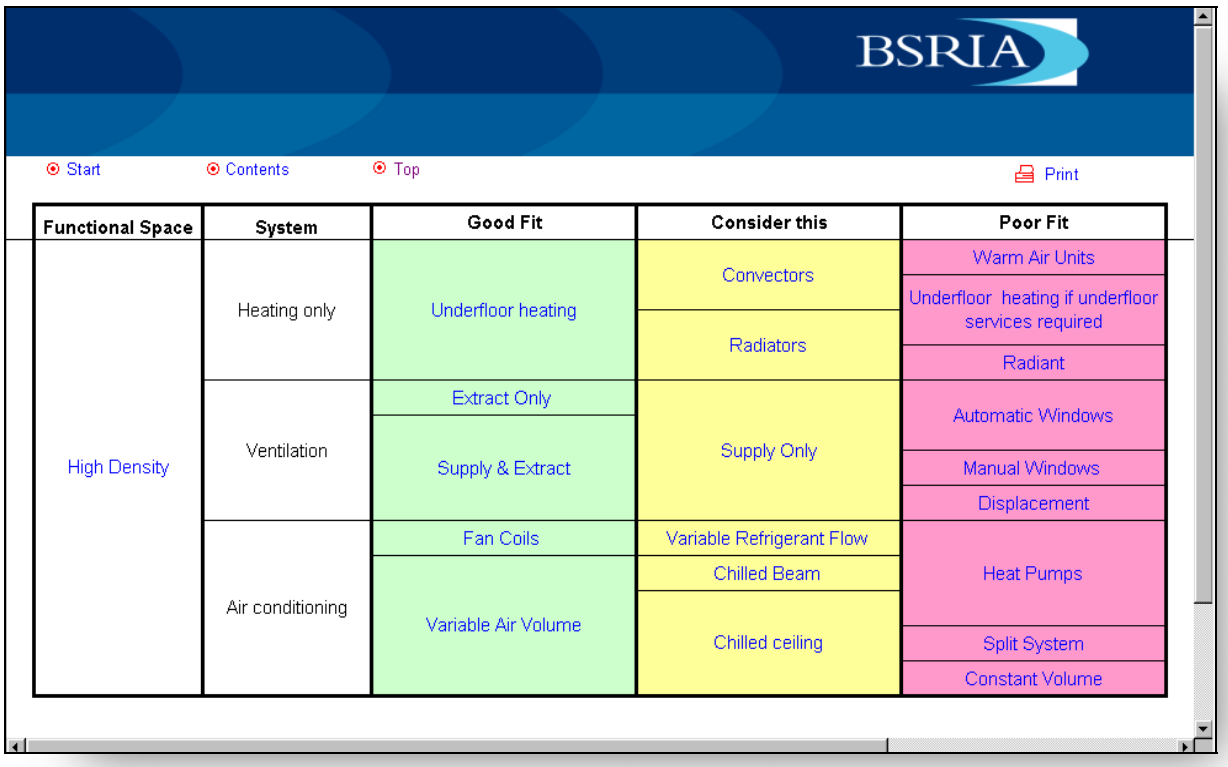


Figure 2: Example of a functional space table in the decision tool.



Functional Space	System	Good Fit	Consider this	Poor Fit
High Density	Heating only	Underfloor heating	Convectors	Warm Air Units
				Underfloor heating if underfloor services required
			Radiators	
				Radiant
	Ventilation	Extract Only	Supply Only	Automatic Windows
		Supply & Extract		Manual Windows
				Displacement
	Air conditioning	Fan Coils	Variable Refrigerant Flow	Heat Pumps
		Variable Air Volume	Chilled Beam	
			Chilled ceiling	
				Split System
				Constant Volume

Figure 3: A filled in example from part of the decision table.

Decision Table				
Project title	Headquarteres Bldg - Bracknell		Date	19/08/04
Client	BSRIA Ltd			
Project number	FN0070820			
Functional space Go to functional space	1st floor open plan office			
Size (square metres) 400 Comments on Contains some high heat output areas		Number of occupants: Initial: 50 Growth (25 in 5 years)		
Component	1	2	3	Comments
Activity level		✓		
Occupancy pattern				Normal 8h30-17h00
Space requires high protection			✓	
Environment				
High degree of remote indication			✓	
Simple control	✓			
Provide individual control of temperature, ventilation air, and lighting			✓	Perimeter lighting control separate
Provide adjustable floor diffusers with under-floor displacement air supply systems		✓		From main body
Provide maximum access to natural daylight and views to the outdoors	✓			Minimise external noise
Maximise conditioning through natural means/methods	✓			
Clean appearance/ Aesthetically neutral		✓		
Heat/cool large spaces		✓		See comments above
No false ceilings		✓		
No false floors	✓			
Clean ceiling appearance		✓		
Close temperature control (±2°C)			✓	
Good temperature control		✓		
Flexible working hours			✓	
High occupant comfort	✓			
Maximise energy efficiency				
Specify materials and furnishings that are low emitters of indoor air contaminants such as volatile organic compounds (VOC).		✓		
Minimise recirculation while assuring energy efficiency through energy recovery.	✓			
Provide recessed grates, 'walk off' mats, and other techniques to reduce the amount of dirt entering the building			✓	Read in receptions
No haze, loss of light transmission, or colour change, during entire expected service life of glazing		✓		
Space requires special solid waste disposal			✓	
Space requires special liquid waste disposal			✓	
Stated environment maintained 100% of time		✓		
Stated environment maintained less than 100% of tim	✓			
Separate ventilation from cooling and heating		✓		
Minimise water usage	✓			
Capital, operation and maintenance				
Low maintenance complexity				
Low operating complexity				
Low maintenance cost				
Low operating cost				

Figure 4: The professional response form.

Professional Team Response	
Project titles	Date
Client	
Project number	
Functional space[1]	
Size in square metres	Number of occupants
Comments on space[2]	Initial Growth (……..in…….years)
Contentions in functional requirements identified and why contention exists	
Options available to resolve contention (state business advantages and disadvantages, plus functionality provided beyond that required by client)	
Chosen solution	
State:	
[1] **Functionality provided beyond that required above and why this cannot be removed**	
[2] **Functionality required by client which cannot be provided by chosen solution and why this cannot be provided**	