Routledge
Taylor & Francis Group

Construction Management and Economics

ISSN: 0144-6193 (Print) 1466-433X (Online) Journal homepage: www.tandfonline.com/journals/rcme20

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To cite this article: Akintola Akintoye (1994) Design and build: a survey of construction contractors' views, Construction Management and Economics, 12:2, 155-163, DOI: 10.1080/01446199400000021

To link to this article: https://doi.org/10.1080/01446199400000021

Construction Management and Economics (1994) **12**, 155–163

Design and build: a survey of construction contractors' views

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Received 3 April 1993; revised 13 August 1993

Design and build (D & B) has become a popular mode of procuring construction work. A total of 52 construction firms responsible for 25% of UK construction output for 1991 were surveyed using a structured questionnaire to investigate their current views on this procurement route. The Novation D & B is widely used although not favoured by contractors. The contractors would like consultants to continue to provide them with concept design and specification and would rather support the develop and construct technique. 'Design and manage' and 'design, manage and construct' are not attractive to clients and resented by contractors. The usage of D & B on private sector projects is ~21% of work-load from this sector compared to 12% from public sector.

Keywords: Design and build, procurement, design and manage.

Introduction

'Many major private and public sector contracts are now let to Design and Build contractors. The system is working. It is gaining credibility' (Chevin, 1992). Design and build (D & B) has become a popular mode of procuring construction work. A lot of advantages have been claimed for its use even for complex construction work. Watson (1990) reported on the use of D & B on a 390 bed hospital project and described the achievement of the D & B team on this project as a 'rarity'. According to him, 'the team broke all records in preparing from blank paper to start on site within six months. Hospital lead-in time by traditional routes would have taken six years'. One of the most important advantages acclaimed to D & B is greater price certainty because of shorter lead-in and construction timetable.

Much research has been undertaken to examine D & B in terms of its development, the construction industry's perceptions of it, its organizational forms and its attributes (Pepinster, 1987; Rowlinson, 1987; Swan, 1987; Janssens, 1991; Hughes, 1992). It is not the intention of this study to review these aspects of the D & B procurement route. The essence of this study is to investigate the current views of construction contractors on this procurement route. The views of the UK contractors were sought by means of a structured questionnaire survey. It is expected that this survey will complement other studies on performance, attributes and usage of this procurement system from the contractors' point of view.

Survey methodology

A four page questionnaire (available from the author) was mailed to 100 UK construction contractors engaged in D & B. The selection of these contractors is not random, but based on a list of 100 construction contractors, published in *Contractor File 1992* (New Builder, 1992) who are engaged in D & B. The questionnaires were accompanied with a letter, indicating the objectives of the study, addressed to the managing directors of these firms.

Within 1 month of mailing, 30 completed questionnaires had been returned. A reminder letter with another copy of the questionnaire was mailed to the 70 firms who had not replied. A further 33 replies were received within 1 month of the reminder letters. Table 1 shows the number of questionnaires sent and received.

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Table 1 Statistics of the survey questionnaires

Number of questionnaires sent	100
Number of positive replies replied	52
Number of negative replies received	11
Per cent of positive replies to total sent	52
Per cent of total replies to total sent	63

The eleven negatives replies wrote letters in relation to the following

1. firm has gone into receivership;
2. firm has not yet undertaken any design and build projects;
3. firm does not have spare time to fill questionnaire;
4. firm has corporate policy not to divulge sensitive information;
5. questionnaire not substantially completed;
6. company has policy not to participate in questionnaire surveys due to many questionnaires being received from many sources.

Table 2 Official designations of the respondents

Designation	Number	Per cent
Directors	16	31
Managing director	12	23
Deputy managing director	5	9
General manager	1	2
Design and build manager	2	4
Projects coordinator	2	4
Chief planner	3	6
Marketing manager	8	15
Project manager (D & B)	1	2
Assistant to managing director	1	2
Not indicated	1	2
Total	52	100

Directors include marketing, development, commercial, engineering and business development.
Marketing manager includes marketing services manager, building enterprise manager, business development, assistant marketing manager and corporate market research manager.
Chief planners include chief planning engineer and deputy chief engineer.

Table 3 Construction work experience of respondents

Experience in years	Number	Per cent
<5	1	2
6–10	2	4
11–20	13	25
21–30	21	40
31–40	15	29
Total	52	100

Respondents' positions and working experience of the construction industry

Tables 2 and 3 indicate the position of the respondents and their working experiences in the construction industry. More than 50% of the respondents are directors. Ninety-four per cent have more than 10 years' work experience in the construction industry. Using position and work experience in the construction industry as bases it can be inferred that the respondents have adequate knowledge of the theme of this study to support confidence in the data obtained through the questionnaires.

Table 4 Years firms have been involved in construction activities

Years	Number	Per cent
<10	0	0
11–20	7	13
21–50	17	33
51–100	15	29
101–200	11	21
>200	1	2
Not indicated	1	2
Total	52	100

Table 5 Mean turnover of firms in the last 3 years

Turnover (million)	Number	Per cent
<10	1	2
11–20	1	2
21–50	18	35
51–100	10	19
101–200	11	21
200–500	7	13
>500	4	8
Total	52	100

General information on the construction firms

Table 4 shows that the majority of the firms (85%) have been involved in the activities of the construction industry for more than 20 years. Table 5 indicates that the bulk of the firms (96%) surveyed were responsible for an annual turnover of more than £20 million in the last 3 years (1989–1992). These firms can be considered as either medium or large size construction firms. The mean yearly turnover of these firms over the past 3 years was approximately £9000 million (mean = £192 million).

Design and build activities of construction firms in private and public sectors

Fifty per cent of the firms have <10% of a year's involvement in D & B contracts. This is not surprising, if one looks at the background to the development of

Table 6 Years firms have been involved in D & B

Years	Number	Per cent
<5	9	17
6–10	18	35
11–15	5	9.6
16–20	5	9.6
21–25	5	9.6
26–30	5	9.6
>30	5	9.6
Total	52	100

Table 7 Construction works procured based on D & B as percentage of all work from public and private sectors, respectively

Percentage of all work	Public sector		Private sector	
	Number	Per cent	Number	Per cent
0	10	19	3	6
1–5	11	21	7	13
6–10	10	19	10	19
11–20	10	19	14	26
21–30	6	12	6	12
31–40	3	6	4	8
41–50	1	2	5	18
>50	1	2	3	6
Total	52	100	52	100

D & B as a new contract procurement system (CIOB, 1988; Hughes, 1992).

Construction enjoyed a boom in the 1980s due to favourable economic and political conditions that produced incentive and encouragement for private sector investment in construction works. This period witnessed the urgency of clients for early procurement of their building to secure an economic windfall. Coupled with this, the clients were interested in guaranteed lower construction costs. The attributes of D & B fitted these requirements and awareness of the clients.

Table 7 shows the D & B works from the private and public sectors as a percentage of the overall work-loads of each of these sectors. Analysis of these data shows that on average, 12 and 21% of the workload of contractors from public and private sectors, respectively were procured by D & B. Approximately 20% of the responding firms have never been involved in public sector contracts using D & B, compared with 6% from the private sector. This may suggest that the principal characteristics of the D & B are better suited to the private sector. This is not surprising in the sense that the private sector is usually regarded as being price and profit conscious and has less restraint to changes compared with the public sector which is associated with bureaucracy and the need for open accountability.

Design and build techniques

D & B means that the contractor accepts the responsibility for both designs and construction of the building to meet the requirements of the client (CIOB, 1988). In recent times variants if this procurement route have become noticeable (CIOB, 1988) including the following: design development and construction, design and management and British Property Federation (BPF) system.

Six techniques (or hybrids) of D & B, from construction procurement literature and practice, were identified and defined for the respondents. These techniques are as follows.

1. Traditional design and build. The contractor accepts the total responsibility for both the design and construction to meet the requirement of the client.
2. Package deal (including turnkey contracts). The contractor provides standard buildings or system buildings that are adapted to suit clients' space and functional requirements.
3. Design and manage. The contractor gets a fee for managing all aspects of planning and design and supervising the subcontractors. The contractor has design responsibility.
4. Design, manage and construct. This is similar to 'design and manage' except that the contractor is involved in construction of some work sections in addition to coordinating the activities of the subcontractors on the site.
5. Novation D & B. The client passes his architect to the contractor to produce detailed drawings as part of the contractor's team. During the design stage through to the appointment of the D & B contractor, the architect works directly for and is paid by the client. Once a contractor had been appointed the architect's appointment is assigned to the contractor for whom the architect produces any outstanding information which is necessary to construct the work. Payment for this section of the architect's work is made by the contractor. In some cases, once practical completion of the work has been reached, the architect reverts to being employed by the client to prepare the list of defective and outstanding items, monitor the completion of the same and certify the completion of the project at the end of the defects liability period. Payment for this section of the architect's work is made by the client.
6. Develop and construct. This is a hybrid of D & B in which the contractor inherits the design that might have been produced by client's consultants up to Stage D on the RIBA Architect's Appointment Scale. This is developed further by the

Table 8 Techniques and methods of D & B

Techniques/methods	Mostly used		Favoured	
Traditional design and build	28	54%	32	62%
Package deal including turnkey	8	15%	12	33%
Design and manage	5	10%	2	4%
Design, manage and construct	5	10%	9	17%
Novation design and build	22	42%	2	4%
Develop and construct	25	48%	12	23%

contractor in terms of detailing taking into account the construction technique to be adopted for the project. This is different from Novation D & B in the sense that the architect that provides the concept design is not passed to the contractor by the client.

The respondents were asked to identify the hybrids of D & B that they had widely been involved with in the past and the ones preferred or favoured. The aim was to identify the technique(s) of D & B mostly used in practice. Some of the respondents identified more than one technique.

Table 8 shows that traditional D & B, develop and construct and Novation D & B are the D & B techniques that are widely encountered in practice. Design and manage and design, manage and construct are less popular. This is probably because these types of procurement system, which are mostly fee-based, are similar to management contracting in terms of attributes. Management contracting is generally regarded as involving little or no risk on the part of the management contractor who has no incentive to keep the construction costs down. What the client is looking for is the possibility of transferring the bulk of the risks involved in the construction work to the contractor by demanding a guaranteed sum. The table also shows that the traditional package deal (including turnkey contracts) is not widely used.

A majority of the contractors (62%) favour the procurement of construction work by the continuous use of traditional D & B contracts where the contractor has full responsibility for the design, from concept design to detailed and production drawings and construction services. This is followed by the package deal (including Turnkey contracts) (33%) – another method of construction procurement where the contractor is in total control of design and construction.

The current use of develop and construct is less favoured by contractors. Given a 48% current usage, only 23% of respondents favour its future use. Novation D & B is resented by almost all respondents; only 4% of the respondents favour its continuous use as a D & B technique.

Table 9 Projects on which respondents' firms have used D & B

Types of project	Private sector		Public sector	
	Number	Per cent	Number	Per cent
Health/hospital	16	31	17	33
Educational	12	23	15	31
Housing	23	44	16	31
Commercial				
Offices	32	63	8	15
Retail/shopping	21	40	2	4
Leisure	20	38	10	19
Industrial/defence/ distribution	38	73	10	19
Civil engineering	17	33	16	31
Refurbishment	24	46	7	13

Table 10 Project types on which respondents expect the use of D & B in future

Types of project	Private sector		Public sector	
	Number	Per cent	Number	Per cent
Health/hospital	15	29	16	31
Educational	10	19	14	27
Housing	24	46	16	31
Commercial				
Offices	33	63	12	23
Retail/shopping	17	33	1	2
Leisure	21	40	9	17
Industrial/defence/ distribution	36	69	10	19
Civil engineering	10	19	11	21
Refurbishment	7	13	6	12

Use of design and build on project type basis

Table 9 shows that D & B had been mostly used on the procurement of office and industrial buildings in the private sector, followed by refurbishment and residential projects. D & B had not been widely encountered (<35% response in all the cases) by the contractors on public sector projects.

The respondents were asked to indicate the project types in which they expect a future design and build procurement route. The essence of this question was to find out if the contractors expect the future use of D & B to depart from the past. Table 10 shows that respondents do not expect a significant change in the use of D & B on a project type basis in the future. However, the use of D & B procurement methods on public sector

Table 11 Time, cost and quality advantages derived (per cent) by using D & B compared with traditional alternatives

	Time		Cost		Quality	
Percentage	Number	Per cent	Number	Per cent	Number	Per cent
0	2	4	2	4	12	24
1–5	4	8	8	16	12	24
6–10	14	24	19	38	7	14
11–15	7	14	9	18	5	10
16–20	8	16	3	6	2	4
>20	9	18	2	4	2	4
No response	6	12	7	14	10	20
Total	50	100	52	100	52	100

office building is expected to increase while this is expected to decline in relation to private sector civil engineering (down from 33 to 19%) and refurbishment (down from 46 to 13%) works.

Some of the reasons given for future decline in the procurement of private sector civil engineering and refurbishment projects using D & B method were:

1. difficulty in defining clients' requirements;
2. difficulty in the apportionment of the risk involved;
3. clients unwillingness to appoint contractors early;
4. susceptibility of work to potential change (variations from client);
5. lack of clarity in client brief – difficulty in obtaining accurate client brief;
6. complexity of construction.

The use of design and build procurement methods for refurbishment projects is particularly not favoured by many respondents.

Time, cost and quality benefits of design and build

Table 11 shows the level of expected time, cost and quality advantages claimed by the respondents by the use of D & B procurement methods.

A majority of respondents (54%) claimed that the use of D & B for project procurement can account for up to 20% reduction in overall project time compared to the traditional JCT80 contracts. Table 12 shows a list of factors identified by the respondents as contributing to the time advantage by the use of a D & B procurement method.

In terms of cost, a majority of respondents (62%) believe that up to 20% can be saved by the use of D & B. This supports the view by Kenworthy (1992) that the cost of building can be reduced with D & B compared with JCT80 by ~15%. The cost savings can be associated with being greater in the use of materials and construction techniques.

Table 12 Factors claimed by respondents as responsible for reduction in overall project time using D & B compared to the traditional JCT80 contracts

A list of factors identified by respondents
1. Incorporation of design process into construction programme – integration of design and construction
2. Overlap of design and construction (reduced lead-in period) – 'Time from initial design to on-site can be as little as 1 month and site work can progress while design is being finalized'
3. Speed of response to alterations – design changes can often be accommodated more speedily
4. Buildability
5. Pre-contract planning is more detailed
6. Opportunity to choose construction methods with shorter lead-in site times
7. One route decisions – better coordination and easier decision making
8. Motivational benefit of the design and construction teams being on the same side
9. Fewer reasons for extension of time
10. Contractors in best position to reconcile time with materials/specification/method of construction
11. Design development and pricing run in parallel
12. Overall scheme (design and specification) agreed with client at start of contract
13. Better rationalization of design detailing
14. Better and right solution prior to activity on site minimizes abortive work
15. Short cuts available to designer/builder – less parties involved in the design

Table 13 Factors claimed by respondents as responsible for reduction in overall project cost using D & B compared to the traditional JCT80 contracts

A list of factors identified by respondents
1. Cost effective design – simplified design solutions
2. Working to an accurate fixed cost
3. Shorter period from conception to completion
4. Early ordering
5. Value engineering appraisal through:
(a) alternative solutions to engineering problems;
(b) early cost appraisal of efficiency of plan layouts;
(c) selection of alternative materials and method of construction
6. Cost benefit are discussed as part of design discussions
7. In-house ability to buy in materials of equal quality at lower prices
8. Reduced design fees
9. Reduced building cost on M & E
10. Better knowledge of construction solutions
11. Better knowledge for specification of alternative materials
12. Contractor buildability input
13. No split responsibilities between consultants/contractors and specialist subcontractors:
(a) release of designers to design exclusively with contractor adopting administration role;
(b) elimination of overlapping functions;
(c) contractor control of time scale;
(d) streamlined communications
14. Limited variation opportunity (no potential claims): fewer problems/delays during construction
15. Contractor's expertise in developing 'the solution' first time
16. Contractor has tight control on specification in relation to cost plan
17. Minimum construction and design risk to client – contractor takes on board more risk than traditional contracts
18. The team know their capability and best practice and are able to work within it
20. Competitive design fees and ability of construction teams to point out expensive options used
21. Practical solutions reflecting current market conditions: contractors' experience of construction market
22. D & B motivates contractor to perform in shortest time
23. Reduced construction time
24. Vulnerable to very competitive subcontract packages

Table 13 shows the factors identified by the respondents as being responsible for cost advantage by the use of D & B procurement method. The cost advantages are summarized by the comment of one of the respondents as follows: 'A wider and more up-to-date access to the procurement market is available via the contractor's organisation and therefore better opportunities exist to examine the cost implications of design options.'

Respondents did not expect to see significant quality advantages following the use of the D & B method. Twenty per cent of respondents did not respond to this question. This may imply one of three things: they expect a reduction in quality, they are not sure or they do not understand the question.

Professional discipline available in-house for D & B

D & B requires that the contractor is in a position to have access to architects and engineers either in-house or in-house supplemented by external consultants for complex projects. The contractors were asked to identify which of the listed professional services were available in-house to provide a design service exclusively or to be supplemented by the external consultants.

Table 14 Professional disciplines available in-house

Sources	Number of firms	Per cent
Architecture	16	31
Structures	22	42
Mechanical engineering	16	31
Electrical engineering	17	33
Process services	5	10
Construction management	47	90
None	4	8

Table 14 shows that almost all the firms (90%) have construction management services provided in-house. Professional disciplines in relation to architectural design and structures are available in $<50\%$ of the firms. This supports the high usage (42%) of Novation D & B. Alternatively, construction firms may have

Table 15 Responsibilities for client appointed architects and engineers

Frequency	Number of firms	Per cent
Design coordination	25	48
Vetting design variations	23	44
Site inspection/supervision officer	12	23
Maintenance manual preparation	15	39
Providing concept design	40	77
Providing specification	33	63
Quality control	3	6
None	2	4

Other responsibilities mentioned by some of the respondents include

1. 'Provision of concept and detailed design under our specialized project managers' direction';
2. preparation of working drawings for schemes;
3. providing alternative design to ensure client have maximum value for money;
4. envelopment with contractor in discussing proposals with client at submission stage;
5. specialized design function.

Table 16 Group responsible for introduction of D & B for most project procurement

Group	Number	Per cent
Client	28	54
Contractors	7	13
Architects	1	2
Quantity surveyors	6	12
Client/contractors dialogue	5	10
Client/contractors/QS dialogue	5	10

formed consortia with consultant architects and engineers to offer D & B services.

Responsibilities for client-appointed consulting architects and engineers

Table 15 shows the responsibilities that respondents wish client-appointed consulting architects and engineers to undertake in D & B contracts.

Contractors want client-appointed architects and engineers to provide project concept design and specification. The responses suggest that contractors want architects to be involved up to the concept design stage in the RIBA scale of appointment. This correlates with respondents favouring develop and construct contracts and a reluctance to accept from the client, architects appointed for concept design and specification.

Initiation of D & B procurement route

Table 16 shows individuals or groups that could be responsible for introducing the D & B procurement route on most construction projects. This table shows that in the majority of cases, initiative for the use of D & B came from clients.

Nonetheless, contractors and quantity surveyors have a prominent part to play in the use of the D & B procurement route. The contractors' introduction of D & B procurement could take the form of advertising, presentations and providing incentives to clients to place an order.

In view of the importance of the need for awareness of D & B by the clients, the respondents were asked about the marketing activities of their firms towards D & B. Sixty per cent of the firms have a functioning marketing unit to support their D & B activities. To be able to provide an adequate D & B service eight firms (16% of the total) have a design and build division as a subsidiary of the main construction firm. For the rest of the firms (84%), D & B is an integral part of the main construction activities.

General comments on design and build

The respondents were asked to give their opinions on some of the comments generally made by clients, architects, contractors, quantity surveyors, engineers, etc., about D & B procurement routes by indicating whether they agree or disagree with a list of statements on D & B in the questionnaire. The level of agreement is measured on a scale of 5–0 (5 denotes strongly agree and 0 denotes strongly disagree). The essence of this section of the study is to cross-examine some of the earlier responses of respondents.

Table 17 shows that respondents generally disagreed with the opinion that the consulting architects and engineers should provide leeway in terms of design and specifications (level of agreement = 1.67). The respondents, however, agreed (level of agreement = 3.63) that the clients often employ their own consultants to provide the concept design.

Contractors were divided (level of agreement = 2.92) on whether the client's brief should be limited to basic space and performance as contended by D & B purists. It is a general consensus of the respondents (level of agreement = 3.79) that the success of the D & B depends to a greater extent on the quality of the client's brief. The fact that the contractors prefer a traditional D & B is supported to a great extent by the respondents that D & B should put a contractor in charge of the whole project both the design and construction (level of agreement = 4.25).

There is general agreement that a better flow of information and communication is achieved by the use of D & B compared with a traditional contract procurement route. Hughes (1992) noted that, 'The communi-

cation patterns observed in design and build projects are amongst the most effective to be found on any form of procurement'.

Summary and conclusions

A questionnaire survey of this nature may not necessarily provide conclusive evidence of the complete views of contractors on the use of a D & B procurement route. However, the total turnover of firms surveyed (£9000 million) represents ~25% of UK contractors' output for 1991. This and the calibre of the respondents, in terms of their work experience in the construction industry and the strategic position they occupied in their respective firms, give us confidence in the opinions expressed in this study. The results of the study are summarized and commented as follows.

1. The Novation D & B (where the client passes the consultants to the contractor) is widely used in practice, but is not favoured by the contractors. This is because it does not put contractor's organization in charge of the whole project but gives them the responsibility. The contractors would like the consultants to continue to provide them with concept design and specification and would rather support the develop and construct technique.
2. 'Design and manage' and 'design, manage and construct' which are mostly fee-based are not attractive to clients because they offer no incentive for contractors to control cost. The use of these techniques is equally not favoured by the contractors either because it offers no potential support from the clients or because contractors would like to convince the client that they are capable of bearing the contract risk (a very attractive feature of D & B for clients).
3. The critics' contention that D & B cannot be used on complex projects is not supported by this survey. This survey shows that D & B has been used on private sector health/hospital, refurbishment and civil-engineering projects. However, most respondents expect a decline of D & B on refurbishment and civil engineering projects due to difficulties in defining clients' requirements, difficulties in apportioning risk, lack of clarity in clients' briefs, etc. Refurbishment and civil engineering contacts are associated with job variations, remeasurement and repricing as construction progresses, all of which are not conducive to D & B procurement. Although, the current use of D & B for refurbishment and civil engineering is high, its expected lower use due to the identified problems, shows that D & B contractors have been relatively unsuccessful in these construction submarkets. Changes in the nature and volume of work, which characterize refurbishment and civil engineering contracts, may be costly to client using D & B. This is neither in the long-run interest of client nor the D & B contractor who may lose the trust of the client.
4. The use of D & B in private sector projects is about 21% of work-load from this sector compared with 12% for the public sector. Although, the D & B is a growing market it remains necessary for contractors to improve the private and public clients' awareness of the D & B procurement route.

There is need to establish a formal relationship between contractors and consultants engaged in D & B: Novation D & B may not necessarily be the answer in view of divided loyalties to the contractor and the client that may be associated with this approach. Nonetheless, D & B contractors require the services of consultant designers as D & B's share of the construction market

Table 17 Level of agreement on general comments on D & B procurement

General comments	Level of agreement
Better flow of information and communication than traditional contracts	4.51
Put contractors in charge of the whole project	4.25
Success or not of D & B depends on the quality of client's brief	3.79
Designers' membership of construction team provides flexibility and better quality of design	3.78
Clients often appoint designers to provide concept design	3.63
Contractor can relate better to specialized needs on a project than the consultants	3.39
Provides competitive prices for each section of work comprising a project	3.10
D & B restricts clients from making changes to project requirement once tender is accepted	2.96
D & B works better where client's brief is limited to basic space and performance requirements	2.92
D & B provides for design to be done at a staggering speed into the construction stage	2.78
Clients hardly give contractors free hands in terms of design ideas and materials specifications	2.51
Consultants should provide leeway in terms of design and specification such that contractors cannot compromise on quality	1.67

continues to grow. The survey supports the notion that D & B firms are looking to consultant designers (architects, structural engineers, etc.) rather than employing in-house designers.

The overriding success of D & B demands clear understanding of obligations and performance standards contained in the D & B contract on the part of parties to the contract and the clarity of construction clients' briefs. D & B contractors need to be innovative as much as possible in their approach to D & B and ensure that construction clients are in a position to derive the benefits of this procurement method without sacrificing quality, if the confidence of clients is to continue. Although, respondents claimed that a D & B procurement route is time and cost saving, it should not be seen merely as a means to achieve cheaper construction, but also as a means to achieve better construction, if is to continue to find favour with construction clients.

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