

# An evaluation of design-build as procurement method for building and civil engineering projects in South Africa

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*Recent studies in developed countries such as the United States of America and United Kingdom have proved that the design-build procurement method experiences extraordinary growth. In the Far East this approach is also gaining in popularity.*

*The main objective of this research study, which was conducted in the first half of 1999, was to determine the market share of design-build in building and civil engineering in South Africa. Amongst the other goals were to compare design-build with other project delivery approaches and to determine possible concerns and the future of this concept. Questionnaires and personal interviewing were used to collect the primary data. The response rate was 35.6% – 24 of the 32 respondents had experience of design-build (average ± 21 projects per respondent).*

*The results indicate the following:*

- *Approximately 29% of building and civil engineering projects in South Africa are delivered by the design-build approach.*
- *Design-build can lead, amongst others, to shorter project duration, reduction in cost, enhanced constructability of the design, better relations and fewer disputes and claims.*
- *This concept has the advantage of single-point responsibility.*
- *The main concern is the high cost for bidding, especially of the design function.*
- *A well-defined scope of the work is essential.*
- *Respondents perceived a bright future for design-build in South Africa.*

## INTRODUCTION

Design-build is a procurement approach where the owner of the project is in contract with one entity only that is responsible for both the design and construction.

Design-build is not a new concept. In fact, according to Songer and Molenaar (1996) design-build is the oldest known procurement concept known to mankind. Thousands of years ago, the 'master builder' was responsible for both design and construction. The world's oldest building code (the code of Hammurabi, the King of Babylonia) was written approximately 2200 BC, and literally promulgated an eye for an eye (Kaminetzky 1991). The master builder just could not afford to make a mistake in either design or construction. The evidence of endurance and reliability is the fact that some of those ancient buildings are still standing today and admired by mankind.

During the Renaissance – broadly considered the period between 1400 and 1600 AC – the functions were separated (Songer & Molenaar 1996). The design function became a professional occupation (architects and engineers), while the actual construction was the domain of craftsmen and businessmen. This project procurement method, which is characterised by the separation of the functions, is today known as the traditional method, where the process is usually in series – construction follows design and bidding. It is also known as design-bid-build.

Studies (Naoum & Langford 1987; Songer & Molenaar 1996) confirm that the inflationary 1970s with subsequent rising construction costs and delays in projects procured by the traditional method lead to the formal introduction of the management approaches (construction management and management contracting) and the re-appearance of design-build.

It appears as if the contractor is usually the principal agent in design-build projects. However, in this research study three variations of design-build were investigated:

- The contractor is the principal agent with the designer as a 'subcontractor' to the contractor.
- The designer is the principal agent with the contractor as a 'subcontractor' to the designer.
- Design and construction by one company specialising in both design and construction. This can be described as 'super design-build'.

In normal design-build contracts the owner finances the project. In design-build-finance contracts, also called turnkey contracts, the design-build entity also finances the project and payment is made at the completion when the 'key' is turned over (Gordon 1994). In the other hybrid form, build-operate-transfer (BOT), the design-build entity not only finances the project, but also operates and maintains it for a pre-agreed period. At

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the end of this period all assets are transferred to the owner. This research study, however, concentrated on the normal design-build procurement approach.

## RESEARCH OBJECTIVES

The objectives of the research can be summarised as follows:

- to determine what percentage of projects is delivered by the design-build concept (the main objective)
- to assess which of the three design-build alternatives is most often used
- to compare design-build with other procurement methods on important project selection criteria and to determine which procurement method is preferred by the role players
- to determine the attitudes of local role players on certain issues related specifically to design-build
- to assess which of the three design-build alternatives is preferred by the industry
- to evaluate the award and compensation methods on the design-build concept
- to assess the future of design-build in South Africa

## RESEARCH METHODOLOGY

Owing to time and money constraints, case studies were not considered. The following methodology was used to research the objectives:

- A comprehensive literature review was done to gather more information on the design-build procurement concept and to identify appropriate selection factors against which the attitudes of role players in South Africa can be determined.
- A self-administered questionnaire formed the basis to collect the primary data. It is an efficient approach to collect data and to quantify perceptions of role players in the industry. Telephonic follow-up calls and personal interviews were used to provide validation and clarity to the survey results and to probe deeper into important issues.

## LITERATURE REVIEW

### Reasons why owners select the design-build method

Two independent studies (Ndekugri & Turner 1994; Songer & Molenaar 1996) conclude that the main reason why owners select design-build is the possibility of time saving. The survey of Ndekugri and Turner (1994) concludes that 'clients perceive it as providing better value for money, particularly where time for completion is of essence', while Songer and

Molenaar (1996) state that 'the primary reason why owners select design-build is to take advantage of the time saving inherent in the process'.

Other reasons given for the fast growth of this procurement concept are the following:

- To secure a fixed project cost and fixed time schedule before the start of detailed design.
- This method can reduce costs.
- Single-point responsibility seems to be an advantage.
- A reduction in disputes and claims is possible.
- This procurement concept can improve constructability of the design.
- This approach has been used successfully on any size project, from very small and simple to large and complex.

Other studies (Gordon 1994; Dozzi *et al* 1996) confirm the advantage of the input of the contractor in the early stages of design. The inherent flexibility of the design-build approach makes it possible to take full advantage of the contractor's knowledge and preferred methods of construction right from the planning stages of design. This is of course more often than not impossible with the traditional method, as the design is normally complete by the time the contractor is appointed and hence too late to exert any significant influence.

Some of the major projects recently completed outside South Africa and which have benefited from the flexibility and improved constructability offered by the design-build approach are the following:

- the 414 million pound Pergau Hydroelectric Project constructed in Malaysia (McEwan *et al* 1997)
- the 370 million pound underground cooling water system for the new 1 000 MW Barking Reach Power Station in London (Evans & Hodgkins 1997)
- upgrading and expansions to the Ambassador Bridge, the busiest international crossing between the United States and Canada (Shah 1996)

### Factors influencing the success of design-build projects

In 1997 Songer and Molenaar produced a follow-up research on design-build in the United States of America. The results of this survey demonstrate that there are many primary project characteristics that affect the success of public sector design-build projects. The following five in ranking order are critical on all projects:

- well-defined scope
- shared understanding of scope
- owner's construction sophistication
- adequate owner staffing
- established budget

## Type of project and owner for whom design-build is most suitable

For a long time there has been a school of thought that considered design-build suitable only for small and simple structures (Ndekugri & Turner 1994). However, most respondents in the UK survey of the above authors disagreed completely with this perception, as they have constructed large and complex projects with the design-build procurement approach. The above survey confirms that size and complexity of projects present problems only when there are inadequacies in the owner's brief. A well-defined scope of the work is however important – a fact confirmed in the 1997 survey of Songer and Molenaar.

A survey by Gordon (1994) stresses the importance of owner's interaction on projects where the design needs to be highly creative or where functional fitness for purpose is essential. He recommends the traditional method, or management contracting method, that has an independent designer, in these situations. He argues that the owner has more control over the design in these procurement methods than with design-build.

## Areas of concern about the design-build method

The UK survey of Ndekugri and Turner (1994) highlights two concerns. The first is that contractors still experience considerable resistance from the professions (architects and quantity surveyors). But a more serious concern lies in design liability and related insurance matters. It appears that many design-build contractors fail to insure against design liability. The above authors stress that 'the implied duty applicable to a contractor working under a design and build contract is not just one of exercising reasonable skill and care, however, but one of strict obligation in respect of fitness for purpose'.

Tietz (1999) highlights another two concerns. The first is that, being the principal agent, and because the construction value overshadows design costs, the contractor's opinion tends to prevail when quality of design and construction savings come into conflict. A second, more serious, concern is when the supervisory part of the design team wishes to reject work which the contractor regards as adequate.

## The future of design-build

The UK survey of Ndekugri and Turner (1994) indicates that there is a noticeable trend towards design-build, 'with the majority of client and contractor respondents welcoming this development'. According to Songer and Molenaar (1996) design-build 'has experienced extraordinary growth in recent years'. Songer and

**Table 1 Response and experience of design-build**

	Public sector owners	Private sector owners	Designers	Contractors
Number of questionnaires delivered (Total = 90)	15	15	30	30
Number of valid responses received (Total = 32 = 35,6% response rate) (% of delivered )	4	4	13	11
	26,7%	26,7%	43,3%	36,7%
Number of respondents with experience of design-build (Total = 24) (% of received)	2	4	9	9
	50,0%	100%	69,2%	81,8%
Cumulative number of design-build projects completed (Total = 502) (% of cumulative number)	25	17	163	297
	5%	3,4%	32,5%	59,1%
Average number of design-build projects per respondent	12,5	4,3	18,1	33,0

**Table 2 Involvement in building and the different civil engineering sectors**

Description	Public sector owners	Private sector owners	Designers	Contractors	Mean (by weight)
Number of valid responses received (Total = 32)	4	4	13	11	
<b>Building</b>	2%	92,5%	35%	66%	48,7%
<b>Civil engineering</b>					
Township roads and internal services	12%	2,5%	17%	9%	11,8%
Water and sewerage schemes	61%	2,5%	9%	19%	18,1%
Roads, bridges and stormwater	0%	2,5%	18%	2%	8,3%
Railways, harbours and airports	0%	0%	3%	0%	1,2%
Dams and tunnels	0%	0%	5%	1%	2,4%
Power stations and mining	25%	0%	13%	3%	9,5%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

**Table 3 Involvement of designers and contractors in public and private sector projects**

Description	Designers	Contractors
<b>Traditional method</b>	46%	37%
Public sector projects	54%	63%
Private sector projects		
<b>Design-build method</b>	14%	86%
Public sector projects	25%	75%
Private sector projects		
<b>Other procurement methods</b>		
Public sector projects	0%	0%
Private sector projects	100%	100%

**Table 4 Involvement in the different procurement methods**

Procurement method	Public sector owners	Private sector owners	Designers	Contractors	Mean (by weight)
Number of valid responses received (Total = 32)	4	4	13	11	
<b>Traditional method</b>	54%	30%	77%	59%	62,0%
<b>Design-build</b>					
Design company is principal agent	0%	3%	8%	1%	26%
Contractor is principal agent	3%	26%	8%	16%	12,4%
Design and construction by one company ('super design-build')	8%	15%	3%	12%	8,2%
<b>Other procurement methods</b>					
Owner's in-house design using an outside contractor	35%	23%	1%	1%	8,0%
Construction management / management contracting	0%	5%	1%	1%	1,4%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Molenaar confirm that the US Department of Commerce predicted at the time that 50% of all non-residential construction will be constructed by the design-build method by the year 2001.

Miller (1997) confirms that the Hong Kong government is effectively mixing design-bid build (traditional method) and design-build in the construction of major infrastructure facilities. The traditional concept is continuously being used where design alone is critical. They prefer design-build where the innovative integration of design and construction is thought to be critical.

## PRIMARY DATA RESULTS

### Response and analysis of the sample

#### Response

A self-administered questionnaire was the main collection source of the primary data (Grobler 1999). Non-probability selecting was deemed appropriate, as the study generally concentrated on better-known companies and organisations in the building and civil engineering fields in South Africa. A total of 90 questionnaires were distributed to selected parties: 30 to owners of projects (15 to public sector owners and 15 to private sector owners), 30 to designers and 30 to contractors. To improve the response rate, reminders were faxed after a period of approximately two weeks.

Table 1 indicates the response received and experience of the respondents of design-build. Seven of the 32 respondents were personally interviewed – two while completing the questionnaires and the balance after receipt of questionnaires. Telephonic follow-up calls were used extensively to sort out and clarify uncertainties in the completed questionnaires and to probe deeper into important issues, especially with those respondents who were not personally interviewed.

#### Analysis of the size of the sample

All 32 respondents answered the general questions such as involvement in building and the different civil engineering sectors (table 2), involvement of designers and contractors in public and private sector projects (table 3) and involvement in the different procurement methods (table 4). Table 4 supplies results of the main objective of this research survey, namely to determine the market share of design-build in South Africa.

The sample of all four sectors combined is in excess of the recommended theoretical minimum of thirty as per requirements of the 'central limit theorem' (Cooper & Emory 1995). The figures produced in the above tables should therefore be of statistical value. Having said this, however, it is recommended that conclusions that the reader might make from the results of the sectors on a separate basis should perhaps only be of descriptive nature, as the separate samples are too small – especially of public and private sector owners.

The mean value (by weight) is the accumulate total of the product of involvement (in percentage) and the number of responses from each sector, divided by the total number of responses received from all four sectors combined.

The results of this survey (1999) therefore indicate that approximately 29% of building and civil engineering projects in South Africa are delivered by design-build, 62% by the traditional method and 9% by other procurement methods. These figures correspond rather closely with figures for the UK (Cooke & Williams 1998): 28% design-build, 56% traditional method and 16% for other methods.

The second objective of this survey was to determine which design-build alternative is most often used. The results indicate that the alternative where the contractor is the principal agent is used much more than the other two alternatives. Approximately 12% of all building and civil engineering projects in South Africa are procured by this alternative, 8% by the alternative where the designer is the principal agent, and approximately the same percentage by the alternative where design and construction are both in-house ('super design-build').

Listed below are a few examples of local projects procured by design-build in recent times:

• Saldanha Steel Plant	R800 million
• Techno Centre for Vodacom (Bellville)	R116 million
• New offices and warehouse for Siltek (Midrand)	R65 million
• Offices, courtyards and parking facilities for Sanlam Properties (Sandton)	R40 million
• Prison at Louis Trichard (to be completed early 2002)	R300 million
• Nelson Mandela Bridge (Johannesburg) (expected completion April 2003)	R81 million

### *Comparing design-build with other procurement methods and question related specifically to design-build*

Only respondents with experience of design-build (24 off) participated in this

part of the questionnaire: comparing design-build with other procurement approaches (table 5) and questions related specifically to the design-build concept (table 6, resistance from professionals towards the principal party in the design-build entity, and table 7, preference of respondents regarding compensation methods).

In these cases the sample of all four sectors combined is less than the recommended theoretical minimum of thirty and it could be argued that the sample is too small. However, the authors argue that in the South African context, the results (of all four sectors combined) on the questions in the above three tables could be of value.

First, there is a perception that not many building and civil engineering organisations in South Africa have experience of design-build. Against this background it can be argued that a sample of 24 may be quite representative to quantify perceptions of role players.

Second, it is to be remembered that the 24 respondents are in senior positions of well-known organisations in the industry with considerable experience of design-build (which re-appeared in recent time) and it is fair to assume also of the traditional method. The comparisons they have made between the procurement approaches (table 5) and judgements in the other questions should therefore be of high quality and provide credibility to the survey.

Furthermore, the results in table 5 confirm (in many instances with quite large majority) some of the important findings of the United Kingdom survey of Ndekugri and Turner (1994) and the United States survey of Songer and Molenaar (1996). The results confirm for example the main reason for the increase in popularity of design-build as outlined by abovementioned surveys, namely that it can lead to time saving.

The third objective of this survey was to compare procurement methods on different project success criteria and to determine the preferred procurement approach. Respondents were asked to select a procurement method for each of the following fourteen criteria in table 5 and to choose their preferred method in the last question.

### *Analysis of results*

There were a couple of cases where respondents selected two procurement methods. For example, for criterion 1, one of the public sector owners selected both the traditional method and other methods. In such cases the respondent's vote was split 50/50, explaining why with only two public sector owners the distribution on criterion 1 is 25% for the traditional method and 75% for other methods.

While comparisons between the sectors could be misleading, as the individual samples are very small, it is nevertheless interesting to compare specifically the results of designers and contractors

(nine respondents each) on some of the more contentious criteria. Both samples agree that design-build leads to shorter project duration. The majority of designers perceive the traditional method to be more cost effective and better suited to large and complex projects, whilst the majority of contractors voted for design-build. The majority of both sectors argue (designers with smaller majority) that design-build is more flexible regarding changes to the scope of the work. The majority of designers and contractors also felt that design-build leads to better communication and relations between the role players and that this concept has less disputes and claims.

Having read the resistance from the professionals towards the contractor in design-build in the UK survey of Ndekugri and Turner (1994), the general positive attitude of the designers (eight from civil/structural consulting engineering organisations and one from an architect firm) towards design-build in this survey came as a surprise. Six of the nine design respondents selected design-build as their preferred project procurement approach; the other three preferred the traditional method.

With reference to question 12 (which procurement method has less responsibility grey areas), a respondent of a large public sector owner made the comment that on a risky project they prefer design-build which offers single-point responsibility.

## **Results of questions related specifically to design-build**

### *Resistance from professionals*

The reader will recall that contractors in the UK survey (Ndekugri & Turner 1994) experienced considerable resistance from the professions (architects and quantity surveyors). Professions in the above survey were mostly employed by the contractor. It will therefore be interesting to compare results and also to determine resistance experienced for the other alternative where the professionals (designers) are the principal agent in the design-build entity (refer table 6).

It is interesting to note that the results for all four sectors combined for the two alternatives are very much alike. While conclusions from the results of the sectors on a separate basis could be misleading because of the small samples, it remains useful to note that designers in the South African survey actually experience more resistance from contractors' professional staff than the other way around. Unfortunately no real explanation for the higher resistance experienced from contractors' professional staff surfaced in the interviews. What came out clearly, however, is that this phenomenon is very much dependent on the personalities involved on a project.

**Table 5 Comparing procurement methods on different project selection criteria**

Description	Method*	Public sector owners	Private sector owners	Designers	Contractors	Mean (by weight)
Respondents with experience of design-build (24 off)		2	4	9	9	
(1) Can best establish project cost before start of the detailed design	T	25%	13%	33%	11%	20,8%
	D	0%	62%	67%	83%	66,6%
	O	75%	25%	0%	6%	12,6%
(2) Can best establish schedule	T	25%	0%	39%	11%	20,8%
	D	0%	75%	61%	83%	66,5%
	O	75%	25%	0%	6%	12,7%
(3) Leads to shorter project duration	T	0%	0%	17%	6%	8,6%
	D	50%	50%	83%	89%	77,0%
	O	50%	50%	0%	5%	14,4%
(4) Is more cost effective / better value for money	T	0%	0%	61%	6%	25,1%
	D	50%	50%	39%	89%	60,5%
	O	50%	50%	0%	5%	14,4%
(5) Is suited best for large and complex projects	T	0%	50%	67%	33%	45,8%
	D	50%	0%	33%	67%	41,7%
	O	50%	50%	0%	0%	12,5%
(6) Is suited best to small or simple projects	T	0%	0%	11%	33%	16,5%
	D	0%	75%	89%	56%	66,9%
	O	100%	25%	0%	11%	16,6%
(7) Can best accommodate contractors' preferred method of construction	T	0%	0%	11%	0%	4,1%
	D	100%	88%	89%	94%	91,6%
	O	0%	12%	0%	6%	4,3%
(8) Is more flexible regarding changes to the scope of the work	T	0%	12%	44%	22%	26,7%
	D	50%	50%	56%	72%	60,5%
	O	50%	38%	0%	6%	12,8%
(9) Leads to better constructability of the design	T	0%	0%	0%	0%	0%
	D	100%	75%	89%	100%	91,7%
	O	0%	25%	11%	0%	8,3%
(10) Leads to better communication between the role players	T	0%	0%	39%	0%	14,6%
	D	50%	63%	61%	89%	70,9%
	O	50%	37%	0%	11%	14,5%
(11) Leads to better relations between the role players	T	0%	0%	39%	11%	18,8%
	D	50%	75%	61%	78%	68,8%
	O	50%	25%	0%	11%	12,4%
(12) Has less responsibility grey areas	T	0%	0%	33%	11%	16,5%
	D	50%	100%	67%	78%	75,2%
	O	50%	0%	0%	11%	8,3%
(13) Has less liability and insurance related problems	T	0%	0%	44%	33%	28,9%
	D	50%	75%	56%	56%	58,7%
	O	50%	25%	0%	11%	12,4%
(14) Has fewer disputes and claims	T	0%	0%	22%	0%	8,3%
	D	50%	75%	78%	89%	79,3%
	O	50%	25%	0%	11%	12,4%
(15) Which method do you prefer?	T	0%	0%	33%	0%	12,4%
	D	50%	75%	67%	83%	72,9%
	O	50%	25%	0%	17%	14,7%

\* T = traditional method, D = design-build and O = other procurement methods.

**Table 6 Resistance from professionals towards the principal party in the design-build entity**

Description	Public sector owners	Private sector owners	Designers	Contractors	Mean (by weight)	
Respondents with experience of design-build (24 off)	2	4	9	9		
Resistance from designer's professional staff – contractor is principal agent:						
	Very strong	0%	0%	22%	11%	12,4%
	Strong	0%	75%	11%	11%	20,7%
None	100%	25%	67%	78%	66,9%	
Resistance from contractor's professional staff – designer is principal agent:						
	Very strong	50%	0%	22%	0%	12,4%
	Strong	0%	25%	33%	22%	24,8%
None	50%	75%	45%	78%	62,8%	

## The preferred design-build alternative

The results indicate that the alternative, design and construction by one company housing both functions in-house ('super design-build') is ranked highest by the industry. However, there is no skewness in the rankings, as the scores are very close, indicating that no one alternative is preferred out of hand.

One recalls that the results (table 4) indicate that the design-build alternative where the contractor is the principal agent is used more than the other two design-build alternatives. One can rightfully ask why the preferred alternative ('super design-build') is not the one mostly used. One possible explanation for this is that there are many more contracting companies also doing design-build than there are 'super design-build' companies. This means that the chance of using the alternative where the contractor is the principal agent on projects is simply greater than that of the 'super design-build' alternative.

## Evaluation of award methods on the design-build concept

The results indicate the following practices and preferences:

- Private owners are more inclined to negotiate a project, as they normally prefer to work with specific designers and contractors, while the public sector usually calls for competitive tenders, available to all interested parties.
- Most designers and contractors prefer negotiating a price. During the interviews the following reasons surfaced: first, that they are normally in a better position to secure the work through negotiations, and second, that a higher price could be negotiated than achieved through competitive bidding against stiff competition in the open market.

Obviously price should not be the only award criterion – previous records of quality of work, management ability and other important project success criteria should be included in an award system. This was not investigated in this study, however.

## Evaluation of compensation methods on the design-build concept

Three methods were investigated, namely fixed-price (unit rates and lump sum), guaranteed maximum price and cost-plus. The results of all sectors combined on involvement are as follows: 75,2% of design-build projects are compensated through fixed-price, 17,9% guaranteed maximum price and only 6,9% through cost-plus.

Preference of the respondents regarding compensation methods is listed in table 7.

**Table 7 Preference of respondents regarding compensation methods on design-build procurement**

Description	Public sector owners	Private sector	Designers	Contractors	Mean (by weight) owners
Respondents with experience of design-build (24 off)	2	4	9	9	
Fixed price	100%	0%	0%	75%	25%
Guaranteed maximum price	0%	33%	56%	11%	33%
Cost-plus	44%	23%	45,5%	41,7%	12,8%

It came out clear during the interviews that owners avoid cost-plus wherever possible. Uncertainty in total cost prior to start of construction appears to be one of the main reasons. What came as a real surprise is the relatively low support contractors have towards cost-plus. However, contractors agreed in general that on complex projects, or where the risks are high, cost plus is a more fair method.

## Popularity of the different forms of contract on design-build projects

The results (weight basis) of all four sectors combined are as follows:

- new engineering contract (NEC) –24,8%
- owner's in-house standard form of contract –24,9%
- principal agent's in-house standard form of contract –33,4%
- other –16,9%

Other forms of contract (as qualified by respondents) include FIDIC and JBCC.

## Areas of concern

The main concerns of the different sectors are summarised as follows:

### Owners

- Project scope and design criteria need to be well defined and understood to ensure success on projects procured by the design-build method.

### Designers

- The majority of respondents are concerned about the high cost for the bidding party. Some argued that the integrity and independence of the design function is under threat of cost considerations.
- Some owners request prices before they are serious.
- One respondent argued that design-build bids are difficult to compare, as all designs are different.
- This particular respondent also noted that some contractors tend to cut corners when they are the principal agent.

### Contractors

- Some respondents agreed with designers that the bidding process is too costly.

- It was also argued that some owners use design-build entities to do informal feasibility studies under the guise of tenders, confirming the argument of designers that some owners request prices before they are serious. A respondent from a very large building organisation confirmed that they favour the idea where the client appoints an architect for the feasibility study; during the design-construct phase the architect and other consultants are employed by the principal contractor.
- One respondent felt that owners go for the cheapest bid, but not necessarily the best, and see it as savings.
- Another respondent argued that the resistance experienced from some designers towards the concept where the contractor is the principal agent is a real disadvantage. It came out clearly during the interview that their company only works with specific design consultancies.

## The future of design-build in South Africa

The results for all sectors combined (on a weight basis) are as follows:

- very good future – 54,2%
- good future – 41,6%
- not a good future – 4,2%

Gauging from the results a bright future is perceived for design-build.

## CONCLUSIONS

The following can be concluded from the results of this South African survey:

- Approximately 29% of building and civil engineering projects are procured by the design-build concept.
- The majority of respondents prefer the design-build procurement concept (72,9% by weight).
- During the comparisons with other project procurement approaches, respondents perceived among others, the following:
  - Design-build can lead to shorter project duration and cost savings when compared to other procurement methods. This can be attributed to the fact that some activities can be done in parallel, leading to a shorter overall project completion

## The preferred design-build alternative

The results indicate that the alternative, design and construction by one company housing both functions in-house ('super design-build') is ranked highest by the industry. However, there is no skewness in the rankings, as the scores are very close, indicating that no one alternative is preferred out of hand.

One recalls that the results (table 4) indicate that the design-build alternative where the contractor is the principal agent is used more than the other two design-build alternatives. One can rightfully ask why the preferred alternative ('super design-build') is not the one mostly used. One possible explanation for this is that there are many more contracting companies also doing design-build than there are 'super design-build' companies. This means that the chance of using the alternative where the contractor is the principal agent on projects is simply greater than that of the 'super design-build' alternative.

## Evaluation of award methods on the design-build concept

The results indicate the following practices and preferences:

- Private owners are more inclined to negotiate a project, as they normally prefer to work with specific designers and contractors, while the public sector usually calls for competitive tenders, available to all interested parties.
- Most designers and contractors prefer negotiating a price. During the interviews the following reasons surfaced: first, that they are normally in a better position to secure the work through negotiations, and second, that a higher price could be negotiated than achieved through competitive bidding against stiff competition in the open market.

Obviously price should not be the only award criterion – previous records of quality of work, management ability and other important project success criteria should be included in an award system. This was not investigated in this study, however.

## Evaluation of compensation methods on the design-build concept

Three methods were investigated, namely fixed-price (unit rates and lump sum), guaranteed maximum price and cost-plus. The results of all sectors combined on involvement are as follows: 75,2% of design-build projects are compensated through fixed-price, 17,9% guaranteed maximum price and only 6,9% through cost-plus.

Preference of the respondents regarding compensation methods is listed in table 7.

**Table 7 Preference of respondents regarding compensation methods on design-build procurement**

Description	Public sector owners	Private sector	Designers	Contractors	Mean (by weight) owners
Respondents with experience of design-build (24 off)	2	4	9	9	
Fixed price	100%	0%	0%	75%	25%
Guaranteed maximum price	0%	33%	56%	11%	33%
Cost-plus	44%	23%	45,5%	41,7%	12,8%

It came out clear during the interviews that owners avoid cost-plus wherever possible. Uncertainty in total cost prior to start of construction appears to be one of the main reasons. What came as a real surprise is the relatively low support contractors have towards cost-plus. However, contractors agreed in general that on complex projects, or where the risks are high, cost plus is a more fair method.

## Popularity of the different forms of contract on design-build projects

The results (weight basis) of all four sectors combined are as follows:

- new engineering contract (NEC) –24,8%
- owner's in-house standard form of contract –24,9%
- principal agent's in-house standard form of contract –33,4%
- other –16,9%

Other forms of contract (as qualified by respondents) include FIDIC and JBCC.

## Areas of concern

The main concerns of the different sectors are summarised as follows:

### Owners

- Project scope and design criteria need to be well defined and understood to ensure success on projects procured by the design-build method.

### Designers

- The majority of respondents are concerned about the high cost for the bidding party. Some argued that the integrity and independence of the design function is under threat of cost considerations.
- Some owners request prices before they are serious.
- One respondent argued that design-build bids are difficult to compare, as all designs are different.
- This particular respondent also noted that some contractors tend to cut corners when they are the principal agent.

### Contractors

- Some respondents agreed with designers that the bidding process is too costly.

- It was also argued that some owners use design-build entities to do informal feasibility studies under the guise of tenders, confirming the argument of designers that some owners request prices before they are serious. A respondent from a very large building organisation confirmed that they favour the idea where the client appoints an architect for the feasibility study; during the design-construct phase the architect and other consultants are employed by the principal contractor.
- One respondent felt that owners go for the cheapest bid, but not necessarily the best, and see it as savings.
- Another respondent argued that the resistance experienced from some designers towards the concept where the contractor is the principal agent is a real disadvantage. It came out clearly during the interview that their company only works with specific design consultancies.

## The future of design-build in South Africa

The results for all sectors combined (on a weight basis) are as follows:

- very good future – 54,2%
- good future – 41,6%
- not a good future – 4,2%

Gauging from the results a bright future is perceived for design-build.

## CONCLUSIONS

The following can be concluded from the results of this South African survey:

- Approximately 29% of building and civil engineering projects are procured by the design-build concept.
- The majority of respondents prefer the design-build procurement concept (72,9% by weight).
- During the comparisons with other project procurement approaches, respondents perceived among others, the following:
  - Design-build can lead to shorter project duration and cost savings when compared to other procurement methods. This can be attributed to the fact that some activities can be done in parallel, leading to a shorter overall project completion

time. For example, site establishment, buying of some of the materials, appointment of subcontractors and certain construction activities can overlap design.

- The majority of respondents argued that design-build leads to better communication and relations between the role players and that this concept has fewer disputes and claims.
- Design-build can lead to enhanced constructability of the design. (However, owners have less control over the design and a well-defined scope is of utmost importance.)
- Design-build offers the advantage of single-point responsibility.

## RECOMMENDATIONS

The authors have the following recommendations when design-build is employed:

- Owners should provide a well-defined scope of the work and make sure that design-build entities understand it completely.
- Design-build entities should be compensated for costs incurred during the bidding process to avoid owners doing informal feasibility studies under the guise of tenders. (First selection of design-build entities could be done on experience – this should be at no cost to owners/clients.)
- The owner should, wherever possible, appoint an independent quality con-

trol agency, or have trained in-house personnel to supervise quality. This is to cater for the concern mentioned by Tietz (1999), namely that there is sometimes disagreement between the designer and contractor in the design-build entity about quality of the work.

- Use the cost-plus compensation method on projects where it is practically impossible to estimate the total cost and provision necessary to cover the risk to the contractor. With most of the financial risk removed, the contractor can concentrate on other important project success criteria such as: safety, completion on time and quality of the end-product.

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### References

- Cooke, B & Williams, P 1998. *Construction planning, programming and control*. Macmillan.
- Cooper, D R & Emory, C W 1995. *Business research methods*. Fifth edition. Richard D Irwin.
- Dozzi, P, Hartman, E, Tidsbury, N & Ashrafi, R 1996. More-stable owner-contractor relationships. *Journal of Construction Engineering and Management*, 122(1).
- Evans, J F & Hodgkins, D J 1997. Barking Reach power station cooling water system. *Proc Instn Civ Engrs Wat, Marit & Energy*, Paper 10948, February.
- Gordon, C M 1994. Choosing appropriate construction contracting method. *Journal of*

*Construction Engineering and Management*, 120(1).

Grobler, K 1999. An evaluation of design-build as procurement method for building and civil engineering projects in South Africa. Submitted in partial fulfilment for the degree Magister Ingenieriae in Engineering Management, RAU.

Kaminetzky, D 1991. *Design and construction failures*. McGraw-Hill.

McEwan, E, Luke, I W & Idiculla, J 1997. The Pergau Hydroelectric Project Part 1: Project management. *Proc Instn Civ Engrs Wat, Marit & Energy*. Paper 11162, September.

Miller, J B 1997. Engineering systems integration for civil infrastructure projects. *Journal of Management in Engineering*, 13(5).

Naoum, S G Langford, D 1987. Management contracting – the client's view. *Journal of Construction Engineering and Management*, 113(3).

Ndekugri, I & Turner, A 1994. Building procurement by design and build approach. *Journal of Construction Engineering and Management*, 120(2).

Shah, J B 1996. Innovative design-build approach – Ambassador Bridge project. *Journal of Management in Engineering*, 12(4).

Songer, A D & Molenaar, K R 1996. Selecting design-build: public and private sector owner attitudes. *Journal of Management in Engineering*, 12(6).

Songer, A D & Molenaar, K R 1997. Project characteristics for successful public-sector design-build. *Journal of Construction Engineering and Management*, 123(1).

Tietz, S 1999. From Egan to the 21st century – commenting on the Egan Report, Rethinking Construction (July 1998). *The Structural Engineer – Journal of the Institution of Structural Engineers*, 77(7).