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# The Contractor as Designer

## L'entrepreneur-projeteur

## Der Unternehmer als Konstrukteur

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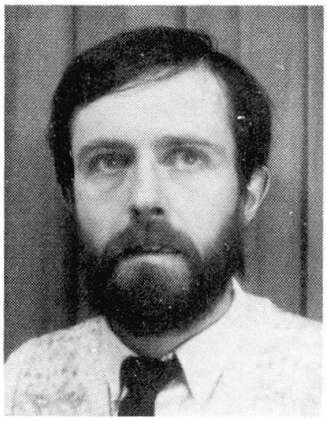

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**SUMMARY**

The paper investigates the performance of Design-Build contractors compared with Traditional, Architect-lead projects. The paper initially investigates the theoretical advantages and disadvantages of contractor designed projects as opposed to architect designed projects. The contractors method of working and planning is then analysed and the results of site based analysis of delays and productivity are reported. The paper concludes with an analysis of the time and cost performance of a number of contractor-designed projects and the response of client organisations to this performance.

**RÉSUMÉ**

Cette communication compare l'exécution des projets conçus et construits par les entrepreneurs et celle des projets traditionnels menés par l'architecte. L'exposé examine les avantages et les inconvénients des projets conçus par l'entrepreneur et par l'architecte. La méthode de planification et d'exécution de l'entrepreneur est analysée, et les résultats de l'analyse sur le chantier de la productivité et les retards éventuels sont présentés. L'exposé se termine par une analyse de la performance en termes de délais et de coûts dans plusieurs projets réalisés par l'entrepreneur et de la réaction des clients envers cette performance.

**ZUSAMMENFASSUNG**

Dieser Beitrag vergleicht die Leistung von Bauunternehmern, die sowohl für die Konstruktion als auch für die Ausführung verantwortlich sind, mit Projekten, die auf herkömmliche Weise von Architekten geführt werden. Zuerst werden die theoretischen Vor- bzw. Nachteile von Projekten, die vom Bauunternehmer konstruiert worden sind, verglichen mit jenen die von Architekten konstruiert wurden. Der Beitrag analysiert die Arbeits- und Planungsmethoden des Unternehmers sowie die Produktivität und die Ursachen von Verzögerungen. Den Abschluss bildet eine Analyse von Zeit- und Kosteneffektivität von einer Anzahl Projekten, die von Unternehmern konstruiert wurden und die Reaktionen von Gruppen von Kunden auf die erbrachten Leistungen.

## 1. INTRODUCTION

This paper reports on research conducted as part of a Science and Engineering Research Council sponsored project to conduct a comparison of design build and traditional contracts. The work has been completed recently and is reported more extensively by Rowlinson (1).

### 1.1 Procurement Form

This report concentrates on the comparison between Pure Design Build and the Traditional approach to construction as defined below.

Pure Design Build

> Both the design and construction teams are parts of the same organisation and all necessary design expertise resides within the organisation. This type of organisation rarely undertakes other than design build projects. The advantages of team working can be realised fully.

Traditional approach

> This system was the norm in Britain at the time of the Banwell Report (2), 1964, where the Architect is the first member of the building team to be appointed and he advises on the selection of other consultants, coordinates their work and then oversees the construction work undertaken by a contractor selected in competition. This system rarely allows the builder any practical design input and requires most inter-organisational supervision.

### 1.2 Procurement Form Characteristics

Table 1. illustrates some of the criteria identified as being desirable in the building process and rates the opportunities for fulfilling these criteria by adopting one of the two approaches to procurement. A design build approach has the best opportunity to produce speedy construction due to the overlapping of the design and construction processes which can occur and can perform well in terms of meeting time schedules and cost budgets due to the shoprt lines of communication within the building team, corrective action can be taken rapidly. The fragmented nature of the traditional approach slows all communications, especially on a complex project, and complicates the decision making process. There is a risk that, with the commercial rather than professional orientation of the design build organisation, design criteria may be compromised in achieving these other targets.

As far as the building team is concerned, design build scores well on integration and coordination as the team members are in close proximity and opportunities for feedback from site are frequent and directed to specific individuals first-hand. This must improve "buildability" within a short period of time. Traditional contract organisation allows greater use of expertise outside the scope of any one organisation but does not encourage the integration of Computer Aided Design and Draughting

throughout the construction process. This aspect should lead to great increases in efficiency for those design build organisations prepared to invest in and develop this technology.

| | DESIGN BUILD | TRADITIONAL |
|---|---|---|
| BUILDING PROCESS | | |
| Buildability | High | Low |
| Timeliness | High | Average |
| Adherence to Budget | High | Average-Low |
| Speed | High | Low |
| Functional Design | Average-Low | High |
| BUILDING TEAM | | |
| Team integration | High | Low |
| Team Coordination | High | Average |
| External expertise | Low | High |
| Feedback from site | High | Low |
| Use of integrated CAD | High | Low |

Table 1. Opportunities for Good Performance

## 2. SITE PRODUCTIVITY

An argument often used in support of the design build approach to construction is that the early involvement of the contractor allows for the production of a more buildable design. If this argument is true then it should be possible to determine a significant difference in the productivity attained on similar sites by the two methods: the number of manhours expended to produce a square metre of building should be less for design build than traditional contracts.

### 2.1 Method of Investigation

The initial approach to this problem was to adopt J J Adrian's approach (3) of considering delays to be an indicator of productivity performance. Problems occurred however in the collection of factual data on delays, particularly in obtaining adequate cooperation from site supervisors without expending excessive amounts of time and money on each site. These problems led to the more direct approach of collecting manhour data from the site agents' daily site returns. This approach has been criticised in the past as being unreliable but the comprehensive nature of the forms completed and the need for good records, as all sites employed almost entirely staffed by subcontract labour, suggested that the data was of sufficient quality to be both reliable

and valid. This assumption was validated by sampling a test site on a number of occassions and comparing the data with that recorded by the site agent.

The data was collected on a trade by trade basis from similar projects completed in the years 1983 and 1984. Traditional contracts were supplied by one company and Design Build by another, separate company of similar size. The total manhours expended on each contract by individual trades (excluding site supervision) was aggregated and then normalised by division by the total internal floor area of the buildings constructed. This was the basis of the comparison which is recorded in Table 2.

| £ | Type | mh/sq m | £/sq m | £K | Ave |
|---|---|---|---|---|---|
| 1 | Trad | 2.5 | 421 | 670 | |
| 2 | Trad | 2.3 | 458 | 790 | |
| 3 | Trad | 0.97 | 162 | 780 | 1.84(T) |
| 4 | Trad | 1.55 | 518 | 1600 | |
| 5 | DB | 1.92 | 479 | 550 | |
| 6 | DB | 1.85 | 363 | 1540 | 1.78(DB) |
| 7 | DB | 1.56 | 228 | 990 | |

Table 2. Project Data

## 2.2 Results

It can be seen from Table 2 that on average the design build contracts were slightly less expensive in terms of manhours expended per square metre but this difference is not statistically significant. The sign test and Mann-Whitney test show no statistically sinificant difference in the results and so the conclusions drawn are as follows:

1 A larger sample, say twenty projects may well show a statistically significant difference in the cost in manhours accrued by each procurement method.

2 There is no evidence in the work conducted so far to show that a significance difference in productivity exists between the two procurement methods.

## 3. PERFORMANCE

The research was extended to cover an analysis of the time and cost performance of different procurement forms on 40 case study projects and the results of this study are summarised below and in Figure 1.

### 3.1 Performance Comparison

The main findings of the research are as follows:

#### 3.1.1 Procurement Methods

1 Design build projects have a tendency to overrun the **planned preconstruction times** by 40% on average; this compares with an overrun of 20% for all projects.

2 Traditionallly organised projects overrun by 7% on average compared with a mere 2% overrun by design build projects on **planned construction times.**

3 Both procurement methods are likely to overrun on **budgeted costs** but by 4% only. There is no significant difference between the performance of either.

4 There is a very significant difference in **fees charged** to the client by the building industry under each procurement method. A client may expect to pay 10.6% in addition to the tendered construction cost under the traditional approach whereas only 3.9% with a design build project.

5 There is no evidence to suggest that there is any difference in the **prices tendered** by either method.

6 The implication of conclusions 4 and 5 is that, when all charges paid for a construction project are taken into account, the **client pays less by taking the design build approach.**

#### 3.1.2 Client Satisfaction

1 Clients expressed **dissatisfaction** with the performance of design build projects more often than they did with traditional projects. In particular criticism was levelled at the quality of the building produced and its inability to meet functional requirements.

2 Clients expressed **above average satisfaction** with the performance of design build projects more often than they did with traditional projects.

3 The paradoxical nature of conclusions 1 and 2 can be rationalised in terms of the **more variable performance** attained by design build projects. It is possible to go one step further: **pure design builders** scored badly on quality and function; **disparate** design builders, formed by different organisations for individual projects, scored badly on time and cost performance.

### 3.1.3 Procurement Form Utilisation

1 34% of building contractors offer a **design build** service of some type.

2 Design build work accounts for 26% of **contractors turnover** in industrial building (1984).

It is worth pointing out here that the research has shown that as much as 26% of industrial construction is undertaken using design build variants and up to 20% of all construction generally. This compares with 5% at the time of Banwell and 10-15% in 1974 (Sidwell).

## 4. CONCLUSIONS

The work reported here has shown that there are inherent advantages peculiar to each procurement form but that these are not always fully realised. Although it is believed that design build construction should be more productive this has not been proved conclusively in terms of manhour inputs. It has been shown that design build contracts perform well as far as timeliness and adherence to budget are concerned but that doubts remain about the quality of the final product.

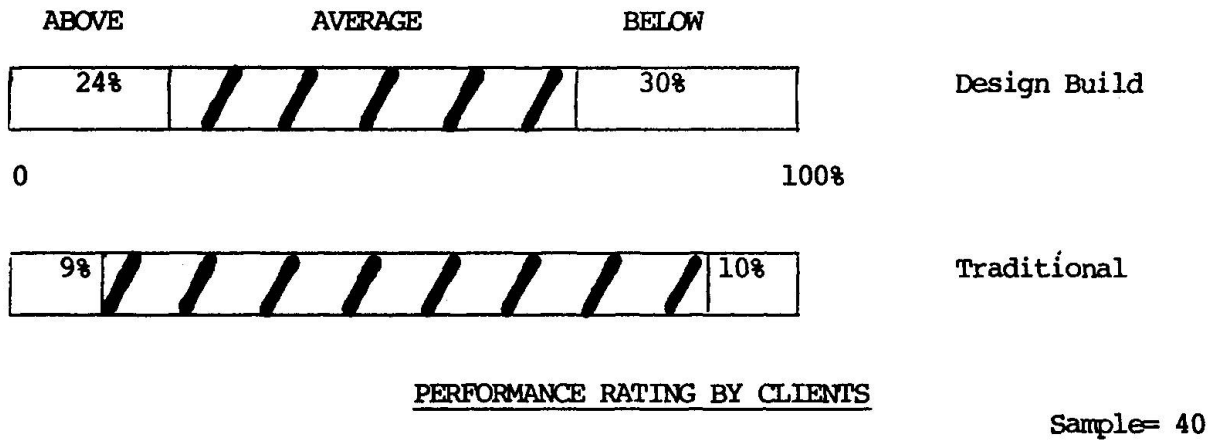


Figure 1. Performance Summary

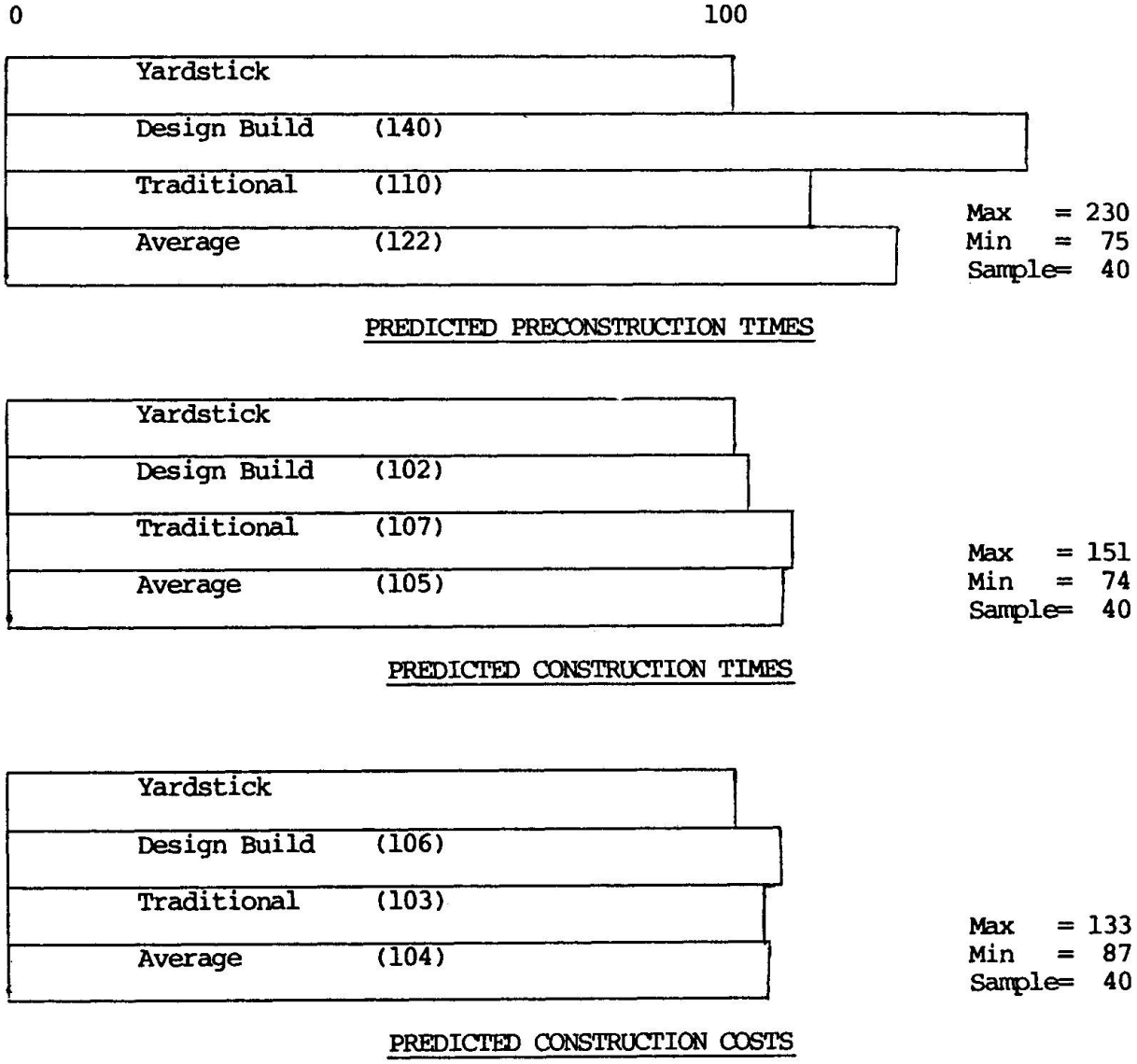


Figure 1.(cont.) Performance Summary

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