
CONSTRUCTION PROJECT DELIVERY SYSTEMS: AN ANALYSIS OF SELECTION CRITERIA WEIGHTING

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ABSTRACT

A postal questionnaire survey is described involving a sample of 41 clients, 34 contractors and 35 consultants and concerning their experiences and attitudes to a variety of project delivery systems and the criteria used for selection. The results indicate that a simple set of the criteria are generally adequate and sufficient for procurement path selection and that there is a reasonable consensus on their appropriate weighting for each path. It is also shown that similar clients generally do not have similar project delivery needs but nevertheless only one delivery method, that of novation, best satisfies the needs of those involved in the study.

Keywords: Project delivery systems, procurement, criteria, criteria weights, client needs, utility rating.
INTRODUCTION

It is generally accepted that a project may be regarded as successful if the building is delivered at the right time, at the appropriate price and quality standards, and providing the client with a high level of satisfaction (e.g., Naoum and Langford, 1988). One important influence on this, identified in the Banwell and Emerson reports of the 1960s, is the type of delivery system implemented. These have proliferated in recent years and their characteristics have become a major field of study in their own right (e.g., Turner, 1990; Franks, 1990; Nahapiet and Nahapiet, 1985). One result of this is a general consensus that there is one delivery system that is in some sense "better" than all others for an individual project but that no one delivery system is likely to be better than others for any project.

Several studies have considered how this "best" individual project delivery system may be identified (e.g., NEDO, 1983) by reference to a set of project characteristics, attributes or criteria, the most advanced of these being Singh (1980) and Skitmore and Marsden (1988) who propose a procedure involving weighting factors and priority rating for project attributes such as speed, certainty, flexibility, quality, complexity, risk avoidance and responsibility, price competition and disputes/arbitration. For this procedure to be of practical use it is necessary to first fix the weighting factors which relate these attributes to individual delivery systems independent of individual projects. One problem with this however is that the factor weights cannot be obtained easily by objective means and have to be elicited from practitioners in the field and it has been reported that practitioners have found difficulty in reaching a consensus on such matters (Hamilton, 1987, reported in Skitmore and Marsden, 1988). A further problem is that the client priority ratings have to be established for each project. This can be further exacerbated for clients who may not have the necessary experience even to produce an adequate brief. Nahapiet and Nahapiet (1985) however found the main factors affecting choice of delivery method to be the characteristics of the client as well as the project characteristics and requirements, suggesting that similar clients with similar project requirements may have similar and consistent priority ratings.

The purpose of the study described in this paper was to address these two problems in the context of Australian, and specifically the state of Queensland, practice. A postal questionnaire survey was conducted with a sample of contractors and consultants to establish if a reasonable consensus existed on factor weighting’s and a similar postal questionnaire survey was conducted with a sample of clients to establish if a reasonable consensus existed amongst subgroups of clients on priority ratings for similar types of projects. The results of this study was to show that, for the samples involved, a reasonable consensus did exist for the factor weighting’s but not for priority ratings. A further, and very surprising, result was that, having applied the established factor weights and the individual project priority weighting’s to individual projects, the predicted delivery system was in all cases that of novation followed by the traditional system - generally the reverse of the actual choice made.
DATA COLLECTION

A sample of clients were invited to weight predetermined criteria for projects they had procured or envisaged to procure in the near future. They were also asked to complete a second questionnaire via a telephone interview to establish the type of delivery system had been applied to the procurement of their buildings and whether or not they were satisfied with the way in which the buildings had been procured. A sample of consultants from the disciplines of quantity surveying, architecture and project management were also invited to provide subjective weighting’s for the various delivery systems against predetermined criteria using utility factors. A sample of contracting organisations were also contacted.

Client Sample and Procedure

Questionnaires were mailed randomly to one hundred clients throughout Australia, (with the exception of the Northern Territory), selected through the Yellow Pages, Business Directory and the client base of the Building Owners and Managers Association. Clients were given over one month to reply to the questionnaire and it was stated in a letter that if they had any queries pertaining to the purpose of the research to give me a call. Initially only twenty clients returned their questionnaires. Therefore, the questionnaire was again mailed to a further fifty clients using the client base of a Project Management firm, Construction Project Analysis and Rawlinsons Chartered Quantity Surveyors. These clients were given two weeks to answer the questionnaire resulting in a total of forty one being eventually received, of which approximately 25% were Property and Development Companies, 25% Investors, 30% Occupiers and 20% Local and Central Government Authorities (note of the 20% there was only a 7% reply rate from Local Authorities). These results indicate an even spread of client. Once the deadline date for the return of the questionnaires had passed, those clients who had replied to the questionnaires were contacted and interviewed via the telephone. All forty one clients cooperated in the follow up interview.

Contractors Sample and Procedure

Questionnaires were mailed randomly initially to fifty contracting organisations building divisions throughout Australia, and followed up with a telephone call. Thirty eight replied to the questionnaire, weighting the design and construct options with utility weighting’s of 110 or 100. Contractors stated that contractors design and build and package deals were becoming increasingly popular forms of delivery system. Contractors were asked why they believed this to be the case. Thirty four contracting organisations stated that they believed it was to do with clients wanting to allocate risk and advocate all responsibility to the party who was going to construct the building. It was also suggested by that clients wanted a guaranteed maximum price before construction commences on site.
Consultants Sample and Procedure

Questionnaires were randomly mailed to one hundred consultants throughout Australia, selected through the Yellow pages of each state and by using professional institutions directories of professional members. Consultants were given over one month to reply to the questionnaire and it was stated in a letter that if they had any queries pertaining to the purpose of the research to give me a call. Only ten questionnaires were returned within the time allocated. Each consultant was then given a telephone call in order to establish why they had not returned the questionnaire. As a result of the telephone call a further ten questionnaires were returned. Questionnaires were also mailed out to another fifty consultants throughout Australia and were given one month to return the questionnaire. Fifteen questionnaires were returned bringing the total sample size to thirty five.

ANALYSIS

Data from the questionnaires was extracted to derive weighting’s of utility factors. The utility weighting’s of the contractor respondents were however found to be biased toward design and construct forms of delivery system and therefore excluded from the analysis. The remaining weighting’s were then examined to determine whether or not the respondents gave similar weights for the same criterion for differing project types.

Clients

The most common form of arrangement used by the client respondents is the traditional lump sum and documentation with (56%) with novation the next most popular system (18%) and the management system of design, manage and construct the least used (3%). 74% of clients procured their development less than one year ago.

Clients were classified into either that of (1) Investor, (2) Property and Development Companies, (3) Local and Central Government Authority or (4) Occupiers (after Turner, 1990). Clients weighted each criterion using the scale indicated in the questionnaire. A summary of each client type with the respective details of how they classified themselves in terms of their experience of market and technical knowledge of the construction industry and the time period as to when they had completed their last building project was tabulated and used as the basis for verifying clients and their perceived satisfaction or dissatisfaction with the form of delivery system actually implemented.
The classification of clients market and technical knowledge of the construction environment is listed as follows;

(A) good technical knowledge of both technical and market factors
(B) good technical knowledge but limited or no market knowledge
(C) limited or no technical knowledge but a firm understanding of market factors
(D) limited or no knowledge of both technical and market factors

Each client's weights were inserted into the summary table and then ranked in order of preference (Table 1). The mean weights of each client type were calculated along with the corresponding mean rank. The coefficient of concordance (W) was calculated for each client type to establish a consistency in ranking's for the predetermined parameters.

(1) Investors

Ten questionnaires in all were received from clients (A-J) who were classified as Investors. Eight (80%) of the ten Investors deemed themselves to have a good technical knowledge of both technical and market factors of the construction environment. The remaining two (20%) stated that they had good technical knowledge but limited or no market knowledge, these being also the two clients which weighted speed as their principle requirement. Investors not weighting speed as their principle requirement used the traditional single lump sum contract and documentation. Those Investors stating that speed was their principle criterion used a construction management form of contractual arrangement.

Investors were asked what type of building had they previously procured, or about to procure. All clients gave their utility preferences for buildings which they had previously procured. It was found that Investors either procured Commercial or Residential buildings. The construction management form was found to be employed on Commercial buildings constructed less than one year ago. Speed was the principle criterion for these clients as they were procuring a shopping centre which needed to be completed before Christmas 1993. These clients had major anchor tenants who were expecting to gain the benefits of the festive season through increased sales, completion on time was an essential requirement. Thus the end user had an influence upon the way in the building could be procured.

Australia has recently been through a deep recession. Confidence is slowly being reinstalled into the economy, especially now that Sydney has won the bid to hold the Olympic games in the year 2000. The first signs of a recession hit the construction industry of Australian in the latter period of 1989 and the first quarter of 1990. Investors have over the past five years have generally employed traditional lump sum and documentation contractual arrangements.
The Investors subsample respondents ranked speed of delivery over a range of 1 to 8 and the utility preference weights of 7 to 20. The mean rank for speed was 6 with a corresponding mean utility preference weight of 13. 80% of the respondents did not have a preference for speed in the procurement buildings whilst 20% of stated their principle requirement to be speed.

The ranking’s for certainty ranged from 2 to 6 (mean 4) and 13 to 19 (mean 16) for utility preferences weights indicating that certainty in terms of a fixed price or a strict completion time was not major requirements of the Investors subsample respondents during the past five years. Interest rates and inflation have been lowered dramatically over the last three years, enabling clients to take advantage of longer periods of credit without being severely penalised. It is assumed that based on the calculation of the mean rank, it can be seen that four clients (40%) stated that certainty in the final cost and completion date was their second or third determinate in the procurement of a Commercial building. Thus no significant conclusions could be drawn from the results pertaining to the significance of certainty and the Investor. However, 80% employed the traditional lump sum and documentation form of contractual arrangement with provides certainty in cost and an the overall completion time.

So do Investors really know what they want? Maybe they should be approaching the end user? Investors were asked to make comment pertaining to any other principal requirements which had been left out in the questionnaire. From the questionnaire replies received from Investors it was found that 70% of clients required another criterion, that of a systematic post occupancy evaluation, before selecting the form of delivery system.

The ranking’s for flexibility indicated that flexibility to alter the design of the building once started on site is not to be a primary requirement of the Investors subsample. However, the respondent who used the construction management form of contractual arrangement gave a utility preference weight of 17 and 18 with corresponding ranks of 2 and 3. In this case the development was a large shopping centre complex it was vital that the end user (mainly the anchor tenant) had an input into the design.

Quality in terms of design is a difficult issue; it is both subjective and modish. What might be quality to one client may not be to the desired standards of another. An examination of the spread of ranks and weights indicated that no specific conclusions could be drawn pertaining to any significance between the Investors subsample and the quality criterion. However, as mentioned above, it is in the interests of Investors to maximise their dollar, therefore they would require a building procured at the least cost.

The ranking’s for complexity indicate that the Investors subsample generally do not require highly complex buildings.
Risk allocation and avoidance and responsibility were found to be the principal requirements of Investors subsample with the ranking’s ranging from 1 to 6 (mean 3) and 13 to 20 (mean 18) for utility preference weights. Juxtaposed with the ranks for the allocation and avoidance of risk it appears that Investors subsample primarily want to advocate responsibility onto other parties and at the same time, convey the aggregate allocation of risk onto the contractor.

90% of the Investor subsample ranked the extent of avoiding disputes within the range of 7 to 9 indicating that this subsample principally do not wish to avoid arbitration. This finding is unusual, as the result of going to arbitration or litigation can be extremely costly. If litigation is followed, then the reputation of the company involved could be at stake, as the press can have access to the court thus making the case public. It should be noted that arbitration is limited in some instances, as there are certain cases where it is not appropriate to go to arbitration, for example, where a dispute concerns substantial matters of law to be settled or disputes concerning the construction of agreements, thus litigation is the only answer.

60% of the Investors subsample ranked price competition within the range 1 to 3 with respondents who undertook a construction management form of delivery system ranking price competition as their fifth and seventh respectively. The remaining respondents used a traditional lump sum with documentation which received ranks of 1 to 4, except one respondent who ranked price competition as his eight criterion.

The coefficient of concordance (W) was calculated for the Investors subsample using the selection criterion as the parameters for which the calculation of the measure of rank correlation for clients ranking’s of each criterion. A coefficient of 0 represents no conformity between the ranks whereas a coefficient of 1 represents perfect agreement. The coefficient for the Investors subsample found to be 0.57, indicating that their ranking’s are fairly consistent.

(2) Property and Development Companies

Ten questionnaires were received from respondents classified as Property and Development Companies (PDC) indicting that they had experience pertaining to market and technical knowledge. The buildings procured by these respondents comprised commercial and retail (50%), residential (30%) and recreational (20%). 60% of respondents had procured a development within the last year (1994) - a period of economic recovery - with 30% procuring developments between one and three years ago (1991-3) and 10% between three to five years ago (1989-90) - a period of economic decline in the Australian economy.

The criterion of speed was ranked and weighted by this group of respondents as their principle requirement suggesting that the PDCs subsample’s principle aim is to make a direct financial profit by identifying a need in the marketplace. The faster the building is constructed the earlier the client can take advantage from the flow of income.
80% of the subsample respondents ranked *certainty* as their second preference making certainty as well as speed of construction their foremost priority preference. An examination of the forms of delivery used by this group of respondents also reveals that 60% used single lump sum and documentation, 30% contractor design and build and 10% construction management.

*Quality* is an area which can be best described at times as modish, however, this depends upon the individual client. PDCs generally need to procure buildings which would attract clients to purchase or rent the property, thus requiring the development to have a reasonable degree of quality finishes, efficient and economical services, and a building which is functional to meet the requirements of the end user. It appears from the results that as a whole, quality is not a main criterion of the PDC subsample.

PDCs are not in the business of procuring *complex* buildings, they generally procure office blocks, hotels or resorts, residential units or retail centres, as they their objective is to make a direct financial profit from the process of development. The results indicate that the PDC subsample's main requirements do not include for a highly specialised building as suggested by the types of building they have procured over the last five years.

The *allocation and avoidance of risk* ranking’s indicate a degree of consistency in the weighting of preference for this criterion. Although the risk is not the primary requirement it can be considered taking an aggregate overview that risk juxtaposed with responsibility are the subsequent criterion for fundamentally determining the method of delivery.

The ranking’s for *responsibility* indicate an impartial preference for the criterion of responsibility simultaneously with the allocation and avoidance of risk. The spread of weights for *arbitration and disputes* deviate amongst clients with only 20% weighting the avoidance of arbitration and disputes with a weight greater than a utility preference of 10. 20% of the respondents attributed a weight of 19 to *price competition* and 80% within the range of 13 to 16.

The coefficient of concordance (W) was found to be 0.27 indicating little consistency between respondents.

(3) **Local and Central Government Authorities**

Numerous Local and Central Authorities (LCGA) throughout Australia, except the Northern Territory were approached but only eight questionnaires were returned. Authorities within Queensland were approached on several occasions, informally via the telephone and formally by mail. Few were cooperative and generally stated that information pertaining to the development of buildings within their local shire was highly confidential. At the time of distribution of the questionnaires there was a degree of political turmoil within Local Authorities of South East Queensland with expenditure of monies being a principle issue.
50% of this group of respondents had a good knowledge of both technical and market factors of the construction environment, these clients being State Government Departments, ie Central Government clients, from New South Wales, Queensland, Western Australia and Victoria. The remaining are Local Government Authorities from Queensland (20%) and New South Wales (20%). The type of buildings which have been procured are residential, recreational, hospitals, educational establishments and administrative buildings.

The ranking’s for certainty ranged from 2 to 3 (mean 2), with 88% ranking certainty as their second preference. The utility preference weights ranged from 18 to 19 (mean 19), of which 88% weighted certainty with a weight of 19, indicating that a firm price prior to the commencement of construction and a strict completion date are fundamental requirements of Local and Central Government Authorities.

The ranking’s for flexibility indicated that the LCGA sample does not have a principal preference for changes in design during the course of the building project. From the listing of buildings which have been procured within the last year by LCGA it is clear that complexity was not a principal requirement of the LCGA subsample. Further analysis indicated that the LCGA subsample wished to ascertain a greater degree of speculative risk, risk of time and design liability.

The ranking’s for responsibility indicated a good degree of consistency and suggesting that the LCGA subsample do not require a single organisation to be responsible for the completion of the programme, design and construction process. A closer examination of the data revealed that 61% ranked arbitration and disputes as their eighth preference, 13% as their seventh, 13 % as their sixth and 13% as their fourth indicating that the LCGA subsample are not particularly anxious to avoid arbitration and disputes.

The ranking’s for price competition indicated this criterion to be the principle factor for the LCGA subsample. This was thought to be most likely due to LCGAs being accountable for the expenditure of funds and an underpinning philosophy of Government Authorities to select the construction team by competition, and accept the lowest tenders.

The LCGA respondents were asked if any additional criterion needed to be addressed within the questionnaire and the foremost statement received was the exclusion of a criterion specifically relating to value for money. It is deemed that the construction team inevitably procure a building for the client which gives the maximum value for the dollar invested. It is of paramount importance for the selected construction team to have this embedded within the framework of their design philosophy in order to achieve client satisfaction. Value for money is a fundamental principle contributor to achieving client satisfaction.

The coefficient of concordance (W) was found to be 0.37 for this subsample indicting little degree of consistency across the respondents.

(4) Occupiers
Of the Occupiers subsample, 27% had a good understanding of market and technical factors of the construction environment, 27% had a good technical knowledge but limited or no market knowledge with the remaining 46% having limited or no knowledge of both technical and market issues. The types of building which have been procured by Occupiers comprised Educational buildings (46%), Telecommunication buildings (18%), Hospitals and Health related buildings (9%), Industrial and Transportational buildings (9%) and Commercial buildings (9%). The time period for which the developments were procured ranged from less than one year ago to over five years ago. The procurement of the Educational buildings were all within the last year, of which 40% of respondents stated that they limited knowledge or no technical knowledge but a firm understanding of market factors, and 40% with limited or no knowledge of both technical and market issues. The remaining 20% had a good technical knowledge of both technical and market factors.

The ranking’s for certainty ranged from 1 to 6 (mean 2), with 63% ranking certainty as their principle preference and 18% as their second. The utility weights ranged from 20 to 13 (mean 19), of which 63% weighted certainty with a weight of 20, indicating that a firm price prior to the commencement of construction and a strict completion date are fundamental requirements of the Occupiers subsample.

The weighting’s for flexibility indicated that the Occupiers subsample do not have a principal preference for changes in design during the course of the building project, for the procurement of buildings types portrayed from sample. Each Occupier respondent appeared to have a disparate view of the definition of complexity and it is interesting to note that the Occupier respondent for whom this criterion was his principle weight had also procured and commissioned a highly specialised Telecommunications building.

An aggregate view the weighting of the allocation and avoidance of risk juxtaposed with the weight of responsibility indicate these together to be the second most important criterion for the Occupiers subsample. 45% of the subsample respondents ranked arbitration and disputes as their ninth preference, 9% as their eighth, 9% as their seventh, 9% as their sixth, 9% as their second and 9% as their principle and making these results inconclusive.

The coefficient of concordance (W) was found to be 0.25 indicating little consistency in this subsample.
Thirty five consultants completed and returned the questionnaires. Of these, 14% were architects, 57% project managers and 29% quantity surveyors.

The most popular form of delivery for the whole sample of respondents was found to be traditional lump sum (42%), followed by novation (34%), contractor design and build (16%) and turnkey and package deals (8%). 100% of consultants thought that the reasons for the popular forms were (1) client wants to reduce the amount of risk they are willing to take due to the prevailing economic climate, (2) clients main priority is cost, certainty in times of recession and (3) clients require lump sum before construction commences. The least popular forms of delivery for these respondents were found to be (1) management method: design, manage and construct, (2) management method: management contracting, (3) traditional method: cost reimbursement and (4) traditional method: provisional quantities. 100% of consultants considered systems 2, 3 and 4 to be not popular within the marketplace with 90% stating that method 1 was unpopular.

The architects and quantity surveyors subsamples principally weighted the traditional forms of delivery with the higher utility preferences (except in the case of cost reimbursement form) whereas the project managers subsample tended to show no preference toward any particular system, their approach to weighting each parameter against each contractual arrangement tended to be impartial (ie show no favouritism). There was no doubt architects and quantity surveyors priority weighting’s favoured traditional lump sum and traditional lump sum with provisional quantities.

The mean value of the consultants utility weighting’s for each criteria against each contractual arrangement is shown in Table 2. The results indicate that method A (traditional lump sum) provides the best quality (mean weighting 100.00) and best price competition (mean weighting 94.50), method E (turnkey and package deals) is the most certain (mean weighting 100.00), best for risk allocation/avoidance (mean weighting 109.70) and best for responsibility (mean weighting 95.60), method F (novation) is the best for avoiding arbitration and disputes (mean weighting 95.60) and method G (construction management) is the speediest (mean weighting 90.50), most flexible (mean weighting 95.60) and best for complexity (mean weighting 105.0). The smallest coefficient of concordance was 0.61 (for arbitration and disputes) and this was taken to indicate the existence of a reasonable consensus on the value of the weighting’s.
A Procurement Path Decision Chart (after Skitmore and Marsden, 1988) was produced for each client respondent using the mean utility values of the consultants' weights from Table 1 juxtaposed with the clients' criteria weights from Table 2.1-2.4. An example is shown in Figure 1. Each delivery system was ranked, with the highest result being ranked 1, method F in this example with a total weighting of 84.59, representing the 'ideal' form of delivery and contractual arrangement.

A total of 41 charts were produced in this way - one for each client respondent - and in every case the ideal form of delivery system is the design and construct novation form, with the traditional lump sum and documentation form ranked as the second choice, irrespective of the type of client or building involved. The positions of ranks for the traditional system with provisional quantities and the remaining design and construct forms, tend to be consistent throughout all the charts, ranks 3 to 5 but on occasions exchange places. The management forms, construction management, management contracting, and design and construct occupied ranks 6, 7 and 8, with management contracting predominantly being ranked eighth with the positions of the remaining management forms exchanging ranking positions. The traditional cost reimbursement form was ranked ninth for all the Charts.

Key; (A) traditional single lump sum, (B) traditional provisional quantities, (C) traditional cost reimbursement, (D) contractors design and build, (E) turnkey and package deals (F) novation, (G) construction management, (H) management contracting, (I) design, manage and construct.
CONCLUSIONS

In many ways, the results of this study are unsurprising - except in the final analysis. It is shown similar clients do not in general have similar needs in their procurement objectives. This may of course be due to the different nature of their individual projects - whether the same client has the same needs for different projects is not examined here. There is a consensus however that the criteria proposed, and their weights, are themselves appropriate for each procurement method. That the application of these weights in the Procurement Path Decision Charts should result in the same procurement decision is totally unexpected and suggests that a replication of this study is needed.

It should be noted however that the two most common procurement methods used by the client respondents are the traditional and novation and the Procurement Path Decision Chart found these also to be the most appropriate albeit in reverse order. The low ranking’s for construction management, management contracting and cost reimbursement are also capable of some explanation. NEDO (1987 Think about Building) suggests that the management system offers price certainty. Management forms do not offer price certainty because at the time of contract, as the exact nature and detail of the of the project are not generally established. Management forms are arguably a derivation of a form of prime cost contract and price certainty must be seen in this context. The device of a guaranteed maximum price is sometimes offered, but it is only possible to obtain price certainty if the maximum being guaranteed is high enough, in effect to contain a target figure that includes sufficient contingency. A maximum guaranteed price concept is not often possible to obtain before the time when a construction contract needs to be signed. The cost reimbursement form is a system whereby the contractor is paid the actual or prime cost for an indeterminate amount of work and in addition an agreed fee is paid to cover management, overheads and profit, it is understandable why this form is not favoured, as the resultant final cost to the client is difficult to determine, as with construction management and management contracting fees are paid on the actual cost of the work undertaken. Also, Barclay (1994) found from his studies that the design, manage and construct form has not been used that extensively within Australia, hence the lower weights and the low overall aggregate rank.

REFERENCES

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