PREDICTORS OF CONSTRUCTION TIME IN DETACHED HOUSING PROJECTS

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ABSTRACT

Building on previous literature on construction time performance (CTP), this study looks at the extent to which Gross Floor Area (GFA) and Number of Levels (NoL) are important factors in determining the construction time in Australian detached housing projects. Using a dataset of 196 comparable detached housing projects the results show that while GFA and NoL correlate strongly with *estimated* construction time, they correlated weakly with *actual* construction time. Dynamically changing events during construction appear to be the reason for the difference. Analyses indicate that cost variations brought about by *Design changes, Site management errors; Site workmanship problems and Unforeseen site problem*s are significant factors in explaining the difference between actual and estimated construction time. Further, these factors affect larger housing projects (>400m^2) more significantly than they do smaller projects (<350m^2). It would therefore seem that even though GFA on its own has a poor correlation with *actual* construction time, this improves when teamed with the above cost variations. These results open up avenues for future research to look more closely at the effects of project dynamics (e.g. using causes of cost increases as a proxy) when predicting CTP, rather than relying too heavily on static variables like GFA or NoL. It is important that such variables are taken into account as a basis for teaching and promulgating an analytical basis to predicting construction time.

Keywords**:** Construction, time performance, Australian housing

INTRODUCTION

There are clear economic drivers which underpin the importance of construction time performance (CTP) in building construction projects. For instance developers cannot derive positive cash flows until buildings are tenanted; building owners are burdened with the changeover costs associated with waiting for a new building to be completed before they can sell an old one; contractors have construction specific time-based costs and sometimes suffer the time-based effects of liquidated damages in their contractual arrangements.

Given the relevance of the above issues, it is notable that Ireland (1995) speculates that as much as 40% time saving may be possible by reducing non-value adding steps in the design and construction process. Sidwell and Walker (1998) point to measured improvements in (CTP) of 19% to 38% between the 1970's and 1990's in commercial projects. Similarly, Ng *et al.* (2001) found that public sector projects in Australia improved in CTP by up to 132% over a 40 year period.

This paper focuses specifically on detached housing construction with a view to raising awareness of the benefits of faster construction times, encouraging best practice and avoiding customer dissatisfaction. With regard to this, much has been written on CTP and even though a number of these studies have included residential projects - including Bromilow *et al.* (1980), Blyth *et al* (1995), Walker and Vines (2000) and Ng et al (2001) – such studies have focused on multi-unit residential projects rather than the specific needs of detached housing projects.

In delineating detached housing from other construction sectors, it is notable that these projects are relatively small in size. Many home building contractors deal direct with the end customers and are geared to do this on a high volume and systematised basis. Such organisations offer standard house designs with standard prices and aim to emulate production line processes onsite. Despite the site being the focus of physical operations many managerial controls used by these volume builders tend to be centralized rather than site focused. This is true for things like design, estimating, contracts administration, client contact, quantity take-off, ordering, and setting up bulk materials and subcontract agreements. These all tend to be handled from head office and only a part-time site supervisor – spread across many project home sites - is required to operationalise the office based controls onsite.

No research could be found that studied CTP under this management setting and as a result, the aim of this paper is to focus on identifying variables that significantly affect construction time specifically for the detached volume home building sector in Australia. In this context, two underlying aims of the study are to focus on variables that lend themselves to: practical decision making in day-to-day operations management; and industry wide benchmarking of time performance.

EXPLAINING AND PREDICTING CONSTRUCTION TIME PERFORMANCE

Construction Time Performance (CTP) is perhaps best described in terms of actual construction time compared against expected construction time. Bromilow initiated research into CTP via the now well known *time-cost* model (Bromilow, 1969) which proposes that construction time can be predicted on the basis of construction costs:

$$T = K \times CB.$$

Where: T is Construction Time Performance in working days, K is a constant describing the general level of time performance for a notional $1 million project, C is project cost, in millions of dollars, and B is a constant based on cost and time.

Following on from this initial work, Bromilow *et al*. (1977, 1988) and others (Ireland, 1983; Sidwell, 1984; Walker, 1994, 1995, 1997) undertook studies to help calibrate the model in Australia and expand understanding of other variables influencing CTP. Efforts were also made to compare and develop the model in other countries such as the UK (Kaka & Price, 1991) and Hong Kong (Chan & Kumaraswamy, 1995; Chan 1999).

In considering the variables that add to the *time-cost* relationship, Walker (1994) looked at gross floor area, number of storeys, building type and procurement method. In further work, Walker (1995) identified that variables having a significant effect on CTP included construction management effectiveness, sophistication of the client and client's representative, design team effectiveness, and a small number of factors describing project scope and complexity.

In yet another paper by Walker (1997), traditional approaches to procurement were found to have a tendency to place the construction contractor in a lower position of authority with respect to the design team, and as a result buildability may suffer, hence influencing CTP. In a study co-authored by Walker and Vines (2000), they focused on multi-unit residential projects which yielded a model proposing that team confidence – being a function of team experience and management competence - mediated success in CTP.

More recently, Bromilow's original *time-cost* model was re-assessed by Ng *et al.* (2001). They sought to update Bromilow's model by testing it using a new set of data structured around different types of projects. For instance, they found that different parameter estimates were needed for different types of building i.e. industrial and non-industrial projects. Even so, they found that no change in parameter estimates was required for variables such as different client sectors, contractor selection methods and contractual arrangements. Finally, their attempts at trying alternatives to Bromilow's original log-log regression model failed to provide an improved fit with the data.

Love *et al's* (2005) more recent study proved to take a different direction than many from the past. They studied the *time-cost* relationship but unlike other studies, they concluded that cost was a poor predictor of CTP - in part, due to it being hard to predict post construction cost at the outset of a project. Instead, they advocated an emphasis on gross floor area (GFA) and number of levels (NoL).

Clearly, much has been written on CTP and a number of observations can be made about the previous literature review. First, the existing literature does not cover the volume home building sector and so it is unclear if the variables that have relevance on larger projects, have the same relevance on smaller and differently managed housing projects. Second, the time-cost model is well developed but a disadvantage is that cost data tends to be commercially sensitive and therefore restricts its usage for industry wide benchmarking. Third, there are a large number of variables raised in the previous discussions and though they may all influence construction time performance, not all are well suited for use as predictive variables. For instance some lack the ability to be measured in an objective way. Fourth, using too many variables to predict construction time runs the risk of creating an overly complicated, if not idiosyncratic model that may become impractical for use by operations managers and for industry benchmarking purposes. Hence, parsimony must be balanced against prediction accuracy.

Given these considerations and following up on the research by Love et al (2005), *GFA* and *NoL* seem to be promising factors in determining CTP in detached housing construction as they meet the aims of being practical to use and well suited to industry wide benchmarking. This is because such data is easy to obtain off drawings, is less sensitive than cost data and has the potential to be obtained from existing data sources such as development approvals databases. The literature (Love *et al.,* 2005) also indicates that these variables are realistic for predicting construction time.

To this end, a number of hypotheses are proposed to study the relationship between construction time and GFA and/or NoL. Two scenarios are considered for this including estimated construction time and actual construction time. There is reason to think the two may be different. For instance, estimated construction time is what construction managers think a project should take to build and is typically used as an assumption for other project planning activities. Actual time is what the project really takes to build. Any difference between the two means that pre-construction assumptions are either wrong or poorly implemented. With this in mind, and because GFA and NoL are static measures that do not necessarily take into account any dynamic changes that occur during construction, these variables may be less potent in predicting actual time than estimated time. The following hypotheses are to be tested as part of the research:

H1: In volume housing projects, Gross Floor Area and Number of Levels are strong predictors of construction time estimates made by construction managers.

H2: In volume housing projects, Gross Floor Area and Number of Levels are weak predictors of actual construction time (as achieved onsite).

There is also the need for a third hypothesis to deal with the event that H1 and H2 differ significantly in outcome. As alluded to previously, this may be a result of dynamic changes that occur during construction. It is thought that this is best dealt with by focusing on the causes of time over-runs (being the difference between estimated and actual construction time). Here, Love *et al's* (2005) previously discussed paper is useful in giving some direction as to which measurable factors may correlate with time over-runs. For instance in their comments about the *time-cost model*, they allude to dynamic increases in construction costs decreasing the ability to predict post construction costs - hence adversely influencing the ability to predict CTP. It therefore seems worthwhile to test whether cost increases (acting as a measurable indicator of dynamic changes during construction) can explain any differences that exist between H1 and H2. On this basis, the following hypothesis is posed:

H3: In volume housing construction, cost increases (being a measurable indicator of dynamic changes during construction) will correlate strongly with time over-runs.

RESEARCH METHOD

The study aims to build on the existing theoretical framework of CTP research and therefore focuses on similar statistical methods to those used by others. In this context, Pearson Correlation was used to determine the linearity of the relationship between selected variables arising from H1, H2 and H3 - including the reporting of p values (the probability of an event occurring by chance) and r values as an expression of the correlation coefficient. For further details on Pearson correlation, Field (2000) provides recommended reading on this topic.

With the above method in mind, it was decided that the best way to address the hypotheses was by gathering numeric reporting data direct from project software databases used by *volume home builders*. Differences between databases meant that only a limited number of builders were able to provide comparable data. As a result, data from two large *volume home building* companies was obtained. Both companies operate in the Sydney (Australian) housing market. In total, data from 196 detached housing projects was obtained - 104 from Builder A and 92 from Builder B. The database software used by the builders provided the following data:

- expected construction time (days)
- actual construction time (days)
- overall cost increases ($)
- individual causes of cost increases including amounts for each cause ($).

In addition to the above, houses in the sample were all built from standard house designs. All models used construction typical of volume housing in the Sydney market including brick veneer walls and concrete slab on-ground floor construction. Dwelling size ranged between 220m² to 500m² in GFA. In terms of number of levels, 48 of the projects were single level and 148 were two level projects.

ANALYSIS - HYPOTHESIS 1

Analysis of Hypothesis 1 involved testing the correlation between the *estimated construction time* (ECT) with both Gross Floor Area (GFA) and Number of Levels (NoL). Table 1 shows the results which indicate that both GFA and NoL had statistically significant correlations with *estimated construction time*. For the whole sample, there was a very strong correlation between estimated construction time and GFA ($r = .78$; $p < .001$). A lesser but still strong correlation existed between *estimated construction time* (ECT) and NoL ($r = .49$; $p < .001$).

	Mean	S.D.	(ECT)	(GFA)
Estimated Construction Time Performance (ECT)	135.21	12.07		
Gross Floor Area (GFA)	384.85	56.07	.78*	
Number of Levels (NoL)	1.77	0.42	.49*	.40*

Table 1: Means, standard deviation and inter-item correlations (r values) between ECT and GFA and NoL
*(Note: Pearson Correlation, listwise deletion, n= 189, †p < .05, §p < .01, *p < .001, two tailed)*

	Mean	S.D.	(ECT)
Estimated Construction Time Performance (ECT)	135.21	12.07	
Gross Floor Area (GFA)	384.85	56.7	.73*
Number of Levels (NoL)	1.77	0.42	.31*

Table 2: Means, standard deviation and partial inter-item correlations between ECT and GFA and NoL
(Note: Pearson Correlation, listwise deletion, n= 189, †*p* < .05, §*p* < .01, **p* < .001, two tailed).

Table 1 also indicates a fairly strong relationship between GFA and NoL (r=0.40; p < .001) thus suggesting the need to undertake partial correlation analysis i.e. to test the correlation between one of these variables and *estimated construction time*, whilst controlling for the other. Table 2 shows the results for this analysis. It can be seen that when NoL was controlled for, the partial correlation between GFA and *estimated construction time* dropped slightly but remained very strong (r=0.73; p < .001). On the other hand, after controlling for GFA, the partial correlation coefficient between NoL and *estimated construction time* dropped more substantially (from r = 0.49 to r=0.31), although the significance level remained unchanged at .001. The results of the partial correlation reinforce the assumption that GFA and NoL, each on their own, is a variable that significantly influence estimated construction time

It appears that Hypothesis 1 is supported but despite this, GFA on its own correlates more strongly with *estimated construction time* than NoL. Therefore, it can be argued for reasons relating to parsimony, that GFA provides a stronger and more practical basis for estimating construction time compared to NoL. This view is also helpful in terms of earlier discussion that GFA is often reported in building approval databases, thus making it ideal for collecting secondary data which may be used in industry benchmarking studies. It would also be a simple operation for construction managers to obtain such information directly off project drawings. In contrast, there is potential for NoL (on its own) to provide misleading results. For instance, split level houses would appear to have an inadvertently higher number of levels without necessarily increasing GFA and could therefore confuse rather than clarify estimates of construction time.

ANALYSIS - HYPOTHESIS 2

The emphasis of H2 was to test the relationship between the *actual construction time* (ACT) with GFA and NoL. Table 3 shows the results of the correlation analysis which indicate that for the whole sample, there was a relatively low correlation between *actual construction time* and GFA, albeit at a high level of significance ($r = .21$; $p < .001$). In addition, no statistically significant correlation existed between *actual construction time* and NoL ($r = -0.05$; $p > .05$). Even so, a strong correlation existed between GFA and NoL. As a result, a partial correlation analysis was again undertaken to test the individual influences of GFA and NoL on *actual construction time*.

The results of the analysis are shown in Table 4 which indicates that as far as the individual effects are concerned, there was a minor increase in the correlation between GFA and *actual construction time* ($r = .25$; $p < .001$) when NoL was controlled for, but it was still considered to be low in overall terms. The partial correlation between NoL on *actual construction time* - when controlling for GFA - changed to being statistically significant and in addition, increased to a slightly larger negative relationship between the two variables ($r = -0.15$; $p < .05$).

These findings indicate that Hypothesis 2 is supported because even though GFA and NoL are statistically significant, GFA is only a weak predictor of *actual construction time* and NoL has a small negative correlation. The apparent reason for the reduced predictive abilities of these variables (compared to findings in H1) may be due to dynamic changes occurring during construction. This issue is dealt with more fully in the following analysis of H3. In addition, it is not entirely clear why NoL has a small negative correlation with actual construction time, albeit almost neutral in impact. Part of the reason could be the aforementioned concern about misleading results from spit level projects but a more likely reason is simply that in statistical terms, actual construction time is dominated more by GFA and the yet to be tested dynamic changes occurring during construction.

	Mean	S.D.	(ACT)	(GFA)
Actual Construction Time Performance (ACT)	164.35	36.19		
Gross Floor Area (GFA)	384.85	56.07	.21§	
Number of Levels (NoL)	1.77	0.42	-.05	.40§

Table 3: Means, standard deviation and inter-item correlations between ACT and GFA and NoL
*(Note: Pearson Correlation, listwise deletion, n= 189, †p < .05, §p < .01, *p < .001, two tailed).*

	Mean	S.D.	(ACT)
Actual Construction Time Performance (ACT)	164.35	36.19	
Gross Floor Area (GFA)	384.85	56.07	.25§
Number of Levels (NoL)	1.77	0.42	-.15†

Table 4 Means, standard deviation and partial inter-item correlations between ACT and GFA and NoL
(*Note: Pearson Correlation, listwise deletion, n= 189,* †*p* < .05, §*p* < .01, **p < .001, two tailed*).

ANALYSIS – HYPOTHESIS 3

This hypothesis involved resolving whether time over-runs correlated with cost increases during construction. The former of these variables quite simply represented the numeric difference (in days) between actual and estimated construction time on each project. The latter is aimed to be a proxy for tapping into the dynamic changes during construction. Due to the detailed nature of the cost data obtained, it was possible to explore this hypothesis at two levels including the overall cost increases on a given project, and the breakdown of overall costs into individual causes that lead to the cost increases.

Results at the overall level of detail confirmed that there was indeed a strong correlation between cost increases and time over-runs (r = 0.49, p=0.01) hence supporting H3 and justifying exploration into the breakdown of the individual causes. In moving onto this level of analysis, it seemed prudent to collapse the many causes of cost increases in the builder's databases, into a smaller and more manageable set of categories.

The categorization used is shown in Table 5.

Collapsed Categories	**Original Categories**
Pre-construction errors (in sales, design, estimating)	• Design error • Drafting error • Bill of Quantities error • Cost estimating error • Colour schedule error • Sales or customer service error • Promotional error
Design changes	• Design change by client • Specification changes • Provisional cost variations • Regulatory changes (req'd by local council)
Site management errors	• Site supervisor error • Delay in releasing material
Site workmanship	• Subcontractor error • Site error • Re-inspection costs
Supply chain problems	• Late/wrong delivery • Faulty materials • Wrong order • Increase in material cost during project • Increase in subcontractor costs during project
Unforeseen site costs	• Extra materials handling costs • Extra scaffolding to meet safety requirements • Extra waste tipping fees • Bad weather • Theft • Vandalism • Damage • Travel surcharge • Liquidated damages

Table 5: Categories of cost increase

Correlation analysis was performed between time over-runs and each of the six categories of cost increases indicated in Table 5. Table 6 shows the results of the analysis which indicates that for the whole sample, except for *Supply chain problems*, the rest of the cost factors had a significant correlation with time over-runs. Of these, *Unforeseen site problems* registered the highest correlation coefficient ($r = .33$; $p < .001$). Other causes with similar levels of correlation included *Site management errors* ($r = .31$; $p < .001$) and *Site workmanship problems* ($r = .31$; $p < .001$). *Design changes* ($r = .22$; $p < .05$) showed a lesser but still noteworthy correlation with *time over-runs*. *Preconstruction errors* showed only a low correlation with *time over-runs* ($r = .14$; $p < .05$).

In trying to extract greater meaning from these findings, it was decided to reintroduce GFA into the analysis to see if its weak impact on *actual construction time* could be resolved more successfully. For instance, could it be that GFA combined with the cost variables (Table 6) could do a better job of explaining time over-runs, than the cost variables on their own. To this end it was decided to create distinct groupings of the projects in the data set based around GFA. Projects with a GFA of less than $350m^2$ were coded as 1 while those with a GFA of $400m^2$ were coded 2. Projects with sizes falling between these two ranges were intentionally eliminated from the analysis to help differentiate the two groups. This led to 60 cases for group 1 ($<350m^2$) and 74 cases for group 2 ($> 400m^2$). The last two columns in Table 6 show the results of the correlation analysis for the respective two groups.

Obvious differences were found between the two groups. In group 1 sub-sample, only *Unforeseen site problems* was significantly correlated with time over-runs ($r = .28$; $p < .05$). On the other hand, in group 2 sub-sample, four out of the six cost factors were significantly and highly correlated with time over-runs which included *Design changes* ($r = .35$; $p < .05$); *Site management errors* ($r = .51$; $p < .001$); *Site workmanship problems* ($r = .48$; $p < .001$); and *Unforeseen site problems* ($r = .38$; $p < .01$).

Although H3 is supported, the results benefit from further explanation. While cost increases are correlated with time over-runs, this is most true in larger houses (> 400m2) rather than smaller houses (<350m2). This is because with larger houses, it is more likely (all other things being equal) that issues relating to *Design change; Site management errors; Site workmanship problems* and *Unforeseen site problems* will have a more significant impact on large houses; while in comparison, this does not occur on small projects where only *Unforeseen site problems* has a significant impact. From this, plain logic would suggest that the margin for errors, complexity and variations will be higher on larger houses compared to smaller ones.

	Mean	S.D.	1	2	3	4	5	6	Project size < $350m^2$	Project size > 400 m^2
1. Time performance	29.47	34.31								
2. Preconstruction errors	2566.44	3723.21	.14†						.14	.20
3. Design changes	980.28	1094.09	.22†	.26§					-.07	.35†
4. Site management error	618.65	1085.71	.31*	.08	-.06				.17	.51*
5. Site workmanship problems	2138.75	4076.27	.31*	.07	-.02	.54*			.15	.48*
6. Supply chain problems	1175.38	1299.41	.11	.02	.13	-.05	-.19		.30	-.10
7. Unforeseen site costs	4961.96	2881.33	.33*	.22§	.09	.23§	.31§	.10	.28†	.38§

Table 6: Means, standard deviation and inter-item correlations between time over-runs for discrete large and small house categories, and the six categories of cost variance
*(Note:Pearson correlation, pairwise deletion. Whole sample n=195; Sub sample 1 (project size < 350m2) n = 60; Sub sample 2 (project size > 400m2) n = 74; †p < .05, §p < .01, *p < .001, two-tailed).*

CONCLUSIONS

The study has gone some way into identifying the critical factors that affect construction time performance in the detached volume housing sector. Findings provide new insights as to how existing variables of time apply to this sector. In addition, cost centric variables have been included for measuring the dynamic changes that occur during construction.

To summarise, Gross Floor Area had a very strong correlation with estimated construction time but a relatively low correlation with actual construction time. Evidence from the study suggests that GFA alone is inadequate for predicting actual construction time and that this is due to the presence of dynamic changes occurring during construction – using cost increases as a proxy for such changes during construction. In addition, it was found that the range of causes of cost increase was more prevalent on larger houses (> $400m^2$) than smaller ones (<$350m^2$). For instance *Design changes; Site management errors; Site workmanship problems;* and *Unforseen site problems* were all causes of cost increases which correlated highly with time over-runs on larger houses. Only *Unforseen site problems* correlated highly with time over-runs on smaller houses. One could therefore logically argue that, *Unforseen site problems* are common to all houses regardless of size. It would also seem that even though GFA on its own has a poor correlation with *actual* construction time, this improves when teamed with the above cost variations.

The study shows that in terms of improving time performance in detached volume housing construction (and the ability to predict it) it is worth considering and hence factoring-in the project dynamics that exist within the project environment. These factors often influence actual construction time in more subtle ways than what conventional project time prediction models allow for. For instance, past models have worked around the *time-cost* model (Bromilow, 1969) but as pointed out by Love *et al.* (2003), initial cost can be a poor predictor because it is hard to predict post construction cost at the outset of a project – a point that is supported by this research. Even so, Love *et al's* (2003) preference for Gross Floor Area or Number of Levels also lacks strength as a good predictor of actual construction time in detached housing and therefore less static predictors are required. For instance this research supports that GFA is a reasonable starting point for estimating construction time but it becomes a poor predictor of *actual construction time* because of the interplay between the previously mentioned dynamic causes of cost increases. Subsequently, GFA can be seen as having a direct effect on actual construction time and also an indirect affect on cost increases.

It is clearly difficult from a management perspective to predict cost increases that happen during construction. Even so, there is potential to try and factor-in guestimates concerning the likelihood of such increases on a given project – say based on the likely degree of deviation from a standard practices, standard labour force availability, standard materials and the level of design customisation. It is important that such variables are taken into account as a basis for teaching and promulgating an analytical basis to predicting construction time.

Future research should test the findings of this research on a larger data set. If this can be achieved and the findings remain stable across a larger data set then the next step would be to build the variables into a regression model, thus making it possible to use in the form of a standard quantifiable tool for predicting and simulating construction time that can be used in both practise and in educational settings.

REFERENCES

Blyth, S.M., 1995. *An investigation into the development of a benchmark for UK construction time performance*, Unpublished M.Sc. thesis, University of Glamorgan, Pontypridd.

Bromilow, F. J. 1969. “Contract time performance expectations and reality”. *Building Forum*, Vol. 1, No. 3, pp 70-80.

Bromilow, F.J. and Henderson, J.A., 1977. “Procedures for Reckoning the Performance of Building Contracts, report”. *Commonwealth Scientific and Industrial Research Organisation, Division of Building Research*, Highett, Victoria.

Bromilow, F.J., Hinds, M.F. and Moody, N.F., 1980. “AIQS survey of building contract time performance”. *The Building Economist*, September, pp 79-82.

Bromilow, F.J., Hinds, M.F. and Moody, N.F., 1988. “The Time and Cost Performance of Building Contracts 1976-1986”. *Australian Institute of Quantity Surveyors*, Canberra.

Chan, D.W.M. and Kumaraswamy, M.M., 1995. “A study of the factors affecting construction durations in Hong Kong”. *Construction Management and Economics*, Vol. 13 No. 4, pp 319–33.

Chan, A.P.C., 1999. “Modelling building durations in Hong Kong”. *Construction Management and Economics*, Vol. 17 No. 2, pp 189-96.

Field, A., 2000, *Discovering Statistics Using SPSS for Windows*, Sage Publications, Thousand Oaks, California.

Ireland, V., 1983. “The role of managerial actions in cost time and quality performance of high rise commercial building projects”. PhD Thesis. *University of Sydney*, Australia.

Ireland, V., 1995. “The T40 Project: Process Re-engineering in Construction”. *Australian Project Manager*, Vol. 14, No. 5, pp 31 - 37.

Kaka, A. and Price, A.D.F., 1991. “Relationship between value and duration of construction projects”. *Construction Management and Economics*, Vol. 9, No. 4, pp 383-400.

Love, P.E., Tse, R.Y. and Edwards, D.J., 2005. “Time–Cost Relationships in Australian Building Construction Projects”. *Journal of Construction, Engineering and Management*, Vol. 131, No. 2, pp 187-194.

Ng, S.T., Mak, M., Skitmore, R.M., Lam, K.C. and Vamam, M., 2001. “The predictive ability of Bromilow's time-cost model”. *Construction Management and Economics*, Vol. 19, No. 2, pp 165-73.

Sidwell, A. C., 1984. “The time performance of construction projects”. *Architectural Science Review*, Vol. 27, pp 75-91.

Sidwell, A.C. and Walker D.H.T., 1998. “Improved construction time performance in Australia”. *Australian Institute of Quantity Surveyors Refereed Journal*, AIQS, Canberra, Vol. 2, No. 1, pp 23-33.

Walker, D.H.T., 1994. “An investigation into factors that determine building construction time performance”. Ph. D. thesis. *Royal Melbourne Institute of Technology*, Melbourne.

Walker, D.H.T., 1995. “The influence of client and project team relationships upon construction time performance”. *Journal of Construction Procurement*, Vol. 1, No. 1, pp 4-20.

Walker, D.H.T., 1997. “Construction time performance and traditional versus non-traditional procurement systems”. *Journal of Construction Procurement*, Vol. 3, No. 1, pp. 42-55.

Walker, D.H.T. and Vines, M.W., 2000. “Australian multi-unit residential project construction time performance factors”. *Engineering Construction and Architectural Management*, Blackwell Science, Oxford, UK, Vol. 7, No. 3, pp. 278-284.

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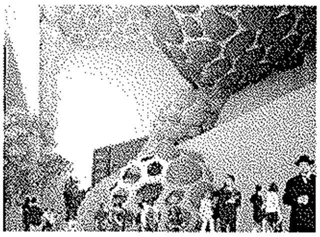

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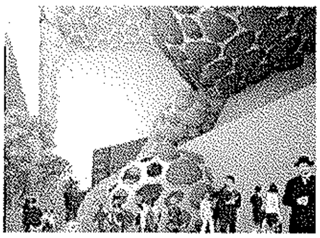
ABOUT AUBEA

The Australasian Universities Building Education Association (AUBEA) is a membership-based, non-profit organization created in 1975 to promote and improve teaching and research in building through communication and collaboration. It comprises academics representing all universities throughout Australia, New Zealand, and the wider Asia-Pacific region which provide education in building-related fields.

AUBEA has a Council made of representatives from member institutions that meets twice a year, and maintains a strong connection to industry and professional associations.

Since its inception, AUBEA has been running an annual conference, intended as a forum for pedagogical and disciplinary reflections, institutional exchange, and collective growth.

Date created: 1 October 2009
Last modified: 06 December 2010
Authoriser: General Manager, Faculty of Architecture, Building and Planning
Maintainer: Web and Multimedia Manager, Faculty of Architecture, Building and Planning



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AUSTRALASIAN UNIVERSITIES BUILDING EDUCATION ASSOCIATION

AUSTRALASIAN UNIVERSITIES BUILDING EDUCATION ASSOCIATION (AUBEA),
35TH ANNUAL MEETING

AUBEA

ABOUT THE CONFERENCE

The focus of this year's conference is the management of construction. Rather than automatically associating the meaning of these two words to the area of expertise labelled as 'construction management', we intentionally set out to interpret their connection in the broadest possible way, to incorporate any discipline that improves our ability to manage the industrial structure, the planning and production process, the distribution process, or the output of building.

What should the sophisticated pairing of 'construction' and 'management' designate or include today — particularly from an intellectual perspective? Predetermined or new academic disciplines, specific training or work issues, micro or macro problems, cultural dispositions towards problem definition and problem solving?

Irrespective of the possible answers, can we presuppose curricular bases? If so, to what extent? Similarly, can we identify — normatively or historically — the kinds of research we should engage with, or the kinds of teachers/scholars who should be involved?

These questions are critical for tertiary educators in building programs across the entire Australasian region, but particularly in Australia, where the dynamics of the industry, combined with the ongoing restructuring of building courses and the faltering support for research in construction, raise issues with regard to the nature and use of the education on offer in the various areas, the market for it, and the role that educational providers should play in advancing or maintaining the state of knowledge.

In light of the changes recently undergone in its overall structure, the Faculty of Architecture Building and Planning at the University of Melbourne is keen to provide a platform for AUBEA to reflect on such issues, by implicitly subjecting its own choices to criticism and debate vis-à-vis alternative strategies and/or agendas.

Contributions are therefore sought from individuals as well as institutions that, on the basis of the questions suggested above, can help map an inclusive territory for managing construction, define or reinforce its environmental connections and boundaries, or steer the travel in specific directions — essentially by clarifying their own intellectual and operative position against issues that are specifically deemed or relevance.

This can be done by describing epistemological stances, work carried out by the presenters, curricular choices, teaching strategies, problems to address, gaps to fill, areas to bridge, tools to develop, knowledge streams to pursue, research undertaken or to undertake, issues to consider, or constituencies to respond to, in every area covered by the programs of building schools.

As in the best tradition of AUBEA conferences, the range of possible topics is wide, with the small proviso that each paper should contribute to stimulate a 'reflective' and possibly organic discussion on the overarching theme.

Student stream

Since higher research degree students are the linchpin connecting academic present and future, a section of the AUBEA meeting will be devoted to the presentation of their work on related matters.

Research funding discussion

In light of the Federal Government's current Excellence in Research for Australia (ERA) initiative, another section of the meeting will be used to discuss the funded research environment in Australia, and the space this leaves to building-related studies.

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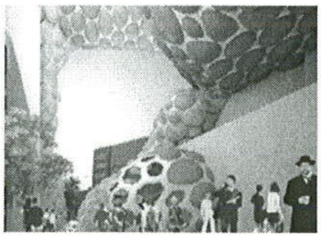

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SUBMISSION DETAILS

Abstracts

Abstracts will be used as expressions of interest and for conference structuring purposes. We would like to receive short, clear abstracts, not exceeding 300 words. They should include the name(s) and affiliation(s) of the author(s), title, and summary of content of the intended paper. Abstracts should be e-mailed to aubea-2010 (@unimelb.edu.au).

Referees will review papers only.

Initial paper submissions

Submitted papers should not be longer than 3,000 words and be formatted in PDF, with a file size not to exceed 5mb. Name(s) and affiliation(s) of the author(s) should only appear in the first page, as shown in the paper template below. Papers should be sent to aubea-2010 (@unimelb.edu.au) with 'AUTHOR(S)SURNAME_aubea2010_initialpaper' in the Subject field. If the author is a student, the Subject field should read: 'Student_AUTHOR(S)SURNAME_aubea2010_initialpaper'.

» Paper template (Word, 55 kb)

Format guidelines for the paper are as follows:

Length: 2000 - 3000 words.
Paper size: A4, 1.5 lines spacing.
Margin: 2.5cm top/bottom and 3.5cm left/right.
Title: Times New Roman, upper case bold, 14 point, 24 pt before and 18 pt after.
Text: Times New Roman, 12 point, 6 pt before and 12 pt after.
Main Headings: Bold and all in capitals, 24 pt before and 12 pt after.
Sub-Headings: Bold and lower case, 12 pt before and 6 pt after.
No underlining.
Images, charts and tables should be titled, numbered, and embedded in the text.
Captions: Times New Roman, lower case, 10 point, 0 pt before 24 pt after.
Harvard referencing.

In principle, the structure of the paper should contain an abstract outlining purpose, scope, methods and conclusions, plus selected keywords. The text should be organized in separate sections consisting of introduction, main body, conclusions, and references.

All submissions will be double blind peer-reviewed.

Final paper submissions

All accepted papers must be submitted electronically in their final form as a Word document, to the same address and by 26 June. The Subject should be 'AUTHOR(S)SURNAME_aubea2010_finalpaper', or 'Student_AUTHOR(S)SURNAME_aubea2010_finalpaper'.

All final manuscripts will be included in the electronic conference proceedings subject to peer review acceptance.

CONFERENCE PROCEEDINGS

Conference proceedings will be available as part of the conference package. The technical committee will select the best papers and invite its authors to extend them into chapters for a book on education and research on the management of construction or articles for the *Australasian Journal of Construction Economics and Building.*

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