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# Information


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**Surveying and Built Environment** is an international peer reviewed journal that aims to develop, elucidate, and explore the knowledge of surveying and the built environment; to keep practitioners and researchers informed on current issues and best practices, as well as serving as a platform for the exchange of ideas, knowledge, and opinions among surveyors and related disciplines.

**Surveying and Built Environment** publishes original contributions in English on all aspects of surveying and surveying related disciplines. Original articles are considered for publication on the condition that they have not been published, accepted or submitted for publication elsewhere. The Editor reserves the right to edit manuscripts to fit articles within the space available and to ensure conciseness, clarity, and stylistic consistency. All articles submitted for publication are subject to a double-blind review procedure.

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# Editorial

## PROFESSIONAL ETHICS AND THE UNIVERSITY

> *'The true and adequate end of intellectual training and of a university is not learning or acquirement, but rather, is thought or reason exercised upon knowledge, or what may be called philosophy'.* (Newman)

A global financial tsunami triggered the bankruptcy of the investment bank Lehman Brothers in September 2008. This event, which has hit Hong Kong investors hard, reminds us of the value of prudence and the significance of professional ethics. The danger for professional people occurs when the demand of an employer or client, rightly or wrongly, is considered a sufficient moral ground for being reckless about the public interest. That is one of the key reasons why bank employees actively solicited walk-in depositors to purchase high-risk financial products for which the bank itself was merely an agent. Such employees nowadays are likely to be university graduates.

The message is about much more than professional negligence and the solution is not subject to government regulation alone. The collapse of world-class banks and accounting firms, or rather their failure, may also be considered a weakness in standards that go into creating syllabuses and curricula of some world-class universities. This raises an important question as to the nature of modern education itself.

Closer to home more than one university is craving the acquirement of 'world-class status', thus becoming highly sensitive to outside comment and the findings of university ranking exercises. Its staff have become hyperactive in turning out papers, capturing government research grants, and hiring those capable of so doing. Sadly, what it means to attain 'world-class' status has never been discussed. Local research relevance, sorry to say, counts little in recruitment or promotion as few academics are experienced professionals. 'Local' has become bad, 'international' (meaning foreign rather than comparative) is now good, an erroneous epistemological distinction suggesting a sub-conscious rejection of universal knowledge or values.

What is certain however is that the notion of a university here in Hong Kong is far from inhering a breadth of outlook, turn of mind, habit of thought, and capacity for social and civic interaction, in other words truly *sapientia et virtus,* the motto of the University of Hong Kong.

Virtues? A world-class economist states in his work, *'Do not say that because you are a person of principle, you will never concede on certain principles. Every person has a price, and my soul is saleable. Its price is high. But if you give me huge "benefits" and I only have to concede on some minor principle, then I will make a deal with you. And this is what we call "substitution".'* Indeed, much 'substitution' has been occurring according to prices. Absolute values and principles have few adherents.

Victims of this state of affairs are not only students and the general public but also university teachers, whose real job should be intellectual and educational, and not largely self-focused paper writing and grant hunting for promotion, larger departmental budgets, departmental fissiparousness, personal reputation, higher salary, more travel to international conferences, etc.. There must be a loftier objective beyond being graded and praised by others as 'world-class', a description often in reality associated with man-made disasters.

Employment demands made on the average Hong Kong academic detract from, indeed militate against being valued for ideas and reduce her/him to the condition of begging for favours from school administrators and grantors. The national history of the Manchu Dynasty in suffocating ideas for fear of the influence of intellectuals, by keeping scholars busy with documentary research which had little social or political relevance, provides an apt parallel from the past. There is a need for academics to self-examine seriously their role in the world of learning and in society. Once they start this process, the door for a better future will open.

**Professor Lawrence Lai**
Editor Vol 19 Issue 1

# Call for Papers

## PROPERTY RIGHTS, REGULATIONS AND SUSTAINABLE DEVELOPMENT

Contributions are welcome for the next issue of *Surveying and Built Environment* in 2009 in the fields of surveying and development, with a focus on property rights, regulations and sustainable development. Both theoretical and practical contributions are welcome.

Submissions must not have been published previously and should be in Word format. Submission Guidelines are given at the end of each issue.

Only articles that demonstrate novelty and a theoretical or practical contribution (in the form of propositions and/or verifiable hypotheses) in the context of a rigorous literature review can be considered. Evidence of ethics clearance by relevant institutions must be provided for papers involving human data collected by social surveys.

All submissions will be screened first by the Chief Editor before they are blind refereed. A definite decision by the Editorial Board will be made within 60 days of submission. Comments of referees and editors will be disclosed to authors if their works are refereed.

Please send contributions by email in the first instance to Professor Lawrence Lai (email address: wclai@hku.hk) or any of the editorial members.

Deadline for submission: 31 May 2009

Surveying & Built Environment

# The Reality Versus the Legality of the Demarcation District Sheets

SC Leung*, TPF Sham* and CHW Tang**

## ABSTRACT

By references to the Hong Kong government records in the period of the Demarcation District Survey (1898 – 1905), this article summarizes the background of the creation of the Old Schedule Lots from both the views of the law professionals, the Land Court, and the survey professionals, the Survey Department. Illumination of the nature and accuracy of the DD Sheets leads to discussion on the current uses of the legal land grant plan of the Old Schedule Lots.

## KEYWORDS

Demarcation District Sheets
Cadastral Survey
Land Court
Contractual spirit

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## INTRODUCTION

Much has been published on the Demarcation District (DD) Sheets, but this paper attempts further discussion by referring to more historical documents so as to confirm their nature as the product of an occupation survey. Their reliability is analysed and then followed by a review of the wisdom of treating them as an exact boundary record. The legality of the DD Sheets is viewed in the light of their real nature.

## THE BACKGROUND

Soon after the British assumed complete control of the New Territories in 1898, the Hong Kong colonial government found that the tenure used under the Ching Dynasty was inadequate and that this newly acquired territory was in danger of becoming a white elephant for the administration. There was an urgent need to establish a sustainable land tax system. The Secretary of State for the Colonies, Sir Joseph Chamberlain, in his confidential communication with Sir Arthur Henry Blake, Governor of Hong Kong, dated 6 January 1899, agreed with Sir J.H. Stewart Lockhart, the Colonial Secretary of Hong Kong, that the questions of titles to land in the New Territories should be settled as early as possible. Chamberlain opined that '*Security for all reasonable rights in regard to land will be a great inducement to content and loyalty, and to the popularising of British rule'*. (Colonial Office, 1900, p.115)

Chamberlain also stated that '*the Land question, however, by no means ends here, and there will be much left to consider after the preliminary survey is complete'*. (Colonial Office, 1900, p. 115) The Hong Kong Government later performed a successful land reform in the New Territories where the land tenure problem was duly tackled by the Land Court with the information from the Cadastral Survey. Chamberlain's statement unfortunately foreshadowed that there was no follow-up on the initial land grant survey. Problems surfaced when the grant plans, i.e. the DD Sheets, were used beyond the built-in accuracy to determine boundaries, not to mention meeting present-day development standards.

Several ordinances were enacted between 1900 and 1904 to deal with land matters in the New Territories by the formation of the Land Court. Land claims were made to the Land Court which had set up procedures for demarcation. The procedures were reported by the Hon. H.H.J. Gompertz, Member of the Land Court (1900-1902), and later the Chairman of Land Court (1902-1904) in the *Government Gazette* of 1901 and listed as follows:

> *The initial step is to select and mark out the boundaries of a District and a notification from His Excellency in the Gazette then fixes a date after which the Court will receive no claims in respect of that District. Notices are published directing claimants to attend the Court where the proper forms are filled in for them by the clerical staffs. A demarcation party is sent out and persons are invited to attend and give particulars of*

> *ownership pointing out their land, the outlines of which are then put in on the Cadastral Map with an appropriate lot number. (Hong Kong Government, 1901, p.916)*

The Land Court processed the claims with the DD Sheets outlined with lot boundaries from the claimants, the area calculated in acres to two decimal points, the forms signed by claimants and the Demarcation Books prepared by the Land Court staff. The Land Court treated the DD Sheets as showing the 'exact position' of the lots, the demarcation procedure being laid down as follows.

> *Finally if we suppose that the last day of receiving claims in 'X District' is the 31st July, on the 1st August the Court will be in possession of the following documents:-*
> *(a) Cadastral Maps showing the exact position of every claim.*
> *(b) A statement prepared by the Survey Department giving the areas of every claim in acres to two decimal points.*
> *(c) The claim forms signed by the claimants themselves.*
> *(d) The Demarcation books giving particulars as to ownership, nature of cultivation, &c., collected on the ground.*
> *(Hong Kong Government, 1905a, p.40)*

The Survey Department used the plane tabling method and provided the Cadastral Maps (DD Survey Sheets at 1:1980 scale and 1:3960 scale). The cadastral survey covered the whole of the New Territories and, as reported in the famous Newland report, 328,639 lots in 477 Demarcation Districts were surveyed (Newland, 1904), plus the 20,000 house lots not shown in the 1:3960 scale Demarcation District Sheets also demarcated by the Land Court (*Hong Kong Government, 1905b, p.407*), with a total number of lots around 350,000 lots.

The DD Sheet was registered under the Block Crown Lease[1] as a grant plan where the boundary clause in each Block Government Lease states that "which said piece or parcel of ground is more particularly delineated and described on the plan or plans of Survey District No…". DD Sheets showed the relative positions of padi-fields using field-bunds as boundaries. Limited by scale, the 1:3960 DD showed consecutive houses as shaded blocks, which were individually shown on 1:1980 DD (see extracts in Figures 1 and 2 below). No coordinate framework was recorded on DD Sheets. The Lot Index Plan, as a work of correlation of current features with coordinates onto the DD Sheets, which is obviously not direct legal evidence of boundary delineation on the ground, is of popular use today.



[1] *Block Crown Lease has been renamed as Block Government Lease after 1997.*

Figure 1: A 1:3960 DD Sheet

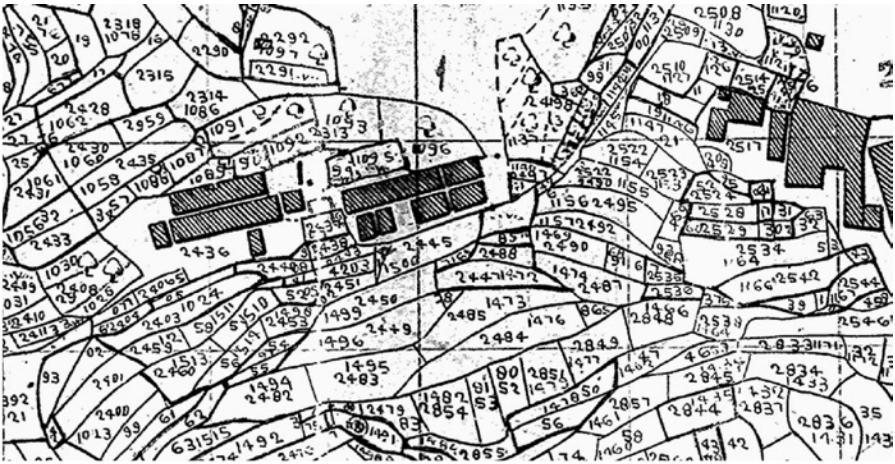
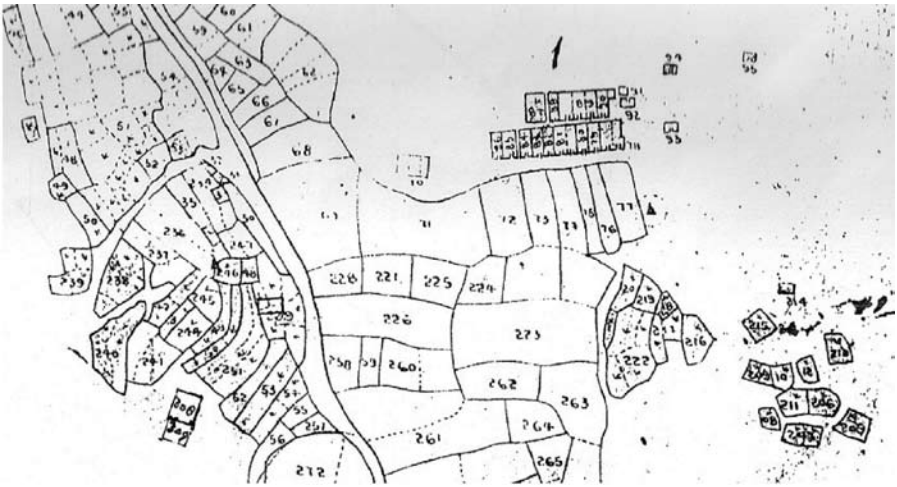


Figure 2: A 1:1980 DD Sheet



## THE NATURE OF THE DEMARCATION DISTRICT SHEETS

There appears to be a popular misunderstanding by legal practitioners that as a matter of law the Block Crown Lease was granted as set out in the DD Sheets and not based on the actual occupation of the lot. This misunderstanding is most unfortunate, destructive and must be fully addressed. The facts are actually that while the former part of this belief is true the latter part is not. The DD Sheets were indeed used as the grant plans in Block Government Leases, yet the delineation and description in the DD Sheets was based on actual occupation.

To discuss the subject of the DD survey fully, the starting point should be the nature of the DD Sheet content. What are the lines therein representing? According to the history of the DD survey, the lines were intended to represent physical features actually existing on the ground at the time. Documentary evidence includes:

(a) Proclamation to NT Villagers, 1899.
The Chinese proclamation, issued by His Excellency Sir Henry Arthur Blake on 12 July 1899 to the NT villagers, declared the intention of the DD survey. This proclamation was contained in the *Supplement to the Hong Kong Government Gazette* No. 26 of 28 April 1900. The English version of this is as follows:

> *All you owners of land must report all the land in your possession. Should it be found at any time that land owned by any person had not been reported, it will be treated as Government land. A survey will shortly be made of the whole of the Leased Territory, so that the boundaries of the various holdings may be clearly known. (Hong Kong Government, 1900, p.383)*

The proclamation indicated that the DD survey objects were the physical features representing the then existing land holdings in possession of the owners.

(b) Land Court Report, 1901.
Hon. H.H.J. Gompertz as a member of the Land Court signed the report of the Land Court on 4 March 1901. This report contained the relevant survey information: *'A demarcation party is sent out and persons are invited to attend and give particulars of ownership pointing out their land, the outlines of which are then put in on the Cadastral Map with an appropriate lot number' (Hong Kong Government, 1901. p.916)*. This document revealed the same message that the lot boundaries were recorded according to occupation features as pointed out on the land.

(c) Land Court Report, 1902.
The report on the New Territory, for the year 1901 published on 1 May 1902 in *The Hong Kong Government Gazette* also by Hon. H.H.J. Gompertz but this time as President of the Land Court. As part of this report, Hon. H.H.J. Gompertz mentioned about his instruction to the Demarcators that, in

order to save time of revisiting a site, *'all ground under actual or recent cultivation is to be mapped and given a lot number, whether an owner is immediately forthcoming or not' (Hong Kong Government,* 1902a, pp. 700-701). The message to note is that the mapped features must be in actual cultivation.

(d) The Demarcation Rules, Land Court, 1902.
In the opening paragraph of appendix A to the report (c) above, it is stated that *'The objective of Demarcation is to ascertain on the spot the exact position and area of each individual holding' (Hong Kong Government,* 1902b, p.704). Its rule number 4 reads that, *'...mark out the limit of the lot carefully with bamboos, one at every angle and give it a lot number' (Hong Kong Government,* 1902c, p.705). This document may further strengthen the understanding that lines on the DD Sheet must be the physical limits of land holdings.

(e) Newland's Survey Report, 1904.
This was the general report on the survey of the New Territory from November 1899 to April 1904, written by Mr W. J. Newland, the surveyor in-charge, on 11 May 1904. In this report, it is mentioned that: -*'they (the surveyors) marked the various holdings as pointed out by the tenant ..'*.(Newland, 1904). This report confirmed all that had been quoted above.

(f) The Schedule of the Block Government Lease, 1905.
The Schedule recorded in its remark column *'padi fields, house, latrine, etc'*. These textual descriptions of physical features corresponded with the DD Sheets descriptions which represented the physical features, not just lines created out of any design or authoritative rulings.

(g) The Symbols in the DD Sheet, 1905.
On the DD Sheet, there are various symbols which can be proved to represent embankments, building lines and field bunds. This form of depiction in the sheet must indicate that the sheet contents were reflecting what the surveyors actually saw otherwise just single lines would have represented all boundaries. Furthermore, the lot boundary lines on DD Sheets were later compared with the old aerial photo details. They tallied and thus indicated the occupational nature of the lines on DD Sheets.

With the above evidence, the fact that the DD Sheets contents did represent ground features at the time of the survey period (circa 1899 – 1904) should be well established.

What needs to be discussed next is whether the DD Sheets are good representatives of the ground features or not and, if not, should a blind faith be attached to their face value as the boundary record?

## THE QUALITY OF THE DD SHEETS

The second point for discussion is therefore the quality of the DD Sheets – whether or not it is really poor.

Given the situation and the assigned purpose, the DD Sheets were not too bad for achieving their function one hundred years ago. However, in fact, some DD Sheets did contain large errors. Definitely, the DD Sheets can no longer serve the need of present day developments. Evidence of their poor quality includes the following.

(a) Survey Report of Mr Geo. P. Tate, 1901.
Mr Geo. P. Tate, surveyor in charge of the Kowloon Survey Department, made the survey report of the New Territory, at the close of the field season of 1900-1901, on 15 July 1901 (*Hong Kong Government*, 1902d, p.708). The report stated that *'the nature of the country is broken and mountainous, and the greater part is some of the most difficult country that I have ever seen'* (ibid) .

In view of the difficult surveying environment, coupled with the smallness of the mapping scale, the poor hygienic situation and the inadequate supply of trained staff, this primitive plane-table survey had already produced location and area reference for the Land Court in the preparation of the Rent Roll. The following historical description by Mr Tate may be of interest: -

> *4. ...Indian experience does not help one very much, as the conditions are so very different in the New Territory, and it is better and safer, in the absence of all previous information such as a summary settlement would provide, to work slowly, establishing every step taken in the preparation of the Rent Roll, with the map of individual holdings at hand for purposes of reference* (ibid, p.708).

(b) Report on the New Territory, 1901.
The Colonial Secretary, Sir J.H. Stewart Lockhart, made the report on the New Territory, for the year 1901, on 22 March 1902. The survey part of this report mentioned the reason for changing the survey scale from 16-inch to the mile to 32-inch to the mile by saying that: *'it was impossible to represent the small terraced fields or the survey in detail of the villages on the scale of 16-inch to the mile' (Hong Kong Government,* 1902e, p.696). This was in support of the above showing that the difficulty of the survey was real.

(c) Survey Errors discovered in 1901.
In changing the survey scale from 16-inch to the mile to 32-inch to the mile, some areas were resurveyed. Even after a lapse of just a few years, the resurveyed boundaries were often found not to agree with those in the earlier survey. This is evidenced from the said Newland's report. The relevant contents are now quoted as follows:

> *'No. 4 District was originally surveyed on the 16-inch scale in January, 1900, and, after an interval of nearly 3.5 years, a resurvey was made on the 32-inch scale. In this interval a great many changes had taken place. ... Consequently the areas of claims as derived from the two surveys will not in all cases agree'.*
> *'... The boundaries of these claims*

*in the original survey were so vaguely given, that they could not be pointed out again exactly, for the resurvey, even by the claimants themselves. Hence a margin of difference must always be allowed, even where the face of the ground has not undergone alteration. ...'*

*'The larger scale of the second survey allows more detail to be shown; hence a margin of difference must be allowed in the smaller cultivated lots even where the boundaries are unchanged'.*

*'I might add that in all big Cadastral Surveys, it is found impossible to make a resurvey tally exactly with the original, ... the difference between two surveys when put in figure form in the area column, lot for lot, though they seem alarming to the non-professional eye, have regularly to be discounted as absolutely unavoidable.'*

W. J. Newland said it all, and convincingly, that a boundary survey could never be exact particularly when mapped in a small scale. Yet, he was resurveying only at double the scale and an interval of 3.5 years. What can we expect nowadays when we are to resurvey one hundred years later and at a true scale, i.e. in coordinates of mm precision, being 2000 or 4000 times the scale of the DD Sheets. W. J. Newland must be respected as the author of the DD Sheets and his remarks on the achievable reliability cannot be ignored.

(d) Newland's Survey Report, 1904.

Newland, 1904 basically repeated what Sir J. H. Stewart Lockhart had said, that *'As the cultivation in the hilly Districts remaining to be surveyed, consisted of small terraced fields running up hillsides and narrow valleys, the average size of the field was so small that it was found impossible to represent such minute detail on the 16-inch scale with any degree of utility.....'.* The impact of the survey difficulty on the quality of the DD Sheets can be imagined.

(e) The advice on the updating of the DD Sheets by invited eminent surveyors.

This advice included that made by the British Surveyor General, Mr Winterbothem in 1929 and Brigadier Eartine Hotime in 1959 who both expressed the same view that the DD Sheets needed revision and up-dating before they might serve as the proper boundary record. (Leung, 1986)

(f) Examples of some poor DD Sheet content.

There is no lack of examples that the DD Sheets contained blunders, such as that a row of village houses in Tap Mun is found to fall partly in the sea area whereas the authentic village houses are lying parallel to the shoreline at about 70 degrees difference in orientation. Somewhere near Sha Tau Kok, a village of 10 houses in a row is shown in the DD Sheet as only 5 in number. A portion of a DD Sheet at Ma On Kong is found to be noticeably different from the Double Lot Sheet which should be more original than the DD Sheet. Many lots along the edge of a DD Sheet conflicted with the lots along the matching edge of the adjoining DD

Sheet whereas these two groups of lots should share common boundaries. Some buildings in Cheung Chau contain lines joining the diagonally opposite wall corners as the lot boundaries. It is common knowledge to surveyors that a DD Sheet can be full of survey, plotting, and tracing errors.

(g) The Sampling Survey of the Area Discrepancy.
Land surveyors have a good understanding of the quality of the DD Sheets as the boundary record. If DD Sheets are used at their face value, i.e. accurate to the registered units of 0.01 acre, Tang, Lam & Cheng,(2003) pointed out that 35% of the lots (sampling size - 15 DD Sheets) in 1: 1980 scale, the DD Sheets mismatched with the graphic area on the DD and 62% of the lots (sampling size - 6 DD Sheets) in 1:3960 scale mismatched with the graphic area. The research result indicated that one-third and two-thirds of the 1:1980 scale DD Sheets and 1:3960 scale DD Sheets respectively have area discrepancies. In area discrepancies, 10% of them exceeded one-third of the registered area.

According to the above, the DD surveyors as the authors of the DD Sheets, the Survey General/Brigadier as the advisors and the contemporary land surveyors as the expert users all pointed out the unsatisfactory quality of the DD Sheets. The inadequacy must be established beyond the least possible doubt.

## THE USE OF DD SHEETS AS A LEGAL BOUNDARY RECORD

Unfortunately, the DD Sheets were regarded as gospel by many people. Administrators referred to them for land grants and various boundary enforcement, landowners referred to them for transactions and boundary disputes, judges referred to them for court rulings and surveyors might also refer to them for boundary re-establishment. Even when the inadequacy of the DD Sheets is established, people still dare not challenge their legal status for fear of exposing more problems.

Regarding the DD Sheets as the only legal document for re-establishing the boundaries appeared to be based on the spirit of contract and the declaration in Indenture of the Block Government Lease that the boundaries are ‘as particularly and described in the plan’. Are these two aspects really indisputable? We take them as our third point for discussion.

(a) The Contractual Spirit.
According to the history as revealed above, the DD Sheets were only an ad hoc product not submitted to any stringent quality control. If a sheet was foreseen as the perpetual boundary record, a better checking mechanism should have been devised to scrutinise the accuracy of its content. Although this one-sided contract has been continuously used by people for nearly a century, the Block Government Lease still lacked the signatures of

the grantees. Needless to say, the grantees had never been represented by any surveying experts at the time of registration. For a responsible Government as the initiating party, such an ill prepared contract must be treated with care. If not, the Government may in fact be facing a possible risk of misrepresentation.

(b) The Boundary Clause in the Indenture.

The phrase *'particularly delineated and described'* should indicate the relative hierarchy of the lease content and the DD Sheet. Naturally, the plan as the better medium to describe the boundary must dominate. However, it should not preclude the referral to the ground monument which is the subject of description by means of DD Sheets, Schedule as well as the derived registered area, as the superior boundary evidence. Taking the identity card as an analogy, the lease content corresponds to the printed name on the identity card and the DD Sheet to the photo. While the photo must be more representative than the printed name in identifying a person, none of these two should prevail over the person himself as the best identity. This way of identifying the boundary should have no violation of the spirit of contract.

(c) The Need for Plan Interpretation.

Every line in the DD Sheets can therefore be regarded as conveying two messages, viz. the graphical position of a boundary and the representative nature of a physical feature. The line position should not be accepted on its face value but must be subject to a professional interpretation to identify what is the feature it represented. In case a physical feature is discovered in close proximity to a line on the DD Sheet and proved to be the authentic boundary, this feature must be accepted as overriding the plan position. If the representative nature of the DD content is ignored, only half of the value of the contract document is considered and should not be the correct approach.

(d) Critical Wordings in the Original Land Grant Exercise.

To complete this part of discussion, two more points must be addressed. Firstly, the use of the term 'exact position' in the Land Court Report on work from 1900 to 1905 and secondly, the adoption of acre (expressed to the hundredth of it) as the area unit in the Schedule.

The statement *'Cadastral Maps showing the exact position of every claim'* appeared in the Land Court Report of 1902 as has already been quoted in the Background section above. Apparently, this document seems to be the very source of misunderstanding prompting legal practitioners to treat the grant plan as 'exact' from the outset. If the word 'exact' is interpreted in its correct context and against the historical background, it must refer to the true possession of individual claims of land such that an owner must not over claim or dishonestly claim. The term could only be taken in a literal sense but never to connote any scientific significance. In no way should this term be dictating our interpretation of the DD Sheets content as above discussed.

Regarding the area measurement unit of one hundredth of an acre, the crudeness

of the survey is clear. The subsequent conversion of areas to square feet (then further to the tenth of a square metre) was only a paper exercise which was indeed illogical. It may be noted that in 1966 when the area conversion exercise was underway, a land surveyor, Roy Davey, in his report [paragraph 7 of folio 1 of Government file no. NT 5/196/66] specifically warned of the inadvisability of the conversion concept.

If the Government is to consider the registered area as a committed grant condition, the converted figure in footage should be discounted. Only the area in acreage should constitute the committed item. To interpret the DD Sheets intelligently and the registered area as the content of a contract should be conducive with the spirit of contract. This interpretation exercise is distinct from 'changing' the boundary or the area and no alarm should be caused.

## CONCLUSION

To recapitulate the foregoing, we have established the few points that:

Firstly, the DD Sheets were to depict actual occupation features for owners to claim their land holdings. All past survey and administration documents may serve as the strong evidence to support this assertion.

Secondly, the DD Sheets though not too bad for their original fiscal purpose, were inadequate to serve as a conclusive boundary record. The crudeness of the DD Sheets is readily evidenced. Hence, the DD Sheets must be subject to interpretation particularly by referring to ground monuments if available.

Thirdly, even if the contractual spirit is considered, the DD Sheets should not be accepted solely on face value. Their legal status must be viewed in the correct perspective of how they were produced and what they had attained. Their role can be likened to the sketch of an artist who never claimed it as final, but the sketch was snatched off the drawing board and used for actual construction. The role of the sketch must not be confused with the final drawing yet to be produced.

We must recognize the historical truth and treat the DD sheets according to their real value.

## ACKNOWLEDGMENT

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Surveying & Built Environment

# Transfer of Development Rights Approach: Striking the Balance between Economic Development and Historic Preservation in Hong Kong

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## ABSTRACT

Can the Transfer of Development Rights work in Hong Kong? This paper looks at the fundamentals of the TDR; the current control on property development and its effect on heritage buildings; the conditions for applying the TDR in Hong Kong; and examples of completed TDR cases, before concluding that the future looks promising for TDR applications here. It examines certain TDR cases like the early Letter B land redemption certificates; the redevelopment of the Hoover Theatre into the Paliburg Plaza and Regal Hotel in Causeway Bay; the HSBC Tower at 1 Queen's Road Central; Tai Fu Tai at San Tin, Yuen Long; the Morrison Hall in Tuen Mun; the well-known case of the Ohel Leah Synagogue on Robinson Road, Mid-Levels; and the recent case of King Yin Lane at 45 Stubbs Road. With the establishment of the Development Bureau in July 2007 overseeing planning, land, buildings, works and heritage, it is possible to find the fulcrum between economic development and historical preservation.

## KEYWORDS

Transfer of Development Rights
Balance
Economic development
Historic preservation
Hong Kong

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## INTRODUCTION

Based on a UNESCO-sponsored conference paper in 1999, Cody (2002) wrote an interesting article on the Transfer of Development Rights (TDR) as an incentive for historic preservation in Hong Kong. After examining the strengths and weaknesses of five TDR-related cases of the 'Letters B' land redemption certificate (Nissim, 1999); the Lee Theatre; Pun Uk in Yuen Long; the London Mission Building; and Cheung Kong Centre, he was cautious about the viability of this incentive scheme in Hong Kong.

After a brief introduction, this paper will consider the fundamentals of TDR; the current control on property development and its effect on heritage buildings; the conditions for applying TDR in Hong Kong; and examples of completed TDR cases, before coming to the conclusion that the future looks bright and sunny for TDR applications here.

The establishment of the Development Bureau in July 2007 - which puts planning, land, buildings, works and heritage under one roof - makes it possible to find the fulcrum between development and preservation.

## FUNDAMENTALS OF TDR

*Early Practice of the Transfer of Development Rights*

The TDR can be applied in Hong Kong as an effective tool in preserving many of the heritage buildings under threat and at minimal public cost. Interestingly, Hong Kong has pioneered and practiced a form of the TDR since the 1960s. The government implemented a land redemption certificate system for land resumed in the rural area, which was commonly known as the Letters A and B. Lai (2000) argued that the Letter A/B system had the beauty of settling compensation for resuming rural land in the New Territories for small house development with minimal government spending.

This worked so efficiently in the transfer of development rights that Cody (2002) suggested resurrecting the Letter B system. He also lamented the unfortunate case of the Lee Theatre[1] in Causeway Bay where no transfer of plot ratio was permitted under the rigid planning and density control mechanism for 'non in-situ sites'.

*Rationale behind the TDR*

In essence, the TDR is the transfer of surplus development rights from a sending site to a receiving site. Commercially, the transfer of surplus development rights from one lot to another enables a developer to increase density at the receiving site in a popular district so that he can reap higher profit. In the United States, developers benefit from the clarity and consistency that the TDR programmes offer (Pruetz, 1997), and they make development more predictable. The sending lot owner can realize his unused development rights and recoup a lump sum from the sale.

It can be argued that the difference between the existing and permissible plot ratio can be transferred and traded openly in the market place.

Proceeds from these sales could be used for preservation, maintenance or improvement of the historic heritage buildings. This would perhaps help to ease the burden on public spending and provide an incentive for private owners to maintain their private lot.

*Need for Sustainable Development*

In his Policy Address the Chief Executive spelt out a policy statement on heritage conservation which was endorsed by the Executive Council in 2007. Increasingly, the public is concerned about the hidden environmental and social cost of development. This is expressed in outcries and sometimes by radical actions taken by green groups, consumer advocates and political parties. Conservation and economic growth are not mutually exclusive and are in fact compatible with each other. The need is to strike the balance between preservation and development.

*Theoretical Basis*

Increasingly economic considerations are taking precedence over cultural, political, social and aesthetic values when it comes to making decisions and in allocating resources for conserving cultural heritage. This trend is occurring in many countries and often decisions about what and how to conserve are strongly influenced by economic considerations. The Getty Conservation Institute (GCI) of the United States has conducted in depth studies and attempted to bridge the gap between economic expansion and cultural conservation. The GCI invited various prominent scholars to participate in their research and published their findings in a series of paper in December 1998.[2]

Government intervention can be in the form of issuing administrative orders against demolition; incentives measures like permission for transferring development rights, and direct funding in repairing heritage sites. King Yin Lane was saved this way when the owner and the Government reached an understanding on 25 January 2008. The owner will surrender the whole site to Government after restoration and an adjacent slope site of similar size will be granted to the owner for the same development parameter of 0.5 plot ratio and maximum three storeys, see http://www.amo.gov.hk/en/news_20080711.php.

## CURRENT CONTROL ON PROPERTY DEVELOPMENT AND ITS EFFECT ON HERITAGE BUILDINGS

*The Harsh Reality Facing Owners*

The harsh reality for cultural conservation is that the market demand for properties has been so intense that prime sites with development potential are very much sought after. As evident in older areas like Sheung Wan or Wanchai, many pre-war buildings could only provide low return for their owners because of their old age, functional obsolescence and rent control measures. In the meantime commercial retail activities and large-space users had expanded and moved to other popular commercial areas. While government subsidies on repair and maintenance for private heritage buildings were

virtually unheard of until lately, there was little incentive for owners to hold on to dilapidated or under-developed structures, which offered low income.

*Existing Control Over Building Development*

The Planning Department, Lands Department, and Building Department are the key bodies that look after and maintain control on the real estate and building development relying, respectively, on the Town Planning Ordinance, the Government leases and the Buildings Ordinance and administrative Practice Notes (Lai, Ho and Leung 2004) .

It is worth mentioning that the government has taken the view that terms of the Government leases can be varied to allow changes in the use of land. This can be for a longer term in the form of lease modification or land exchange, or for a temporary basis such as short-term waivers for minor changes of uses. These changes of lease conditions form a solid base for land related income to government.

*Compensation to Owners of Declared Monument Buildings*

The relevant Ordinance governing compensation for land resumption for conservation purposes is the Antiquities and Monuments Ordinance (Cap 53) enacted in 1976.[3] Its main purpose is to protect historic buildings and antiquities in Hong Kong. The spirit of the Ordinance allows the authorities to preserve significant historic structures for the public's benefit and for the enjoyment by future generations.

Frequently, when a site of historic interest is under threat or is about to be demolished, the government announces in a *Gazette* notice a proposed monument status for the site. There were two occasions when the proposed monument status was used, firstly in the case of the Ohel Leah Synagogue in 1986, and in the case of the Morrison Hall at Tuen Mun.[4]

Ohel Leah Synagogue

Morrison Hall

**Figure 1: Government declared a proposed monument status for both the Ohel Leah Synagogue and Morrison Hall in order to preserve the buildings.**
*Source: photo by Raymond Chan*

A Declaration of 'proposed status' is valid for twelve months and may be extended. However the affected owner may object to the 'proposed' status. If an objection fails, he can make an appeal to the Chief Executive (CE). The CE may direct the declaration to stand, vary the declaration or withdraw the declaration altogether. The CE's decision is final and is not subject to review by the Court.

Currently there are over 80 declared monuments in Hong Kong http://www.amo.gov.hk/en/monuments.php, but because of the discretionary compensation system, the Authority has issued declarations sparingly. However, extensive surveys for heritage buildings have been conducted and a record of the locations of important heritage buildings is kept by the Authority. In 2007 the Government listed nearly 500 buildings in Hong Kong as historical buildings, but King Yin Lane was not on the list.

## CONDITIONS FOR APPLYING THE TRANSFER OF DEVELOPMENT RIGHTS IN HONG KONG

In order to make the TDR a success in Hong Kong, it is necessary to establish an efficient, open, fair and transparent system so that there is clarity and a reasonable procedure for the public to follow. The Hong Kong experience and additional control mechanisms required for implementing the TDR are considered here.

### *Lessons from Letters A and B*

Hong Kong practiced some kind of transfer of development rights in the form of land redemption certificates commonly known as Letters A and B during the 1960s to 1980s. According to the former Director of Lands, Bob Pope,[5] these redemption certificates were issued to fulfill the desire of indigenous New Territories landowners for owning land. Pope argued that an attachment to the land was established long ago as the rural community had by tradition made a living through farming and were dependent on land to survive. Major clans had owned land for generations and were influential in local politics, as such their co-operation was beneficial in new town development and the government was keen to appease them by offering two square feet of building land in exchange for five square feet of agricultural land resumed. Building land surrendered was exchanged on a foot for foot basis.

In the final phase of operating Letters A and B, the government was concerned that there was insufficient land for redemption by certificate holders. The issuance of Letters A and B came to a halt in the early 1980s. A flexible approach was made and the government allowed Letters A and B to be used as cash in land premium payment, rates and government rent. In the mid- to late-1980s, most remaining Letters A and B ended up in the hands of major developers like Henderson and Chinachem. They were allowed to bid for prime sites in the new town areas such as sites near the Shatin Race Course. Huge profits were made following the soaring property prices, and developers were able to move

**Figure 2: Large amounts of rural lands were resumed using Letters A and B. These agricultural lands were turned into developable land thus making room for massive housing projects and the construction of railway lines. The above shows a traditional Chinese pagoda at Ping Shan in the foreground and public housing estates in Tin Shui Wai.**
*Source: Photo by Raymond Chan*

these remote rural development rights around without much restriction. Lai (2002) believed that as well as opening up new development areas in the New Territories without offending the indigenous villages, the certificates of land entitlements method also promoted urban renewal in the old urban areas, and hence more balanced development in the core and peripheral areas.

One could argue that the Letters A and B system had taken a different role from its original purpose and became a form of TDR. In most cases the original rural sites being compulsorily acquired were in places like Yuen Long, Tuen Mun and Taipo. Through trading, the passage of time and eventual redemption, building land lots were granted to developers in places such as Tsuen Wan and Shatin thus transferring development rights across districts. Because of this measure the government was able to assemble land and to complete important infrastructure projects with minimal administrative cost or use of public funds.

**Additional Requirements for Implementing the TDR**

Costonis (1974) mentioned a number of requirements in order to facilitate implementing the TDR, and in the context of Hong Kong the following are suggested:

*Designation of TDR Transfer Districts*

A TDR Transfer District is an area or boundary within which development rights can be transferred. In order to allow easy TDR trading and treating

them like ordinary daily sale of properties, it is suggested that TDR sales could commence from trading of rights between similar land lots within the same district. For instance, property rights of commercial/residential zoned sites in an area like Wanchai can be traded within Wanchai.

A TDR transfer district boundary for an urban area of Hong Kong should adopt and follow existing Outline Zoning Plan boundaries. The advantage in using OZP Plans is that most land use zoning restrictions are well defined and their density control specified. With these Transfer District Boundaries in place, further analysis can be made to ensure that the first transfers could take place between sites of similar zoning restrictions, characteristics and land value in order to smooth the way forward.

*Heritage Assessment Certification*
A comprehensive survey check list for heritage properties including confirmation of title ownership, formulation of statements of significance, existing use value, potential development value, layout plans, structural defects, unique repair problems and remedies required can be prepared prior to conferring the TDR status. Such a comprehensive survey certification process is needed to establish a base line for quantifying the TDR values for heritage structures and for determining possible remaining surplus development right values available for a property. Hong Kong has a sizable pool of building professionals and consultants, and their talents can be used in formulating a high standard of reporting for heritage assessment and TDR purposes.

*Valuation for Transfer of Development Rights*
It is suggested that the valuation of Development Rights should be made on a basis similar to resumption of land by the government. This should enable easy administration and allow officials to follow precedents established in similar situations. In fact, the Lands Tribunal has been operating successfully for many years, and over the years, a large number of precedent cases have been built up for assessing compensation for land development rights. Such experience is crucial in formulating a solid base for quantifying and assessing the transfer of development rights in Hong Kong.

As in most land resumption cases, the main principle for assessing land compensation is based on the differences in the open market value before and after a declaration of resumption. This involves the assessment of existing land-use value against possible value after lease modification or change in permissible density and uses.

Accepted Lands Tribunal valuation methods include a 'comparative method', 'residual valuation', 'investment method', 'contractor's method' and 'profits method'. Of these, the 'comparative method' is widely used and preferred by the Lands Tribunal.

*Possible Legal Instrument for the TDR*
There are cases where a successful

application of the TDR principle has been achieved, for example, in the case of the redevelopment of the Hoover Theatre into the Paliburg Plaza and Regal Hotel at the junction of Yee Woo Street and Pennington Street, Causeway Bay.

These adjoining sites comprise two plots of land, and the developer has transferred surplus plot ratio from the office tower portion onto the hotel site. This arrangement proved beneficial as the hotel portion is extremely profitable. The surplus development rights were put to proper uses. If the office lot (Paliburg Plaza) were to be redeveloped, its maximum plot ratio permitted would be equivalent to its existing bulk.

As regards enforcement of the TDR in Hong Kong, instruments such as restrictive covenants can be used. As in the case of the Paliburg Plaza and the Regal Hotel, a restrictive covenant was executed between the parties and registered at the Land Registry. The document stated clearly the transfer

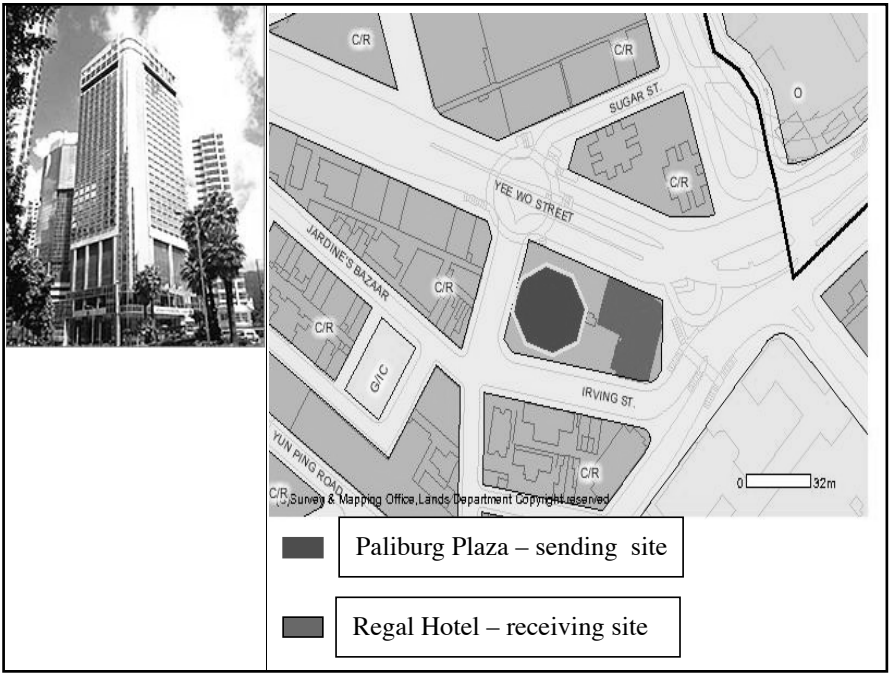



**Figure 3: Paliburg Plaza as shown colored red has transferred its surplus plot ratio to adjoining Regal Hotel shown colored blue. This has resulted in increased floor area at the hotel than what would have been permitted under existing Building (Planning) Regulations.**

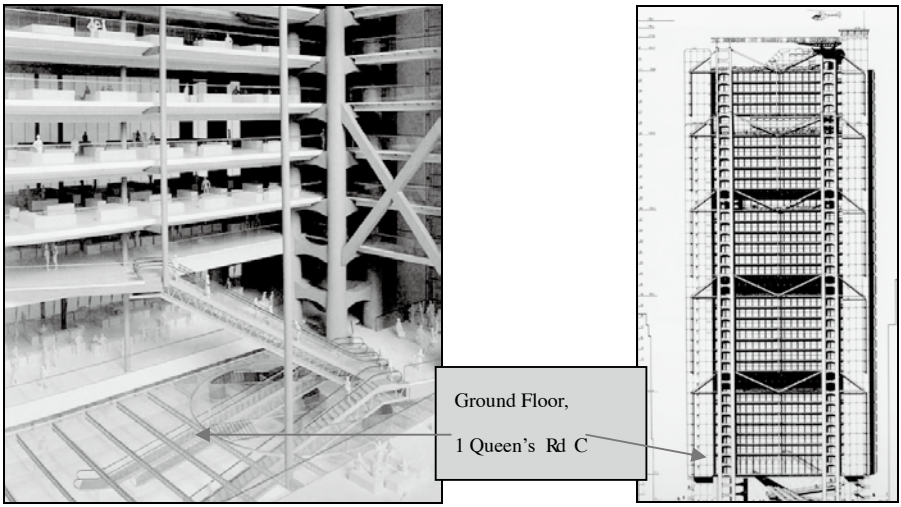



**Figure 4: Ground level of the HSCB Bank Main Building at 1 Queen's Road C. The creation of the plaza at ground level has resulted in an increased plot ratio for the building by 20 % (Lambot & Chamber, 1986).**

of rights between the lots and the permanent diminution of development rights on the sending lot.

*Incentive Zoning and Bonus Plot Ratio*

One important building planning control concept is incentive zoning, better known in Hong Kong as bonus plot ratio, which is related to the TDR. New developments bring about higher density, increased traffic flow and generally impose additional burdens on existing infrastructure. In order to ease congestion, additional open spaces or public amenity areas are needed. The authorities have been encouraging developers to provide these amenities by granting them bonus plot ratio. The intention is to encourage the developer to dedicate part of his site for public amenity purposes. In return he is compensated in having a higher density than would normally be permitted. For example, in the case of the HSBC Tower at 1 Queen's Road Central, where the ground level is used for public passage, in exchange the Bank was allowed additional floor spaces in the upper floor office portion.

There is a limit to the extent of the permissible bonus. By a rule of thumb, the dedication of one square foot of ground floor space will gain five square feet at the upper floor level in Hong Kong.[6] The intention is to compensate owners with an equivalent amount of space for his effort, so that he is not better or worse off than before. Granting of a bonus plot ratio is the prerogative of the government and it is not a compulsory act.[7]

**Summary**
Hong Kong has a well-defined Buildings Ordinance; an established outline zoning plan system under the Town Planning Ordinance stating the specific density permissible in most urban areas or districts; an efficient bureaucratic framework for land administration and registration, and a well-established legal and court system for land compensation cases. Therefore it is well equipped to launch the TDR.

The real estate industry is accustomed to the planning regime and regulatory controls. With the help of the anti-corruption agency there are limited cases of official impropriety. This has helped to lay the ground for launching the TDR.

Hong Kong's law courts are well experienced in dealing with claims or counter claims in land-related court cases, and precedents for land resumption, compensation valuation and related decisions are plentiful. We have a solid judicial system that is well accustomed to offer fair compensation for cases involving land interest disputes. The TDR can be easily accommodated in the Lands Tribunal, District Court or Court of Appeal situations.

## EXAMPLES OF COMPLETED TDR CASES IN HONG KONG

*Transfer of Development Rights for Adjoining Sites*
This type of TDR sites must be contiguous or next to each other. But not all heritage sites have the benefit of being next to another lot ready for development. Many of the heritage sites are surrounded by buildings of different ages or held under fragmented ownership. As developers have no obligation to consider preservation as a compulsory step in building plan submission, they forego conservation opportunities when it seems convenient. Therefore matching suitable transfer sites can be difficult. For this reason a limited number of contiguous site transfers have taken place.

*Completed TDR for Adjoining Sites*
The case of Tai Fu Tai[8] is one example of the TDR of contiguous sites. Tai Fu Tai is a grand, official mansion built by Man Chung-luen in 1865 at San Tin, Yuen Long. Lengthy negotiations between the owners and the government took place and in exchange for preserving the site, the government agreed to exchange land at an adjoining lot, allowing it to be developed for residential use. Tai Fu Tai was restored in 1986 and was hailed as a major success for heritage conservation at the time. The adjoining site is now used as a low-rise residential housing project.

The other well-known case is the Ohel Leah Synagogue[9] in Robinson Road, Mid-Levels. In the case of the Synagogue conservation, transfer of development rights for adjoining sites took place. In this case the developer, Swire, joined with the Synagogue and used its surplus plot ratio to develop a twin residential tower block on an adjoining site. The development is a commercial success as it has achieved a successful transfer of development


**Figure 5: Tai Fu Tai is an example of adjoining site TDR, the dotted line area behind Tai Fu Tai mansion is developed into a residential complex using government land in exchange for conservation of the grand mansion.**
*Source: map from www.centanet.com and photo by Raymond Chan*

rights between sites and the developer was rewarded with a handsome profit.

*Transfer of Development Rights for Non-Contiguous Sites*

Like the TDR at adjoining sites, TDR for non-contiguous sites is a common practice outside Hong Kong. In the United States, the technique has been in use since the 1970s and improved versions are now used in preserving important heritage buildings and land resources such as farmland, rain forest, dessert, swamp, and areas of special

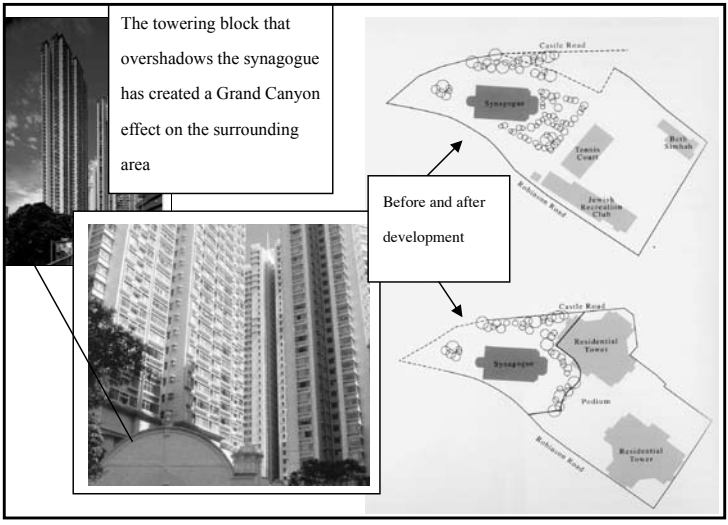
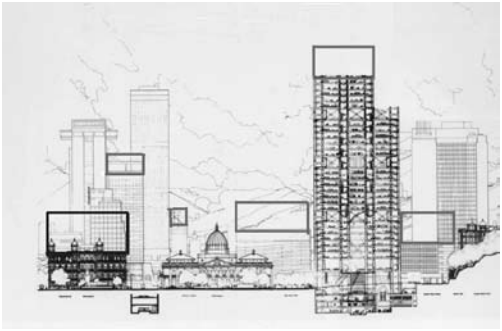



**Figure 6: Plan of the Synagogue and Robinson Place (McDougall & Pettman, 2000)**
*Source: photo from Swire Group Annual Report*

scientific interest (Pruetz, 2003). In Canada and Australia, owners of non-contiguous sites can sell their unused development rights in return for cash to refurbish or preserve heritage buildings.

Similarly, non-contiguous site transfer allows development rights to move from a sending lot and go where they are needed. In the case of Hong Kong we propose that the surplus development rights could go to other sites within the same Transfer District. Surplus development rights could be traded and travel to other sites elsewhere, and not be restricted to an adjoining plot.



The landmark building (A) utilizes only a fraction of the development rights of the site, the remainder of which (B) are transferred to various other sites within a transfer district and appears as additional bulk (C) on neighboring buildings

**Figure 7: TDR for non-contiguous sites**

Another possibility in Hong Kong is to allow redistribution of surplus development rights to different parts of a TDR Transfer District in contrast to confining all transfer on to a single receiving site. The difference between non-contiguous transfers against bonus plot ratio is that it aims to redistribute permissible development rights designed within a district and not to create new ones. When additional bonus development rights are awarded to owners, it is in essence creating additional spaces above what was originally planned within an area. But the non-contiguous TDR simply redistributes and does not disturb existing density or upset infrastructure limits.

## CONCLUSION

Heritage buildings can be considered as a form of public goods in that no one can be excluded from enjoying them. Government intervention in these areas could be in the form of funding, in regulating and administration of these services. While competition for public resources by different interest groups, lobbies and different agencies is relentless, the TDR permits the tapping of an important resource within the heritage building stocks. Generating funds from heritage buildings through the application of the TDR can allow money to be expended for on-going maintenance and repair. The involvement of private property owners is essential, as they also hold the key to the success of the TDR. However, the government should take the lead in conservation and implementation of the TDR in forming bodies like a Land Development Rights Bank.

If the TDR is in place, heritage-building restoration could be self-financed and these restored buildings could continue to generate a reasonable economic return. Thus the TDR could help to shift the attitude of favoring redevelopment and allow owners of old buildings to have an option in restoration. These incentives could change the public perception of heritage conservation. Developers would think more carefully whether there can be profit from restoration. Redevelopment need not be the only profitable option.

Local heritage conservation will gain more if consideration can be given to including the TDR, so that the redevelopment potential from heritage sites can be turned into a useful asset for both the property owner and a benefit for the public. Bold steps put forward by the then Secretary for Planning and Lands, Mr John Tsang, back in 2001 should be in place so that the TDR could work, namely:

To designate heritage areas instead of just individual historical buildings;

To transfer GFA credits from a sending site to a receiving site that are not contiguous; and

To relax the maximum plot ratios and site coverage permissible under the Building (Planning) Regulations and the statutory town plans.[10]

With the proactive steps taken by the Development Bureau in trying hard to preserve such historic buildings as King Yin Lane and the Jessville on Pokfulam Road, there is some light at the end of the tunnel. As the Chief Executive put it in his Policy Address 2007: 'I can assure you that we are adopting a very positive attitude towards heritage conservation. We feel that the time really has come for us to treasure the sense of place, the sense of identity that this generation has developed and attached to Hong Kong's cultural history and the past so that we have a story to tell for our future generations'.[11]

## ACKNOWLEDGEMENT

The contributions by Mr Raymond Chan to this paper are gratefully acknowledged here, and so are the comments by the anonymous referees of the *Surveying and Built Environment Journal.*

## NOTES

1. According to the booklet on relics and historic buildings published by the Wanchai District Council in 1992, the Lee Theatre on Leighton Road was built by the Lee Hysan Family in 1925. The theatre was famous for its revolving stage where both traditional Chinese and Western opera and dance were performed. Most of the time movies were shown here. It has been redeveloped into a 22 storey shopping arcade with a total of 313,770 sq ft gross floor area. The podium and its basement have been used as a gym and department store, and its upper floor comprises a cinema, furniture showroom, health club, shopping spaces and restaurants.

2. In late 1997, the Getty Conservation Institute (GCI) began development of a multi-year inquiry to explore the values and benefits of cultural heritage conservation. The findings of their meeting in California were published in a series of papers and publications by the GCI in 1998.

3. Under the Antiquities and Monuments Ordinance (Cap 53), 'Antiquities' means –
   (a) a relic and
   (b) a place, building, site or structure erected, formed or built by human agency before the year 1800 and the ruins or remains of any such place, building site or structure, whether or not the same has been modified, added to or restored after the year 1799;

   'Monument' means a place, building site or structure, which is declared to be a monument, historical building or archaeological or palaeontological site or structure under Section 3.

   The Ordinance extends to antiquities and monuments on 'private land' which includes land held under a lease, agreement for lease, tenancy, licence permit, deed or other valid title from government. The Ordinance is administered by the Secretary of Home Affairs and for the purpose of the Ordinance is referred to as the 'Authority'.

4. The Secretary for Home Affairs, in his capacity as the Antiquities Authority under the Antiquities and Monuments Ordinance, Cap 53, decided to declare the Morrison Building in Hoh Fuk Tong Centre, Tuen Mun, a Proposed Monument with effect from 11 April 2003. The declaration, which was published in the *Gazette* on 11 April 2003, would have effect for twelve months. This gave the historical building temporary statutory protection from demolition to enable the Government to negotiate with the owner to reach a consensus on its preservation.

5. Bob Pope, former Lands Department Director, wrote an article for the *Hong Kong Institute of Surveyors Journal* in 1984 explaining the origin and structure of Letters A and B.

6. The current Building Ordinance permits additional plot ratio and site coverage where part of a site has to be surrendered, or is resumed, for street widening purposes, or where land at ground-floor level is retained by the owner but dedicated to the public use. Where land is surrendered, the plot may be increased by
   a. 20 % or,
   b. 5 x area of land acquired / area of site left which ever is less.

7. Gordon Cruden was the President of the Lands Tribunal, Hong Kong and wrote extensively on the subject of land law. He mentioned that the granting of an additional plot ratio to a developer is not compulsory and the authority may decide against the granting of an additional plot ratio if it considers such a decision is in public's interest (Cruden, 1999).

8. Tai Fu Tai was an elegant mansion built as a residence in the 4th year of Tongzhi (1865) of the Qing dynasty by Man Chung-luen whose ancestors settled in San Tin in the 15th century. The building is considered one of the most beautifully embellished traditional Chinese buildings in Hong Kong and is renowned for its fine architectural decorations. 'The Governor in Council approved the declaration of Tai Fu Tai on 28 January 1986 and it was formally gazetted as a historic building on 10 July

1987 upon the conclusion of negotiations to transfer development rights of the plot to an alternative site'. *Antiquities Advisory Board Report* (1986 & 1987, p.10)

9. The Ohel Leah Synagogue was built in 1902 by a banker, Sir Jacob E. Sassoon, in memory of his mother, Mrs Leah E. Sassoon. It is a two storeyed Eastern Jewish-styled building. It was restored in 1998. The restoration project obtained the Outstanding Project Award of UNESCO Asia-Pacific Heritage 2000 Awards for Cultural Heritage Conservation.

10. A speech on the transfer of development rights delivered by the Secretary for Planning and Lands, Mr John C Tsang, at the annual general meeting of the Hong Kong Institute of Architects on December 18, 2001. http://www.info.gov.hk/gia/general/200112/18/1218098.htm

11. 'Conserving Hong Kong's Heritage', a speech delivered by Mrs Carrie Lam, Secretary for Development, to the Hong Kong Democratic Foundation on 10 December 2007. http://www.hkdf.org/newsarticles.asp?show=newsarticles&newsarticle=208

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Surveying & Built Environment

# An Alternative Approach to the Short Term Prediction of Residential Property Prices in Hong Kong

HL Yip and EWM Lee*

## ABSTRACT

The behaviour of residential property prices in Hong Kong is so complex that the prediction of this strongly nonlinear time-series remains a difficult task for researchers. Traditional econometric models have been used frequently in modelling the time-series but the results obtained still leave room for improvement. In this study, moving away from traditional prediction methods, we use Radial Basis Function (RBF) to model and forecast short-term residential property price behaviour in Hong Kong. The performance of the RBF model was evaluated by a statistical approach. The result shows that the RBF is able to capture the nonlinearity embedded inside time-series. It successfully modelled the short-term price movement.

## KEYWORDS

Artificial neural network
Radial basis function
Property price

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## INTRODUCTION

Residential property prices in Hong Kong have exhibited strongly nonlinear behaviour in recent decades. The volatile and nonlinear price fluctuation in the market means that all participants in it struggle to predict future price movements accurately, with the difficulty increasing because the underlying functional relationship between input and output is unknown. Furthermore, the actual input variables are hardly detectable. Hence, it is an inherently complicated task to determine the underlying nonlinear structure of the property price time series.

Although it is a difficult job to model property price time-series, an appreciable number of attempts have been made to model the input-output mapping of the property price series and to analyze the market. (Hendry 1984, Drake 1993, Richard *et al.* 1996, Wilson *et al*. 2002, Edelstein *et al*. 2007, Garcia *et al.* 2008, Miles 2008) These studies have not only provided a methodology with which to forecast the residential property market, but have also offered policy makers essential clues for determining appropriate government policy. A successful prediction of future price movement and volatility can also provide a direction in which commercial banks can develop better risk management for mortgages, as volatility is a key determinant of mortgage default probability (Foster *et al.* 1984). This would also be socially useful because the residential property market has long been one of the most vital markets in Hong Kong. Reliable modelling will be able to reduce the uncertainty borne by market participants so that the number of informed agents increases. Thus, a practical and reliable methodology for modelling the input-output mapping of property price time-series is necessary.

In recent years, apart from traditional models, many researchers have made use of artificial neural networks (ANNs) as an alternative in modelling the input-output mapping of time series. ANNs have the well-known ability to model the nonlinear behaviour of time series better than traditional econometric models. (Hill *et al.* 1996, Aminian *et al.* 2006, Moshiri *et al.* 2006) In this paper, we make use of ANNs to forecast the short term residential property price movement in Hong Kong. By using macroeconomic and other related variables as input, we extract the underlying nonlinear functional relationship between inputs and output for the price series.

The remainder of this paper is organised in four sections: Data Collection; Methodology; Results; and Conclusions.

## DATA COLLECTION

The index we use for capturing the general residential property price movement in Hong Kong is from the Centa-City Index (CCI)[1], provided by Centaline Property Agency Ltd. The CCI is a property value index based on

[1] *Data was obtained from http://www.centadata.com/cci/notes_c.htm*

all the transaction records of the Land Registry. The estates included in the index are those with high transaction values and volumes that have been occupied for at least 12 months. The CCI is formulated as follows:

$$CCI_m = \frac{MV_m}{MV_{m-1}} \times CCI_{m-1} \quad (1)$$

where $MV_m$ represents the total market value of the constituent estates for the month m. Hence, (1) can be written as:

$$CCI_m = \frac{MV_m}{MV_{m-1}} \times \frac{MV_{m-1}}{MV_{m-2}} \times CCI_{m-2} \quad (2)$$

We finally obtain equation (3) by repeating the above process where *b* is the base month (i.e. July 1997). The value of CCI at the base period is 100.

$$CCI_m = \frac{MV_m}{MV_b} \times CCI_b \quad (3)$$

## METHODOLOGY

Hence, the CCI measures the change in aggregate value of real estate in Hong Kong compared to that at the base period, which is similar to how the Hang Seng Index works in the Hong Kong stock market. The data we use for training the model is taken from January 1998 to June 2008. During this period, the CCI exhibits two distinct trends. From 1998 to mid-2003, there is a clear downtrend, with an uptrend running from mid-2003 to early 2008. The trends and price movements of the CCI vary over the period in a highly nonlinear manner, which is why we use a nonlinear forecasting method in this study. The monthly movement of the CCI is shown on Figure 1.

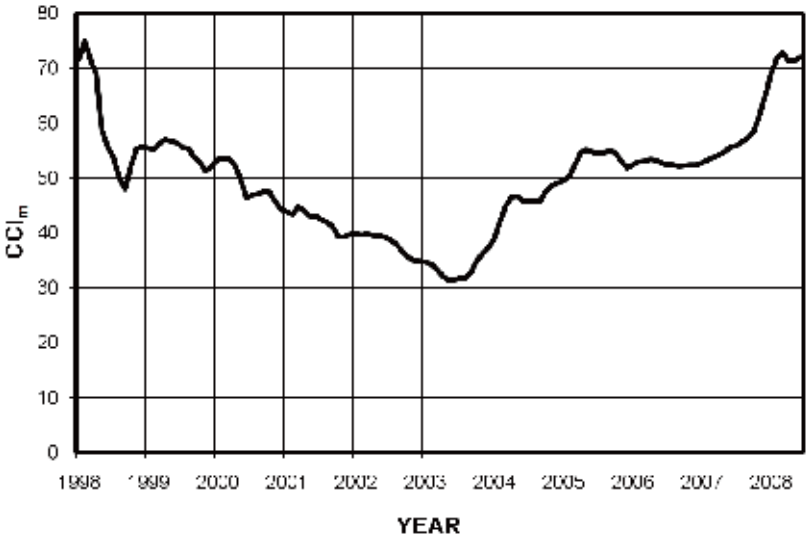


**Figure 1 Time series of the CCI from January 1998 to June 1998 (adopted from http://www.centadata.com/cci/notes_c.htm)**

In analysing the dynamics of property prices, econometric models are typically used. Hendry (1984) introduced an econometric model for existing UK residential property prices that used excess demand as a function of a range of parameters such as real income and lending rate in modelling the changes in house prices. Richard *et al.* (1996) extended Hendry's excess demand function by giving it stochastic and dynamic properties. Drake (1993) employed the Johansen cointegration technique to derive a long-term equilibrium of UK house prices. Miles (2008) found that in forecasting housing prices, a generalized autoregressive model is superior to autoregressive moving average and generalized autoregressive conditional heteroscedastic models. Furthermore, Edelstein *et al.* (2007) introduced a two-equation system to model the residential property price cycle. The two equations are developed econometrically to set up the demand and supply sides of the residential property market.

Although most residential property price modelling has used econometric models, Hill *et al.* (1996) found that ANNs are superior to traditional time series forecasting methods. Artificial neural networks have been successfully used in various areas, such as economic data (Aminian *et al.* 2006), financial price series (Moshiri *et al.* 2006, Pai *et al.* 2006, Blynski 2006), earth science and astronomy (Valdes, 2006), residential sub-markets (Garcia *et al.* 2008) and fire dynamical system (Lee *et al.* 2004). Hence, they can be viewed as powerful tools for use in modelling the input-output mapping of time series. With the presence of input and output data, ANNs are able to model the underlying function and structure from input to output by changing the weight between each neuron to minimise the error that arises. Another benefit of using ANNs is that they do not have to make any assumptions to form the model, which is not true of conventional econometric models. In this study, we adopt ANNs in forecasting the short-term residential property price. To model a property price time-series, time-lagged observations are usually used as inputs to ascertain the underlying function or structure of the input-output mapping. Wilson *et al.* (2002) proposed the use of a time-lagged property price as a single input to forecast the future residential property price. In our model we add other time-lagged observations as inputs to obtain a better result.

**Development of network architecture**

The network form we use here is the radial-basis function (RBF) model. Park *et al.* (1993) provided evidence that RBF is a universal function approximator. Hornik (1991) also found that feed-forward neural networks with activation functions that are arbitrarily bounded and non-constant are universal function approximators. The activation function we adopted in the hidden neurons is a Gaussian function as shown in equation (4) where $\boldsymbol{x}$ is the input vector, $\boldsymbol{\mu}_i$ and $\boldsymbol{\Sigma}_i$ are centre and spread of the $i^{th}$ hidden neuron of the RBF. Linear functions as shown in equation (5) is adopted in the output layer of the RBF where $\boldsymbol{w}$ is the set of weights of the links connecting the

outputs of the hidden neurons to the output neuron.

$$\phi_i(\boldsymbol{x}) = -(\boldsymbol{x} - \boldsymbol{\mu}_i)^{\mathrm{T}} \boldsymbol{\Sigma}_i (\boldsymbol{x} - \boldsymbol{\mu}_i) \quad (4)$$

$$f(\boldsymbol{x}) = \boldsymbol{w} \cdot \boldsymbol{x} \quad (5)$$

These satisfy the condition proposed by Hornik (1991) to ensure that our RBF model can be further verified as a universal function approximator.

**Selection of parameters**

Input parameters

One of the criteria for selecting suitable input parameters is their potential relationship to output. As stated above, the use of lagged prices in modelling residential property prices has been proven successful (Wilson *et al.* 2002). In addition, Hort (1998) found evidence that movement in income has a vital effect on the movement of real house prices in Sweden. This provides our rationale for using lagged nominal GDP as one of our input parameters. Edelstein *et al.* (2007) stated that macroeconomic variables, including the interest rate, crucially affect the residential property price cycle. Furthermore, at the sub-market level, Case *et al.* (1997) suggested that an increase in transaction volume tends to be tied to increases in property prices. With reference to the above pioneer works, we adopt four inputs to forecast the CCI: time-lagged CCI, nominal GDP, best lending rate[2] and transaction volume, expressed as $CCI_{m\text{-}1}$, $GDP_{m\text{-}1}$, $BLR_{m\text{-}1}$ and $Volume_{m\text{-}1}$, respectively.

Output parameters

The horizon we forecast is one month ahead of the present month. Moshiri (2000) suggested that artificial neural networks are superior to other econometric models because they can forecast an inflation time series over a one-month horizon. Hence, we also try to forecast the residential property price one-month ahead. As a result, the output we use for our network is the CCI in the month *m*.

**The number of nodes in different layers**

In the input layer, we employ four nodes. Each node represents each input variable mentioned above at a period of m-1. For the hidden layer, the amount of hidden neurons required is suggested by the following formula (Ward Systems, 1996) where $N$ represents the number of hidden neurons, $N_{in}$ and $N_{out}$ are, respectively, the numbers of inputs and outputs of the problem and $N_{sample}$ is the total number of training samples.

$$N = \frac{N_{in} + N_{out}}{2} + \sqrt{N_{sample}} \quad (6)$$

In line with equation (6), we recruit 10 hidden neurons into our network as an initial trial. We then examine the effect of varying the number of hidden neurons by ±5: that is, from 5 to 15. The results of this variation are presented in Section 4. Finally, we have only one single desired output which is the CCI in month *m*. The architecture of the fully interconnected RBF network is shown in Figure 2.

[2] *The best lending rate is the rate quoted and updated by the Hongkong and Shanghai Banking Corporation Limited*

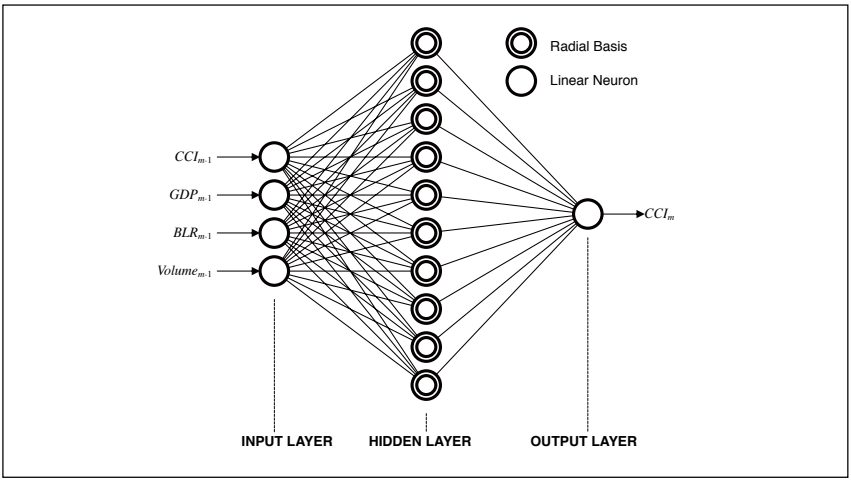


**Figure 2 Architecture of the Radial Basis Function adopted in this study**

**Network training and performance evaluation**

Throughout our data, from January 1998 to June 2008, we have 125 samples. These samples are divided into 3 groups of samples namely training samples, validation samples and test samples. The training errors, which are obtained from applying the RBF model to the training samples, are used to adjust the weights of the RBF models by Turboprop algorithm (Ward, 1996). It utilizes an independent weight update size for each different weight, rather than the usual method of having a single learning rate and momentum that apply to all weights. Furthermore, the step sizes are adaptively adjusted as learning progresses. Turboprop is simpler to use than the other methods because it does not require setting of the learning rate and momentum. The validation error which is obtained by applying the adjusted model to the validation samples is used to maintain the generality of the model to avoid over-fitting. For every epoch of network training, the intermediate network trained by the training samples is applied to the validation samples to evaluate the prediction error (i.e. validation error). For early-stop validation approach, the network training is stopped when the validation error reaches its minimum and starts to increase. The typical progresses of training and validation errors during the network training are illustrated in Figure 3. The test samples do not involve in network training. Upon the completion of network training, the trained network is applied to the test samples. The prediction errors reveal the performance of the trained RBF model.

For these collected total 125 samples, the ratio of the number of training samples, validation samples and test samples is chosen to be 2:1:1.

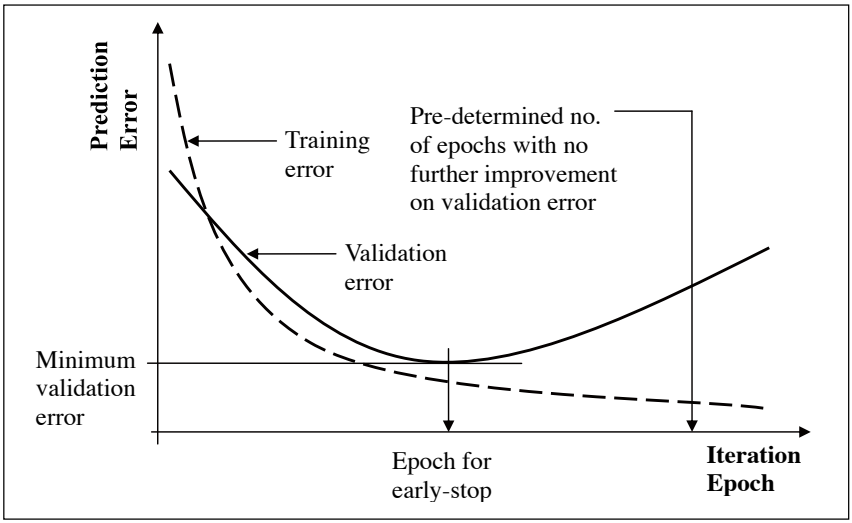


**Figure 3 Early-stop validation for network training**

Therefore, we randomly extract 62 as training samples, 32 as validation samples and 31 as test samples. Of these three kinds of patterns, the training patterns are used to train the networks, and the validation patterns are employed as a stop-training medium if their average error does not decrease for 20,000 consecutive epochs. This procedure ensures that there is no over-fitting of the problem because when training is stopped with reference to errors of a suitably smaller set it tends to reduce the possibility of over-fitting when compared to a large set. Finally, the test patterns are used for measuring the accuracy of the model. We use the correlation coefficient ($r^2$) to evaluate the relationship between desired outputs and the actual outputs of the test set.

The approach to model learning, based on back-propagation learning, is called Turboprop. (Ward Systems, 1996) This approach changes the size of weight updates independently towards different links between neurons, instead of using a uniform learning rate for the entire set of weights. Hence, a training process that is faster than traditional approaches can be achieved.

As the time series involves a random process, random extraction is carried out 30 times to ensure all patterns have equal probability of being selected as test patterns so that a more objective picture of the model's performance can be obtained. (Lee *et al.* 2004a, 2004b, Aminian *et al.* 2006) After the randomly extracted data points are trained once according to our rule and the results are recorded, we start another random extraction process, and continue in this manner until all 30 extractions have been completed. Figure 4 is a flow chart of the neural network training.

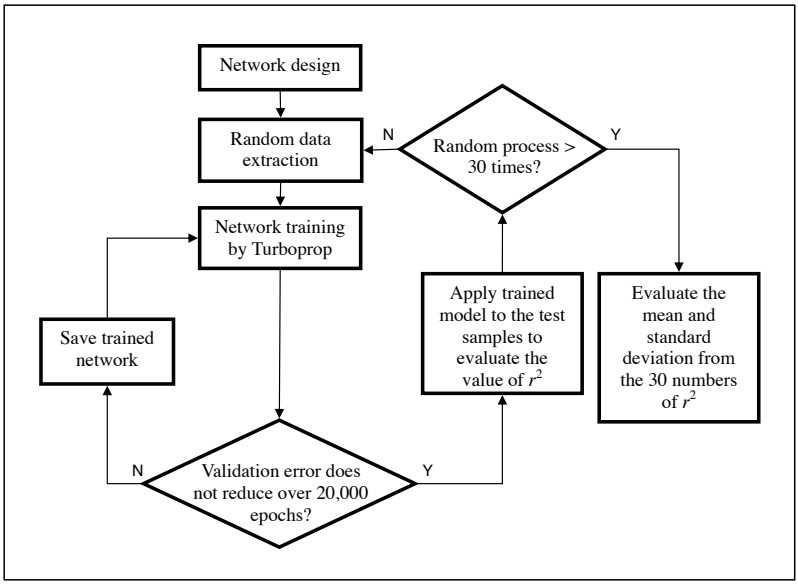


**Figure 4 Methodology in network training and performance evaluation**

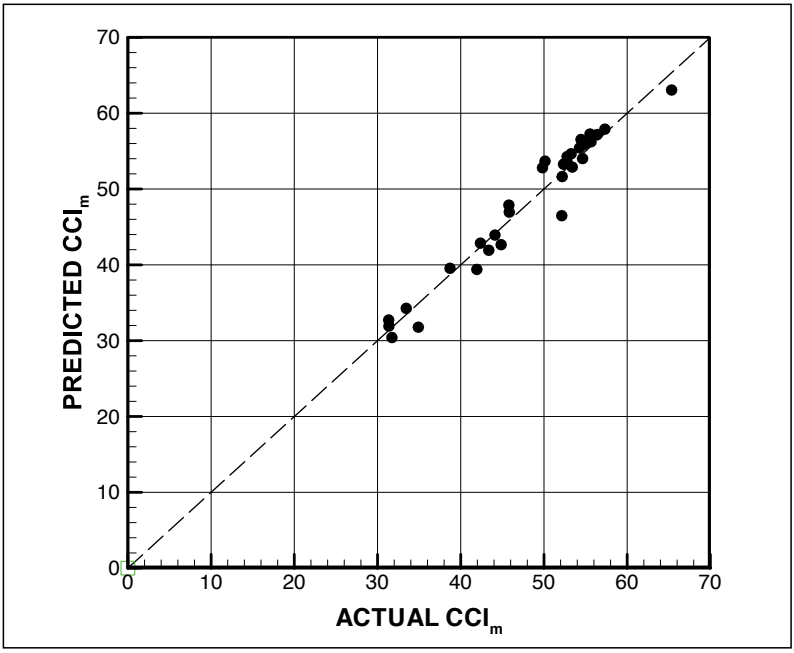


**Figure 5 Typical results of the predicted $CCI_m$ by RBF and the $CCI_m$ of the actual data. The predicted results reasonably agree with the actual data.**

## RESULTS

The model's performance is measured by the correlation coefficient ($r^2$) between the prediction and the data of the test set. It is defined in equation (5).

$$r^2 = \frac{\left[\sum (x-\bar{x})(y-\bar{y})\right]^2}{\sum (x-\bar{x})^2 (y-\bar{y})^2} \qquad (5)$$

Figure 5 shows the typical simulation result of the total 30 runs. It shows that the predicted results reasonably agree with the actual results with value of $r^2 = 0.957$.

Table 1 summarises the results of the model with 30 runs with randomly extractions of data for training, validation and test samples. The standard deviation of these 30 results is only 0.016, which reveals that the model is able to extract the underlying nonlinear functional relationship between input and output parameters to a very high extent.

**Table 1 Descriptive statistics of Correlation Coefficient ($r^2$) on the results of 30 runs**

| Statistical results | Values |
|---|---|
| Mean of $r^2$ | 0.959 |
| Standard deviation of $r^2$ | 0.016 |
| Minimum value of $r^2$ | 0.932 |
| Maximum value of $r^2$ | 0.986 |

Figure 6 illustrates the probability distribution of the $r^2$ value from the 30 simulations. It is presented by beta distribution since the $r^2$ value is bounded within the domain of [0, 1]. The figure indicates that the probability of $r^2$ value being less than 0.9 is practically zero. The distribution exhibits a vigorously upward sloping curve when $r^2 > 0.93$, which indicates that the probability density of $r^2$ is clustering for $r^2 > 0.93$. This result confirms that the RBF provides a well-performed and reliable modelling method in the prediction of residential property prices over a one-month horizon.

Apart from measuring and evaluating the capacity ANNs to predict price series, we have also investigated the effect of the number of hidden neurons on ANN performance. The results of employing ANN structures with 5 to 15 hidden neurons in our 30 randomly timed extractions are given in Figure 7. As variation in the number of hidden neurons has an insignificant effect on the model's performance, we finally adopt 10 hidden neurons as a rule of thumb and with reference to equation (6). A possible explanation for this minute difference is that the capacity to approximate a functional relationship may start in a particular dimensionality of hidden space.

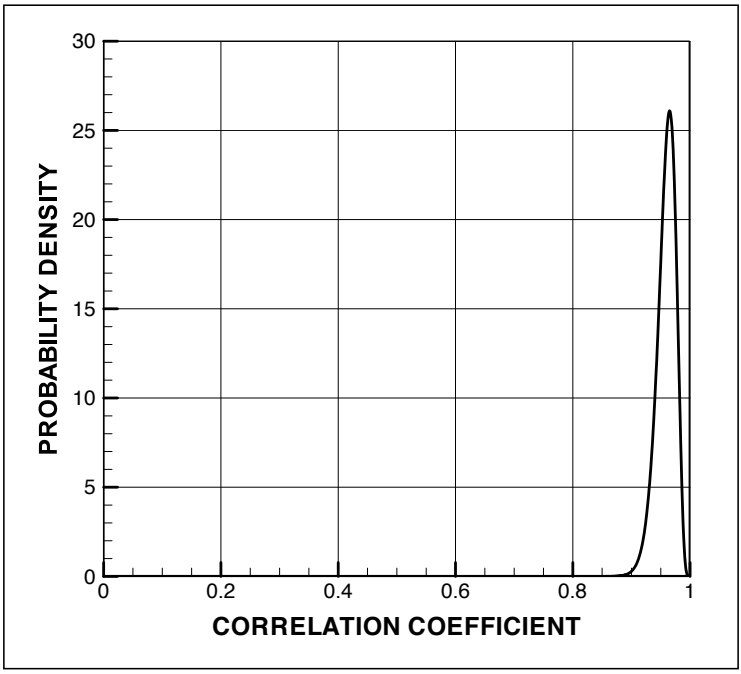


**Figure 6 Probability distribution of the Correlation Coefficient. Beta distribution was adopted since the value of Correlation Coefficient is bounded between 0 and 1.**

## CONCLUSIONS

The modelling and forecasting of residential property prices has long been a complicated process for researchers. Most previous studies used econometric models that attempted to generate the underlying function of the time series. However, few of those models can be used extensively and successfully.

In this study we used ANN, which are well known for their capacity to model nonlinear time-series but rarely used in modelling and forecasting residential property price time-series. By using ANN, we modelled the short-term price behaviour of residential property from January 1998 to June 2008. For the model, we recruited radial-basis function networks as our network architecture and used time-lagged observations as input to forecast short-term price movement. Moreover, to obtain an objective picture of the model's performance, we randomly extracted data points for training and testing 30 times so that each data point had an equal probability of being put into a test set.

Our results reveal that the performance of the model, measured by the correlation coefficient, is so promising

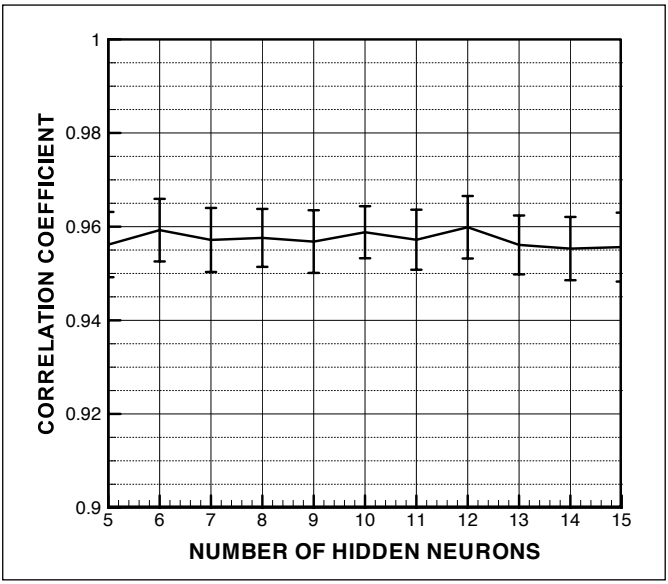


**Figure 7 Correlation Coefficient under different amounts of hidden neurons. The error bars states the 95% confidence intervals**

that short-term residential property price behaviour in Hong Kong can be modelled very successfully. The standard deviation of the 30 values of the correlation coefficient is so minute that the reliability of the model is guaranteed. Furthermore, even if we vary the number of hidden neurons in the network architecture, there is no significant change in the model's performance.

Our study provides an effective methodology for modelling residential property price movement. Due to their very promising accuracy, ANNs could be used to model the underlying nonlinear function of property price behaviour in any region.

## ACKNOWLEDGEMENT

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# Risk-Sharing Mechanism for PPP Projects – the Case Study of the Sydney Cross City Tunnel

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## ABSTRACT

The Cross City Tunnel in Sydney, Australia is a good example of how the improper allocation of risks could affect the success of a Public Private Partnership (PPP) project. It is not incorrect for risks to be passed on to the private sector, especially when they are able to manage them. But maybe there should be a 'partnership' in place when the private sector is unable to manage all the risks themselves. Some critiques considered this project as an unsuccessful PPP as the Government has had to cope with handling much public opinions dissatisfaction and criticisms for their inaccurate traffic forecasts, leading to the investor making a financial loss. This paper aims to derive a risk-sharing mechanism for projects similar to the Cross City Tunnel, by reviewing the underlying causes leading to the 'failure' of this project. In addition, the objectives are to ensure that appropriate risk allocation is achieved in the best interests of all parties so as to make the project successful. Unpredictable circumstances and inaccurate predictions of the Government could make it difficult if not impossible for the private sector to handle the project. In these situations the Government should step in, share the responsibilities and overcome the problems encountered with the consortium. The Government should be able to offer assistance in these circumstances in the form of finance, manpower, governmental procedures, etc. depending on the need. In addition, this paper advocates that such mechanism should be in place for similar projects in the future. Benefits for both sector parties are anticipated when this mechanism is included in the project contract. After all, a PPP is a 'partnership' and the parties should work together to overcome obstacles for mutual benefit.

## KEYWORDS

Public private partnership
Sydney Cross City Tunnel
Risk sharing mechanism

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## INTRODUCTION

The definition of a PPP has been reported by numerous researchers. Each definition varies slightly depending on the author, jurisdiction and the time. As the Cross City Tunnel (CCT) in Sydney, Australia is a New South Wales Government infrastructure project, it is therefore logical to consider their definition of a PPP. According to the New South Wales Government the term 'public private partnership' (PPP) is used to mean:

*'An arrangement for the provision of assets or services, often in combination and usually for a substantial or complex "package", in which both private sector supplier and public sector client share the significant risks in provision and/or operation'*. (Infrastructure Implementation Group, 2005).

In this definition the emphasis is on both the public and private parties sharing a large proportion of the risks in a PPP project. In reality it is not always the case that an equal split of risks is experienced. Often the public sector takes up minimal risk and aims to pass on as many risks as possible to the private sector. This occurs more commonly in developing countries or jurisdictions where the Government has less experience in this alternative procurement method. This paper therefore aims to derive a risk-sharing mechanism for projects similar to the CCT. In addition the objectives are to ensure that appropriate risk allocation is achieved; and that the aims of all parties are to make the project successful. The New South Wales Government further describes that:

*'Privately financed projects involve provision by investors of equity capital and debt capital to fund what might otherwise be wholly publicly funded projects financed from NSW Government borrowings and/or budget revenue'*.

This further emphasizes the importance of the financing of PPP projects. Passing on financial risks is appealing to governments.

The PPP form of procurement is recognized as an effective way of delivering value-for-money public infrastructure or services. It seeks to combine the advantages of competitive tendering and flexible negotiation, and to allocate risk on an agreed basis between the public sector and the private sector (Akintoye et al. 2005). It is essential for the public client and the private bidders to evaluate all of the potential risks throughout the whole life of the project. Public and private sector bodies must pay particular attention to the procurement process while negotiating contracts for a PPP to ensure a fair risk allocation between them. Systematic risk management allows early detection of risks and encourages the PPP stakeholders to identify, analyze, quantify and respond to the risks, as well as take measures to introduce risk mitigation policies (Akbiyikli and Eaton 2004). A fundamental principle (Grimsey and Lewis, 2002) is that risks associated with the implementation and delivery of services should be allocated to the party best able to manage the risk in a cost

effective manner. A delicate balance has to be sought amongst private sector capacity, government regulatory function and public satisfaction.

In general, the typical processes for delivering PPP projects in New South Wales include five major steps (Figure 1): 1. project identification; 2. project approval; 3. planning assessment; 4. project delivery; and 5. project implementation (Infrastructure Implementation Group, 2005). Before a project is even considered it will go through a series of governmental in-house procedures to decide whether it is a public facility or service that is needed. If it is decided to be necessary, the project will have to be approved via the Gateway review process and to see which procurement option it should adopt. Planning assessment via a number of different line agencies would be necessary. Finally the project will be offered to the market, consortia will bid for it and the Government will select the most suitable candidate after a long series of negotiations. The project will typically be designed and constructed over 3 to 5 years. It will then be put into operation and maintained for a further 25 to 30 years as the concession period. Thereafter, the project will normally be returned to the Government, completely ending its life as a PPP project.

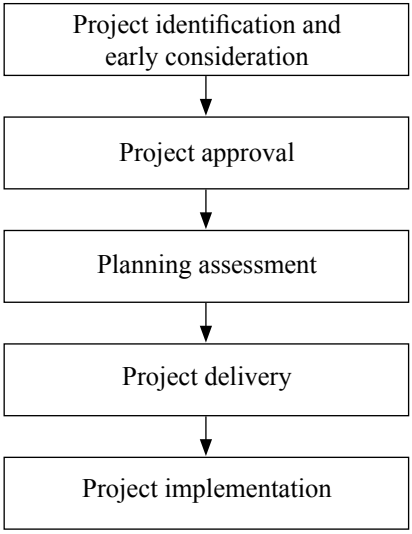


**Figure 1 Typical processes for delivering PPP projects in New South Wales, Australia (Adapted from the Infrastructure Implementation Group, 2005)**

## BACKGROUND OF THE SYDNEY CROSS CITY TUNNEL (CCT) PROJECT

The primary objectives of the CCT project were to reduce through traffic in Central Sydney and as a result easing traffic congestion and improving environmental amenity in the central business district, and on streets approaching the central business district, and to improve the east to west traffic flows (Roads Traffic Authority, 2003).

The CCT is a 2.1 km twin two-lane motorway that runs east and west underneath the busy central business district of Sydney. It opted for a design-build-operate (DBO) arrangement under a 30-year concession agreement. The project was part of a network of a new transportation infrastructure plan of the Roads and Traffic Authority of the New South Wales Government. Its large project sum of AUD680 million meant that a PPP was an attractive option to the New South Wales Government.

The initial concept of the tunnel was mooted in 1998 (Cross City Tunnel Pty. Ltd., 2007). After a series of complex consultations, exhibitions, modification and approvals the private sector was finally asked for an expression of interest on 15 September 2000 (Roads Traffic Tunnel, 2003). In response, a total of eight consortia expressed interest by 23 October 2000. Three consortia were shortlisted and asked to submit detailed proposals for the project on 8 June 2001. All the three consortia submitted their proposals by the closing date of 24 October 2001. It was announced on 27 February 2002 that the Cross City Motorway Pty. Ltd. was selected as the winning consortium.

The construction for the project commenced on 28 January 2003. It was delivered ahead of schedule and took only 31 months to construct (typical for PPP projects). The tunnel was officially opened for service to the public on 28 August 2005. Unsurprisingly the project attracted the private sector from within Australia and abroad. The selected consortium included strong financiers, Cheung Kong Infrastructure of China, Bilfinger Berger of Germany and RREEF Infrastructure of Australia. They would bring in equity and recover the cost of design, construction, operation and maintenance via the tolls collected. Therefore the project company, Cross City Motorway Pty Ltd, was allocated all the demand risk for the project. Innovation was introduced by the contractor. The tunnel was the first motorway in Sydney to have full electronic tolling. There were high levels of expectations by all the parties and the traffic forecast for the tunnel was predicted to be 90,000 vehicles per day.

A number of benefits were sourced from materials published and released from the project company Cross City Motorway Pty Ltd (Cross City Tunnel, 2007) and the government agency client the Roads and Traffic Authority of New South Wales (Government Roads Traffic Authority, 2007). These parties claimed that as a result of the Cross City Tunnel project the following benefits would be experienced:

- 34 traffic signals avoided (16 sets westbound and 18 sets eastbound);
- Major reduction of traffic across the central business district;
- Improved quality of life for pedestrians and cyclists in the central business district;
- Higher reliability of bus services in the central business district;
- Cut trips across the city to approximately 2 minutes, from up to 20 minutes by avoiding traffic lights;
- Improved access and movement within the city for taxis, delivery vehicles, cyclists and pedestrians;
- Make city streets safer and more pleasant for pedestrians, residents and business people by removing intrusive through traffic and providing more footpath space in some streets;
- Reduced traffic noise levels; and
- Better air quality by taking cars off surface streets.

Despite the benefits of the PPP which have been highly publicized, some may consider that there are also many 'failures' in the project. The next section takes a closer look into these 'failures'.

## UNDERLYING CAUSES LEADING TO 'FAILURE'

CCT has been perceived as an unsuccessful project by the general public and as a result the government's image has suffered (Jean 2006). To illustrate some of the negative portrayals of the project, some headlines related to the project were sought and are shown in the Appendix. Among these seven headlines, three are related to the toll. This shows that the toll is probably one of the key factors affecting the satisfaction level of the general public towards the CCT, and also one of the issues that is highly sensitive among them.

The PPP has been given a bad name and investors have been driven away from New South Wales, at least temporarily (AAP General News Wire 2006a). The CCT encountered severe difficulties in reaching the predicted traffic volume. Motorists expressed their unhappiness about the high toll levels (AAP General News Wire 2006b) and the government closing off the surface roads to direct the traffic into the CCT (AAP General News Wire 2006c). These problems resulted from the inaccurate traffic forecast and a flawed concession agreement. Currently, the CCT has entered into receivership and the concessionaire has written off their equity (Project Finance, 2007).

In this project it has been unfortunate that the public client and the private consortium have argued openly in public. Newspapers have reported them criticizing each other for their faults (Field 2006a). The Premier spoke out publicly expressing his frustration that motorists were able to use the toll road without paying. He criticized the operators for not enforcing the charge and how it was unfair for the motorists who did pay (AAP General News Wire 2006d; Field 2006b). On the other hand the consortium also criticized the Premier for failing to demonstrate leadership (AAP General News Wire

2006e). It can be seen how the media has portrayed a tense battle between the public and private sectors. This is an image that nobody wants to create for any project whether it is delivered by a PPP or not. But being a PPP project creates an even higher sensitivity, as taxpayers will query whether they are actually getting value for money from the Government's decision.

Following the unfortunate events experienced, the private consortium requested the Government to pay them a toll subsidy and compensation for the road changes. Unfortunately the two parties were unable to come to a satisfactory agreement (AAP General News Wire 2006f). But in order for the CCT case not to be repeated the Government considered paying the consortium compensation for the Lane Cove Tunnel, which is also in Sydney, if unfortunately traffic forecasts for that are also predicted inaccurately (Cratchley and Jean 2006a; 2006b). This action from the government was positive as it showed that they were aware that there were problems in the CCT project, and that they should share the responsibilities by undertaking more of the risks rather than passing the pressure solely to the private consortium.

In 2005 the New South Wales Government produced a report titled 'Review of Future Provision of Motorways in NSW' (Infrastructure Implementation Group, 2005). The report reviews recent road projects, including the CCT, in order to improve future similar projects. It is unfortunate that more barriers are set up to protect the Government, as a result of which further risks are passed on to the private sector. For example, in the document they expressed their preference for bidders with the 'lowest' toll. This line of thinking is similar to selecting the lowest cost bidder, which should not be the only way to select the consortium. Instead, value for money for the project overall should be their main concern. By focusing on the toll only, other important features adding to value may be neglected such as innovative techniques and skills used in the project to make it more efficient and as a result creating value for money. The quality of the work may also suffer.

In the report it was also mentioned that in Victoria all the main variables which would affect the commercial outcome of the project for all parties would be negotiated at the bidding stage. But in New South Wales the toll level or the possibility of a Government contribution would not be open to negotiation. Therefore whether value for money for the taxpayers is achieved is questionable. The report has indicated that the New South Wales Government is clearly aware of their faults, but whether they actually rectify the situation remains to be seen.

To consolidate the findings reported by the press discussed previously, the underlying causes leading to the 'failure' of the CCT project include:

- Inaccurate traffic forecast;
- High toll levels;
- Government closing off the surface roads to direct the traffic into the CCT;
- Flawed concession agreement;

- The public client and the private consortium arguing openly in public;
- No toll subsidy and / or compensation from the government;
- The toll level or the possibility of a Government contribution was not open to negotiation.

## APPROPRIATE RISK ALLOCATION

Grimsey and Lewis (2002) identified nine main risks affecting all types of infrastructure projects. These included technical risk, construction risk, operating risk, revenue risk, financial risk, force majeure risk, regulatory/ political risk, environmental risk, and project default. On the other hand Lam et al. (2007) identified seven key risk allocation criteria:

- Whether the party is able to foresee the risk;
- Whether the party is able to assess the possible magnitude of the consequences of the risk;
- Whether the party is able to control the chance of the risk occurring;
- Whether the party is able to manage the risk in case it occurs;
- Whether the party is able to sustain the consequences if the risk occurs;
- Whether the party will benefit from bearing the risk; and
- Whether the premium charged by the risk-receiving party is considered reasonable and acceptable for the owner.

According to the terms and conditions set out in the Project Deed of the CCT, the private consortium accepted more or less all the risks associated with the project. The private sector is often willing to take up large risks to gamble for their desired returns. The Government is also concerned about the consortium's readiness to accept risk (Ahadzi and Bowles 2004). But it is a surprise that the Government was willing to allow the private sector to take up such a large proportion of the risks. However in the arrangement the social responsibility will always be the public sector's. Therefore the Government should consider whether the consortium is able to handle the risk effectively. The risks that the consortium agreed to take on board in the Project Deed included (Roads Traffic Authority, 2003):

- All risks associated with the financing, design, construction, operation, maintenance and repair costs of the project;
- The risks that traffic volumes or project revenues may be less than expected;
- Income tax risks; and
- The risks that their works or operational and maintenance activities might be disrupted by the lawful actions of other government and local government authorities or a court or tribunal.

Clifton and Duffield, 2006 undertook a study where they looked into the risk allocation structure for several recent PPP projects in Australia. One of these cases included the CCT (Table 2) and realized that the risks for each party were quite evenly spread. But further study showed that the intensity of the risks allocated to the private sector was actually much greater compared to

those allocated to the Government, as shown in Table 1:

| Risk Allocated to Government | Risk Allocated to Consortium |
|---|---|
| Native title risks | Design, construction and commissioning risks |
| Force majeure | Delay and completion risks |
| Uninsurable risks | Ground/geotechnical conditions risks |
| Legislative and Government Policy | Operation and maintenance/ facility management risks |

**Table 1 Risk allocation structure for the CCT (Clifton and Duffield, 2006)**

Shen et al. (2006) studied the risk allocation for public sector projects in Hong Kong. From the literature they identified a number of major risks affecting public sector projects. In their analysis they selected the Hong Kong Disneyland as a case study. This case study demonstrated which risks would be most suitably allocated to each party. The study concluded that the public sector should be allocated the site acquisition risks, inexperienced private partner risk and legal and policy risks. On the other hand, the private party should be allocated the design and construction risks, operation risks and industrial action risks. Lastly, Shen et al. (2006) advocated the importance of there being some risks which both parties should share. These include development risks, market risks, financial risks and force majeure. Although Shen et al.'s 2006 study was conducted for a project in another country and of a different nature; it is believed that these shared risks as mentioned could also apply to other PPP projects such as the CCT. The CCT suffered immensely due to the market and financial risks. If these were shared risks as suggested by Shen et al. (2006), the intensity of the damage to the consortium could have been minimized.

Traffic revenue risk has been identified as one of the most critical risks impacting the commercial success of road projects delivered by a PPP (Singh and Kalidindi 2006). In order to overcome traffic revenue risk, the annuity-based build-operate-transfer (BOT) model has been presented as a good solution. Unlike the traditional BOT type road economic projects, the concessionaire will be paid a fixed semi-annual annuity by the governmental client. This approach is similar to that used for the social infrastructure PPP projects such as hospitals and schools which are paid by a regular fixed payment. Similarly the annuity-based BOT model will require the concessionaire to achieve certain milestones and standards. The payment will be used to cover the design, construction, maintenance and operation

of the road and its facilities. As a result the concessionaire does not undertake any of the traffic revenue risk. This approach ensures that the governmental client must also undertake their fair share of risks. The risk allocation framework shown in Table 2 shows the appropriate risk allocation for each party under the annuity-based BOT model. Amongst the sixteen risks listed, nine are undertaken by governmental clients. In general the concessionaire is responsible for the risks related to the construction and operational performance of the facility. Other risks which are less predictable and controllable are taken by governmental clients. By adopting this approach the business case may not be as attractive to the private sector. The private sector is often willing to take up more risks in return for the possibility of financial benefits. The private sector should not be solely responsible for taking these decisions. Instead the government should also consider whether they should allow the private sector to take up large risk.

| Risk Allocated to Government | Risk Allocated to Consortium |
|---|---|
| Pre-investment | Delay in financial closure |
| Resettlement and rehabilitation | Time and cost overrun during construction |
| Permit/approval | Time and cost overrun during operation and maintenance |
| Delay in land acquisition | Non-political force majeure |
| Delay in payment of annuity | Performance standards |
| Change of scope | Lane availability |
| Traffic revenue risk | Interest rate risk |
| Change in law | |
| Political risk | |

**Table 2. Risk allocation framework for the annuity-based BOT model (Singh and Kalidindi 2006)**

Another payment mechanism similar to the annuity-based BOT model was proposed, in that the patronage risk stays with the government (Aziz 2007). The shadow-toll design-build-finance-operate (DBFO) system is similar to the BOT system except shadow tolls are used instead of real tolls. The government will pay a toll per vehicle per road kilometer instead of the end users paying the toll. Another option is the performance-based DBFO system. For this payment mechanism the services and the operational performance of the contractor are emphasized rather than the usage of the facility.

From the experience of several road projects including the CCT, the New South Wales Government identified some lessons learnt (Infrastructure

Implementation Group, 2005):

- Need for consultation and communication over the life of project procurement;
- Need for improved community consultations and messages;
- Responsibility of Government client over procurement life of project;
- Greater onus on the consortium to accept full responsibility over the whole life of the concession period.

The fourth lesson learnt indicates that the Government feels that they have accepted too much of the project risks. Therefore they appear to be keen to ensure that the consortium will take a larger responsibility for risks in future.

## RISK SHARING MECHANISM

A PPP should be adopted primarily based on value for money. Obviously the package is accompanied by various other advantages which are attractive to the government such as private financing and the transfer of risks. But the decision to adopt a PPP should not be solely based on these additional advantages.

As discussed previously risks should always be allocated to the party best able to handle them. The party allocated the risk should be the one most able to prevent it from occurring. And if the risk does occur the allocated party should be the one most able to minimize the consequences.

The inaccurate traffic forecast was the main reason that led to the collapse of the project company. As a result of this fault other actions were taken by the concessionaire to overcome the reduced traffic flow. These actions led to further complications which in turn ruined the partnership agreement between the public and private sectors.

In the case of the CCT the inappropriate allocation of risks was believed to be the root cause. In some cases the Government may subsidize or compensate the concessionaire if the project revenue is less than expectation or if the contract is terminated. But often there is much argument as to the amount which this subsidy or compensation should be.

To prevent similar cases from occurring, an optimal risk-sharing mechanism is presented. The risk-sharing mechanism can be adopted in projects of a high risk nature. The CCT was a project of high risk due to its scale and significance. In this risk-sharing mechanism, projects which are traditionally economic infrastructure projects such as transportation projects can adopt a regular fee payment from the government instead of bearing the revenue risk. This approach is similar to social infrastructure projects. As mentioned previously in this paper other researchers have also reported the possibility and feasibility of this arrangement for economic infrastructure projects.

Under this mechanism, the consortium of high-risk economic infrastructure projects will be paid via a regular fee payment. In this way the payment will be based on project performance rather

than usage. As in social infrastructure projects certain risks are still taken by the concessionaire, such as those associated with the design, construction, operation and maintenance. But the other risks should be dealt with by the Government including revenue risk.

Although the economic package for projects paid by a regular fee may not be as attractive to the private sector, this type of mechanism for high-risk projects can help to protect the private sector. By protecting the private sector the government will also benefit, since as always the ultimate responsibility lies with them. The government may be able to pass on most of the financial risks but they cannot avoid the social responsibility. Hence this proposed mechanism is believed to benefit all parties involved.

The details of the proposed risk-allocation mechanism will vary depending on the project itself. But it is likely that the payment will be a regular fee paid to the concessionaire based on performance and activity milestones. Under the agreed payment the concessionaire will deliver a service to the public according to standards as agreed to in the contract. If the concessionaire under-performs then they will be penalized by a deduction of their fees. In this way the concessionaire is monitored by the project's performance rather than usage of the facility. In the CCT project the concessionaire had to bear the revenue risk, hence their main priority was to generate revenue. They used toll prices and redirecting traffic to bring in revenue which just caused public frustration. Although the local government could have prevented these actions, they did not step in. If the consortium had not needed to worry about the revenue, the public would have been more satisfied. As a result the public perception of the facility, the project company and the Government would have been very different!

## CONCLUSIONS

The CCT was designed as part of a large infrastructure network plan for New South Wales, Australia. Due to its complexity and size, a PPP appeared to be an attractive delivery method. Under the PPP procurement the financing would be provided by the private sector. Also expertise and innovation which would otherwise be unavailable within the Government could be sought. As a result the Government managed to pass on many of the project risks to the private sector. Obviously for a project of this size there would be abundant financial opportunities for the private sector, hence they were very willing to take up the associated risks for the chance to be involved. The situation could have been a win-win case but unfortunately this was not actually what happened.

Media reports have reflected the CCT as an unsuccessful PPP project. For the consortium this may have been the case. For the Government, although they have received some negative critiques, at the end of the day they have still constructed a world-class infrastructure facility. For the general public, the scandal may have been more

amusing than having a serious effect. It is not easy and probably impossible to distinguish whether any case is either solely successful or a failure. Instead it is believed that lessons can be learnt from each case.

This paper has looked into a highly-profiled case and tried to recommend solutions to overcome the potential obstacles. As a result a more suitable risk-sharing mechanism for projects similar to the CCT has been presented to achieve win-win service outcomes.

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## APPENDIX

**Examples of Newspaper Headlines relating to the CCT when it opened** (Infrastructure Implementation Group, 2005)

**Appendix Examples of Newspaper Headlines relating to the CCT when it opened**
(Infrastructure Implementation Group, 2005)

## Tunnel cuts William St to one lane to trap drivers

The Daily Telegraph, 6 October 2005

# ‘Cheap’ tunnel buyback mooted

Australian Financial Review, 17 November 2005

# $105m TOLL OUTRAGE

**Motorists pay hidden charge to cross city**

The Daily Telegraph, 6 October 2005

# CROSS CITY GROVEL

**Three weeks toll-free but roads still colgged**

The Daily Telegraph, 14 October 2005-12-02

## Taken for a ride

**Tunnel at the crossroads**

Sydney Morning Herald, 13 October 2005

Changes to contract led to high tolls

The Daily Telegraph, 17 November 2005

Drivers to feel squeeze

Sydney Morning Herald, 28 November 2005

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# Development of a Conceptual Framework for the Study of Building Maintenance Operation Processes in the Context of Facility Management

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## ABSTRACT

Building maintenance operation processes are not noticeable and not attractive. With the development of facility management, there are impacts on the building maintenance operation processes in terms of cost, quality and process. Top management at the strategic level always challenges operation process efficiency from the planning stage to implementation. On the other hand, maintenance personnel at the operational level must face the challenge of insufficient maintenance resources and lack of support from top management. These misalignments do not help the effectiveness of maintenance and operation. This paper is part of a research study focusing on the development of a conceptual framework among the main aspects in building maintenance from the strategic and operational perspectives. The discussions include arguments on the maintenance policy, challenges of strategic maintenance decisions, and impacts on the maintenance operations from the influences of facility management as well as performance management. The aim is to uncover the grounds for the development of research questions in identifying the gaps between the top management at the strategic level and maintenance personnel at the operational level for improving the efficiency of maintenance operation processes. Main research questions are developed based on established overall conceptual framework, which consists of investigation about development of building maintenance objectives, types of challenges of building maintenance strategy, impacts of building maintenance in the context of facility management and improvement of building maintenance operation processes.

## KEYWORDS

Building maintenance
Maintenance policy
Sstrategic maintenance decision
Facility management
Performance management

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## INTRODUCTION

Traditionally, building maintenance is a labour intensive activity and its operation processes are not noticeable and not attractive (Seeley 1976; Jones and Collis 1996; Wood 1999). However, as times change, top management from the organizations' leaders as well as senior managers are now more concerned because building maintenance is a supporting activity for core business (Mak 1997; Chan et al. 2001; Tranfield and Denyer 2004; Osgood 2004). Furthermore, maintenance costs are escalating. One of the core competencies in facility management is building maintenance operation, which is regarded as an important function (Best et al. 2003; Chotipanich 2004). There are misalignments existing between organizational main business and operational sub business. As a result there are arguments about maintenance strategies, standards and resources between top management at the strategic level and maintenance personnel at the operational level, which hinder organizational effectiveness. These deficiencies are due to the lack of justification of the building maintenance objectives.

Management of building maintenance operation process is also changing pace with the development of facility management, which is focusing more on operations related to cost, quality and process aspects. However, maintenance practice in Hong Kong concentrates on time-based and failure-driven processes without a comprehensive maintenance approach (Tse 2002). Apart from the criticism of the effectiveness of planned preventive maintenance strategy (Wood 2003a; Horner et al. 1997, Spedding 1987), there may be similar challenges to other types of maintenance strategy. Facility management also has impacts on the building maintenance operation processes from three different dimensions; organizational facility management strategy, cost and quality aspects. These are considered as important information for the maintenance personnel at the operational level (Amaratunga et al. 2000; Pitt and Hinks 2001). Furthermore, building performance management is a key to managing building maintenance operation processes successfully (Loosemore and Hsin 2001). These processes need participation from all levels within an organization. However, there are gaps between the implementation of organizational performance management strategy and maintenance personnel.

Building maintenance operation processes require effective interactions between top management at the strategic level and maintenance personnel at the operational level in order to achieve organizational common goals with better operational performance. Therefore, understanding the justification of building maintenance objectives, types of challenges of maintenance strategy, impacts on building maintenance operation processes and integration for better performance management strategy is vital to both strategic and operational levels. It also provides more insights for the improvement of maintenance operation processes and specifically helps to minimize the gaps between strategic and operational levels for the benefits of an organization.

## FOUR MAIN ASPECTS IN BUILDING MAINTENANCE

The three components for the development of maintenance policy in the context of building maintenance management are maintenance strategy, acceptable standards and maintenance resources. These components are categorized as the main dimensions in the strategic management of building maintenance. Various studies (Seeley 1987; Spedding 1987; Lee 1987; Barrett 1995; Chanter and Swallow 1996; Horner et al. 1997) define maintenance policy as a management framework, which incorporates employing different types of maintenance strategy to ensure that the building facilities are maintained properly. Maintenance policy varies depending on the types of building facilities. However, it is difficult to agree on maintenance resources. Maintenance policy cannot be implemented effectively without sufficient maintenance resources (Oberg 2002). There are trends to rely on using technology but without matching organizational objectives (Madu 2000; Tse 2002). Managerial influences on the building maintenance policy such as decision making on strategic maintenance planning, formulating of maintenance plans and allocation of maintenance resources, are important for the study of building maintenance. The application of maintenance policy and strategy influences the building maintenance operation processes.

Strategic management involves the directions from the top level of an organization. The senior management usually dominates them. Building maintenance is categorized as a sub-business of an organization and is a supporting function. The strategic link between the strategic and operational levels is conceptualized as an essential component for successfully accomplishing organizational goals (Transfield and Denyer 2004; Drejer 2004; Lasher 2002). Thus, this link between strategic and operational levels is also becoming important for better planning of maintenance activities and resources allocation. Effective strategic management is essential to every business due to the business fluctuation and rapid changes of the external environment (Collins 1993; Lasher 2002; Drejer 2004). According to Tranfield and Denyer (2004) and Osgood (2004) that managing infrastructural assets including real estate, building facility is becoming more important because it is recognized as an important component of organizational strategy and the alignment of corporate and infrastructure strategy is the key for achieving organizational goals and objectives.

However, strategic management is not only the concern of top management. Madu (2000) emphasizes that it has to involve all staff employed in the development of organizational policy because there are gaps in the objectives between the organizational level and its sub-business units. Such gaps create obstacles to maximizing organizations' revenue. Zavadskas et al. (1998) suggest that efficiency-building lifetime strategy is based on the integration of functional considerations, financial optimization and the application of performance. This explains the importance of strategic management in building maintenance as strategic decisions influence building maintenance operation processes. However, the simulation requires strategic and operational analysis and decisions.

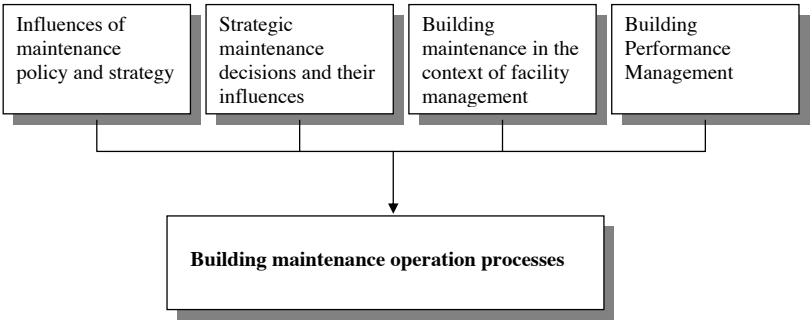
Facility management activities encompass most of the supporting

activities in the building-related business. According to the International Facility Management Association (IFMA) and the British Institute of Facilities Management (BIFM) facility management is in general required to manage people, premises and environmental aspects respectively. The similar concept is recognized by some of the researchers (Chan 1997; Chotipanich 2004). Furthermore, facility management is the management of infrastructure resources and is related to the support of organizational goals. Because of this broad scope, building operation and maintenance is therefore categorized as the sub-function of facility management (Nutt 2004). Amaratunga et al. (2000) argue that facility management is not only to minimize the running costs and maximize space, but also requires focusing on the building assets for people, operational processes and business performance. Facility management influences the building maintenance operation and is involved with several strategic issues by incorporating a strategic approach at the top management level and operational strategy at operational levels.

Measuring performance is becoming essential and it has been developed for helping organizations increase competitiveness and profitability. It is more important in identifying an organization's strength and weakness. Arguments exit on the methodology for performance measurement and it is necessary to identify strategies to achieve goals and objectives (Coetzee 1999; Tangen 2003; Amaratunga and Baldry, 2002). Building performance is one of the key issues for the need for performance improvement and must have contribution to business (Amaratunga et al., 2000). The factors related to building performance are facility efficiency, hygiene standards, indoor air quality, energy efficiency, lighting standards, thermal comfort, safety and information technology. There are challenges in the measuring methods of the performance in buildings. There is a direct link between facility management and performance management. Without knowing these, the performance of buildings is not known and improvement in building performance cannot be identified. In the development of facility management, performance management is essential and influences building maintenance operation.

The development of a conceptual framework follows discussions on maintenance policy, strategic maintenance decisions, facility management and performance management. Operation and maintenance of building maintenance is becoming important to a business and, due to its nature, it is a broad area to cover. The maintenance activity is no longer a standalone activity but requires careful planning of the maintenance processes. There are arguments about the maintenance policy and strategy, which are normally governed by the top management. In the field of facility management, building operation and maintenance is one of the competencies and impacts directly on the building users. The level of satisfaction on the performance of buildings is an indication to the maintenance personnel for improvement. Thus, the four aspects in the context of building maintenance all have direct and indirect connections and influence the building maintenance operation processes. The diagrammatic conceptual framework developed for the study of building maintenance is shown in Fig. 1.

**Fig. 1** ***Conceptual framework developed for the study of the main aspects of building maintenance***




## ARGUMENTS ON THE THREE MAIN COMPONENTS OF MAINTENANCE POLICY

The three main components of maintenance policy are maintenance strategy, maintenance standards and maintenance resources, which are developed from the principle of understanding the length of time for which the building requires maintaining for the present use, the life requirements of the buildings and their fittings and services, the standard to which the buildings and its services are to be maintained. The reaction time is defined as time between a defect occurring and the legal and statutory requirements (RICS, 1990; Seeley, 1987; Lee, 1987; Barrett, 1995; Chanter and Swallow, 1996). The maintenance policy is to integrate different maintenance strategies including corrective, preventive and condition based, the development of the recent five types of maintenance strategy is developed from the corrective, preventive and condition based (Horner et al., 1997; Chan et al., 2001).

Maintenance strategy depends on various factors such as standard, resources and the objectives of the organizations. There are arguments in adopting appropriate strategy recently, in particular preventive maintenance, which is receiving more challenges among other maintenance strategy (Wood, 1999, 2003a; Horner et al., 1997; Spedding, 1987). Loosemore and Hsin (2001) argue that the understanding of the relationship of planned preventive maintenance to facility and the core business objectives is inadequate. On the contrary, there are some suggestions for the better use of planned preventive maintenance (Shen and Lo, 1999; Tse, 2002; Chan et al. 2001). Coetzee (1999) suggests basing it on the detail design of the maintenance cycle processes for the specific organization.

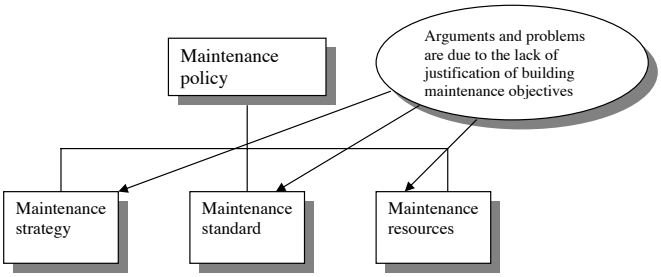
There are arguments about the maintenance standard (Then 1996; Zavadskas et al. 1998; Wood 2003a), which could not be solved in a similar way as the maintenance strategy. It depends on the maintenance resources available, the degree of maintenance standard and business objectives. Then (1996) argues that the maintenance

standard is fundamental to the maintenance process, which is limited by health, safety and use. The author focuses on the two basic components that will affect the maintenance standard, users of buildings, and users' perception of the internal environment of the space occupied. Zavadskas et al. (1998) suggests understanding more about organization and management may raise the maintenance standard. A balanced approach between top management at the strategic level and maintenance personnel at the operational level is required.

Top management is interesting in focusing on the maintenance resources to see if there is any ways to minimize the facility maintenance cost. This boosts recent studies in cutting facility operation cost. Maintenance at the operational level argues that the maintenance budget is always below the needs (Tse 2002; Lo et al. 2000; Lam 2000; Shen and Lo 1999, Pitt 1997) while the top management at the strategic level criticizes the inefficiency of the maintenance, which contributes to the wastage and makes it difficult to get more resources. El-Harm and Horner (2002) identify a number of common factors that affect maintenance costs such as building characteristics, tenant factors, maintenance factors (technical and administration), and political factors. Zavadskas et al. (1998) suggest an effective managing of available resources and Then (1996) suggests that it is necessary to justify the maintenance objectives before getting more maintenance resources. Although technology could help to improve the maintenance process, it is necessary to understand more about the management and operational context and the relationship between a building and its users (Wood 1999).

A conceptual framework is developed from the arguments of maintenance policy. The challenges of the maintenance strategy such as planned preventive maintenance, maintenance standard, and maintenance resources come from the inadequate information about the justification of building maintenance objectives. It is also necessary to justify the effectiveness of using technology in building maintenance. Building maintenance has connections with the organizational objectives, thus understanding the development of building maintenance objectives is important. Otherwise, the arguments and problems continue. The diagrammatic conceptual framework developed for the study of arguments about the maintenance policy is shown in Fig. 2.

**Fig. 2** ***A conceptual framework developed for the study of arguments about the maintenance policy***



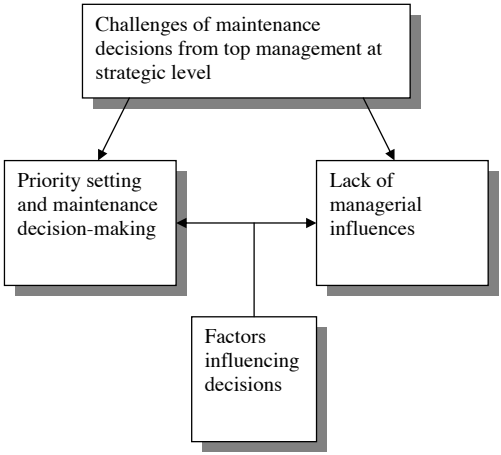
## CHALLENGES OF STRATEGIC MAINTENANCE DECISIONS AND INFLUENCES

There is a trend for having a common organizational strategy in an organization with multiple businesses. A strategy map is defined as a diagram to describe how an organization creates value by connecting all strategic objectives among sub-businesses in an organization (Tranfield and Denyer 2004; Drejer 2004; Lasher 2002). Each individual level sub-business within an organization will have its own strategy by defining the products or service that it will offer. However, there is mismatch when the links are not known and not clearly defined. Thus, some of the studies suggest studying these links among them, which is known as strategic alignment model (Osgood 2004; Madu 2000; Tangen 2003). The concept of the alignment model is to identify the key strategic elements between the organization and its sub-level business. In addition, Osgood (2004) agrees that it is also recognized as an effective tool for collecting, analyzing and communication information. Okumus (2003) suggests that organizational strategy involves all levels of management in an organization.

The major criteria in making decisions on building maintenance activities are building status, physical condition, importance of usage, effect on users, effect on fabric, and effect on service provision. The major common factors influence maintenance personnel in setting priorities for planned maintenance including technical, political, financial, social, economical and legal related (Shen1997; Shen and Lo 1999, Pitt 1997; Alani et al. 2002). Shen (1997) identifies the priority system as including safety, habitable (hygiene, security), operable and the appearance. The author also suggests having further investigation of managerial inputs and under what circumstances that a maintenance item is assigned. There are lots of criticisms on the maintenance personnel, who are rely too much on their technical knowledge and experience and are not concerned with the organizational goals and objectives (Chan et al. 2001; Alani et al. 2002; Amaratunga et al, 2000; Lo et al. 2000). This has an impact on the performance of the buildings. Therefore Madu (2000) suggests having a better communication channel among all levels of an organization.

The development of a conceptual framework follows the studies of the strategic management and building maintenance. There is a mismatch between the strategic and its sub-levels businesses. Top management challenge giving priority to maintenance decisions. Moreover, the managerial influencing at the maintenance operational level is based on technical and personnel experience but without any links to the organizational level. The diagrammatic representation of the conceptual framework developed for the study of challenges of strategic maintenance decisions and influences is summarized in Fig. 3.

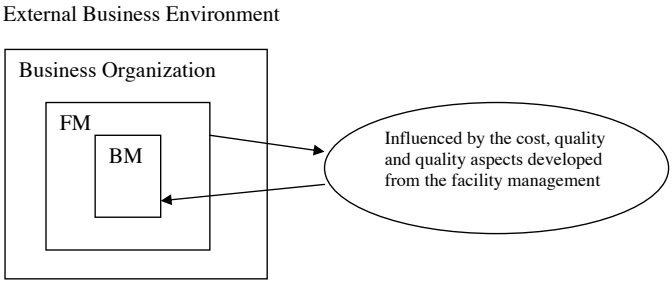
**Fig. 3** ***The conceptual framework for the study of challenges of strategic maintenance decisions and influences***




## THE IMPACT OF FACILITY MANAGEMENT ON THE BUILDING MAINTENANCE

There are various definitions among studies (Thomson 1990; Avis 1995; Barrett 1995; Nutt 1999, 2004). The broad scope of facility management depends on different organizations as they may have different facility management strategies. Because of this, it does not have clear definitions among the studies. In principle, the facility management functions encompass all property related supporting activities. Operation and maintenance of building is one of the facility management functions. Three major aspects in the context of facility management are cost, process and quality, which also have impacts on the building maintenance operations. Thus, a model for building maintenance in the context of facility management is established and illustrated in Fig. 4.

**Fig. 4** ***Model for building maintenance (BM) in the context of facility management (FM)***



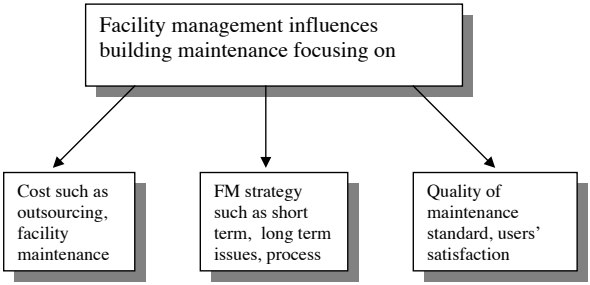
According to Chotipanich (2004) the two focuses in the facility management are strategic issues and operational issues. Operational level is related to strategic management of operation and maintenance of building and strategic direction of a long-term strategy for better relationship with the building users. However, there are three major aspects of facility management. Like the maintenance policy and strategy the facility management requires integrating different strategies for better facility management operation. They are concerned with facility cost, operation process and the quality.

Apart from these three major aspects, it is necessary to understand the organizational needs for facility management functions. Therefore, in the context of operational process, facility objectives are also important. Due to the nature of the broad scope of the facility management function, a contingency approach is required as suggested by researchers. As facility management concerned process, the link between facility management strategic directions and the organizational core business is also essential to successful facility management operation (Alexander 1994; Krumm et al. 1996, Then 1999, 2003). Customers play important roles in the facility management functions and have an impact on the strategic and operational level of facility management. With the nature of the context of building maintenance, a lot of criteria of building elements impact on the facility users such as environmental factors including air quality, ventilation, building defects, cleanliness of the physical environment. Studying the financial impact is also important in building maintenance (Pitts and Hicks 2001; Chotipanich 2004).

With the development of facility management, there are three main impacts on the building maintenance or building maintenance organization. It is believed that outsourcing of building maintenance activities is to maximize maintenance operational efficiency. There are questions of whether there is a cost saving, and a direct connection to the improvement of cost and quality. Like the building maintenance strategy perceived in the facility strategic level, facility strategy governs the building maintenance strategy, therefore it requires two different levels for management of facility management: strategic and operational. There are two purposes in quality, the first is concerned with the customers' satisfaction and the second is to improve the gaps in facility management services if necessary.

The development of the conceptual framework follows the studies about facility management and building maintenance. The building maintenance is the sub-function of facility management and influenced by facility management strategy, cost and quality aspects. Furthermore, there are links between facility management approaches and organizational core business. Since building maintenance is within the scope of facility management, thus facility management has an impact on the building maintenance operation with respect to facility management strategy, cost and quality. The diagrammatic representation of the conceptual framework developed for the study of the impact on facility management is shown in Fig. 5.

**Fig. 5** ***Conceptual framework developed for the study of the impact on building maintenance in the context of facility management***




## BUILDING PERFORMANCE AND BUILDING MAINTENANCE

There is no argument that customer satisfaction is important in the building management processes. However, the concerns about care of the building users are inadequate. It requires managerial inputs including the support of the top management as it involves the strategic and operational processes (Tangen 2003; Coetzee 1999). According to Wood (2003a) there is a link between a building facility and the needs of the end users. In addition, there is an association of maintenance strategy with the requirements of the building performance.

Then (1996) identifies two factors influencing the maintenance standard, users of buildings and users' perception of the internal environment of the space occupied. Some of the researchers (Horner et al. 1997; Wood 1999 and Madu 2000) conceptualize the important dimensions between maintenance approaches and the users' satisfaction. There are fewer studies investigating the relationships between the quality and the building maintenance. As time changes, the studies for the key performance indicators in the context of facility management are changing as well and are based on both financial and non-financial performances.

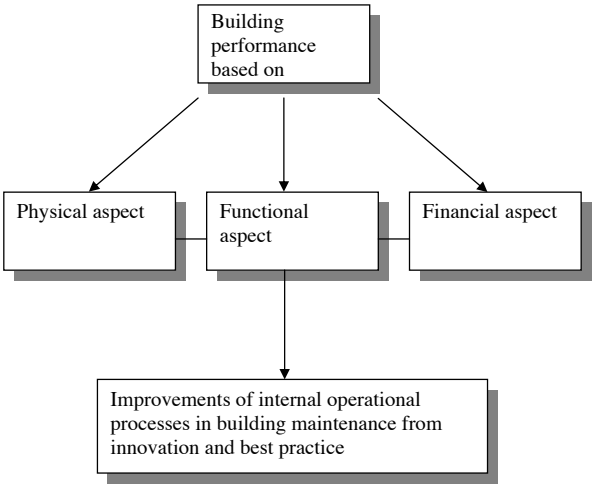
Loosemore and Hsin (2001) use approaches based on physical, functional and financial aspects in measuring building performance. Shohet (2003) uses the similar framework developed from Mcdougall and Hinks (2000) to establish quantitative indices for the evaluation of the efficiency of building maintenance in a building, in which the study concentrated on three major components of building performance, physical - building performance, functional - functional conditions, financial - maintenance efficiency. However, the link of the overall organizational effectiveness to performance measurement is outstanding.

Cooke (1996) focuses on four main perspectives for performance measurement. They are internal, competitive, non-competitive and best practice. Amaratunga et al. (2000) conceptualize a similar framework based on financial, customers, internal

processes and innovation. They are focusing on the comprehensive approaches as they use approaches of innovation and best practice concerning the organizational and operational improvement. Thus, the integration of Cooke (1996) on internal and best practices and Amaratunga et al. (2000) on the internal process and innovation are of a similar nature. They are categorized as essential components for the study of improvement for the building operation processes from the building performance aspect.

The conceptual framework is developed from the studies about performance management and building maintenance. Most of the studies adopt performance management as based on physical, functional and financial aspects. This study focuses on the improvements of the gaps between top management at the organizational, and maintenance personnel at the operational level. Thus it follows the four perspectives developed from the previous studies and in particular focusing on the internal process improvement. The diagrammatic conceptual framework developed for the study of improvement of internal operational processes in building maintenance is shown in Fig. 6.

**Fig. 6** ***Conceptual framework developed for the study of improvement of internal operational processes in building maintenance***



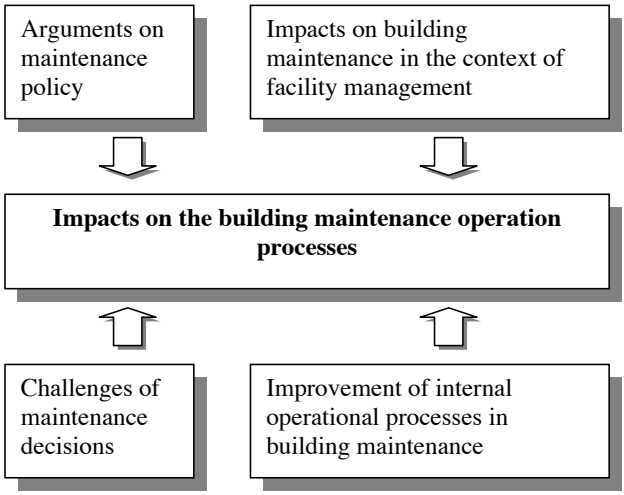
## OVERALL CONCEPTUAL FRAMEWORK

The overview of a conceptual framework focuses on the integration of the following:-

- The four main aspects in building maintenance
- The arguments of the three main components of maintenance policy
- Challenges of strategic maintenance decisions and influences
- Impact of facility management on building maintenance
- Building maintenance and building performance

It is concluded that the maintenance objectives are important to the maintenance organizations and the maintenance management is essentially connected with the strategic level and different sub-businesses levels within an organization. The challenges from the top management in maintenance strategy, maintenance standard and resources indicate that there is a mismatch between them. Most of the previous studies suggest investigating this connection. The development of facility management influences building maintenance in terms of facility management strategy, cost and quality aspects. The building maintenance operational processes are also essential considerations in facility maintenance services. Furthermore, understanding building performance is important to the facility, which has a direct impact on the customers and directly impact on the organization. The differences of performance management between organizational performance strategy and the improvement areas recommended by the maintenance personnel can be integrated for better improvement of building performance. Thus, the overall conceptual framework developed from this summary is shown in Fig. 7.

**Fig. 7** ***Overall conceptual framework developed for the study of building maintenance operation processes***



## DISCUSSIONS

The four main aspects; maintenance policy and strategy, strategic management, facility management and performance management in the context of building maintenance have connections with each other. Previous studies identify that there is a gap between the organizational strategy and its sub-level strategy, which is a barrier to improvement for maximizing organizational efficiency. There are suggestions to study the maintenance strategy and its relationship with the top management at the strategic level. Moreover, previous studies summarize that there is mismatch between the strategic and operational levels. Maintenance organization at the operational level is also finding ways to improve it. However, maintenance personnel are criticized as being too reliant on their technical experience and behaviour and for not connecting with the business objectives.

There are different facility strategies adopted by different organizations in terms of building maintenance in the context of facility management. Most of them are concerned with the cost only, but there is a lack of concern for quality and processes. Outsourcing activities have not been properly managed. There is a gap between the organizational and facility management strategy. As building maintenance is the sub-function of facility management, building maintenance is also concerned with cost, quality and process. Performance management is important to the building management organization. However, previous studies summarize that there is a lack of studies of the building users and the care for human factors. The main concern of the building performance is to improve the supporting services by integration of improvement of the strategic process and the operational process. There is also a lack of information about the relationships between performance indicators and the business objectives. It does not help to improve operational processes for further improvement.

## DEVELOPMENT OF BUILDING MAINTENANCE OBJECTIVES

The maintenance objectives should be considered in connection with the organizational objectives. However, there is a limited number of studies on how building maintenance objectives match with the organizational objectives in the organizational strategic level. In addition, types and characteristics of different managerial inputs from the operational level are not known. There may be difficulties in agreeing on the maintenance objectives and this has an impact on the efficiency and effectiveness of the organization. On the financial issues, most of the previous studies argue about the budget for maintenance activities, identified as always being insufficient and they suggest shifting the focus to the study of organizational needs (Tse 2002; Lo et al. 2000; Lam 2000; Shen and Lo 1999, Pitt 1997).

Previous studies seldom investigate the reasons for the allocation of maintenance resources. Maintenance management decisions depend on strategic directions as well as available resources. However, such information is missing. Prior to studying the relationship between the two levels, an investigation of how the maintenance personnel justify their maintenance objectives is suggested. Moreover, there is lack of study about how planned preventive maintenance is connected

with organizational objectives. It is helpful to understand how maintenance objectives are related to maintenance strategy, which may have influences on the facility management operation processes. There is a gap in the previous studies about the extent to which facilities support core business and the reason why.

Maintenance objective is one of the organizational sub-business objectives and is governed by the organization strategy. The planning of maintenance objectives have an impact on the facility management operation in terms of maintenance strategy, which influence the cost, quality and process directly and indirectly. On the contrary, there is a question of whether the top management is concerned with the maintenance strategy. Maintenance objectives are the fundamental element to explain the scope, the purposes and the aims of the maintenance activities and the relationships with the organizational objectives. However, maintenance personnel are criticized for narrowly focusing on the technical issues and not being concerned with the organizational goals and objectives (Chan et al. 2001; Alani et al. 2002; Amaratunga et al. 2000; Lo et al. 2000). The links between building maintenance operation and organization are important for achieving organizational goals effectiveness.

Investigations about how the maintenance objectives are established and the relationships between building maintenance and the business objectives are limited. It is also important to know how the relationships between the strategic level and the operational level are built up. Therefore some researchers study the alignment map between these two levels in order to have a better planning of maintenance activities and resources allocation (Tranfield and Denyer 2004; Drejer 2004; Lasher 2002). They argue that the mismatch between the two levels is increasing when the basis of the links and the maintenance objectives are not known or not clearly defined. Most of the organizations have not clearly defined their maintenance objectives and some organizations are even without maintenance objectives. In summary, arguments among maintenance strategy, standard and resources are due to the lack of justification of building maintenance objectives. This does not help to minimize and improve the gaps between the two different levels and thus this does not help to establish rational maintenance standards and the maintenance resource allocation.

## MAINTENANCE STRATEGY CHALLENGED BY THE TOP MANAGEMENT

Previous studies identify that there are different approaches in adopting a maintenance strategy (Wood 1999, 2003a; Horner et al. 1997; Spedding 1987; Loosemore and Hsin 2001). Like the maintenance standard and maintenance resources, maintenance strategies are different among different types of organizations. However, most of the previous studies have not addressed the identification of the types and the factors influencing the choice of strategic maintenance decisions at the operation level. It is particularly important to understand more about the two levels of strategy. The investigation of the types of maintenance strategy adopted by the maintenance personnel at the operational level and the reasons for choosing them are not known. This would contribute in-depth knowledge on why the maintenance strategy is adopted. Apart from planned preventive maintenance, which types of

maintenance strategy currently received more challenges on its efficiency and effectiveness are not known.

There is no further information to tell if other maintenance strategies receives similar challenges as planned preventive maintenance from the top management. Are they based on cost, quality and process? The investigation provides better understanding on why the top management challenge on certain types of maintenance strategy and the reasons behind. It helps to identify ways to improve the gaps between them. In addition, there is no further investigation of how maintenance objectives are related to maintenance strategy. It is considered necessary to show how important the maintenance strategy is related to the maintenance objectives. It helps to improve the effectiveness of the organizational business. It would also reduce the gaps between them. The study on how maintenance planning is linked to the measuring process is also needed.

A recent study considers the relationships between maintenance strategy and maintenance performance (Wood, 2003b). There are studies focusing on the major common factors influencing setting priorities for planned maintenance (Shen 1997; Shen and Lo 1999; Pitt 1997; Alani et al. 2002). However, maintenance personnel are criticized for being too reliant on their technical experience, and some of them are focusing on the major criteria influencing priority setting by using an analytic hierarchy process in quantitative analysis.

There is a strong argument, in particular from the senior management, that there are challenges to the effectiveness of planned maintenance (Wood 1999, 2003a; Horner et al., 1997; Spedding 1987; Loosemore and Hsin 2001). Some of them argue that there is no information on how the maintenance personnel at the operational level make decisions on formulating maintenance strategy in terms of planned maintenance, corrective maintenance and condition-based maintenance. In addition, there are suggestions for studying the different approaches that affect the strategic level at the top management for maximizing its maintenance efficiency. The more understanding there is about the challenges of the maintenance strategy, the more it helps to minimize the gaps between top management and maintenance personnel.

## IMPACTS ON THE BUILDING MAINTENANCE OPERATION PROCESSES IN THE CONTEXT OF FACILITY MANAGEMENT

Barriers exist between strategic and operational levels (Pitt and Hinks 2001). However, the study of how these barriers can be improved, which are obstacles in achieving organizational goals and objectives efficiently and effectively, is limited. The internal factors influencing facility management operation processes have direct impact on the building maintenance operation processes, but there has been no further investigation of how these factors influence the building maintenance process in the context of facility management. The methods for improving the operational processes are important but have not been addressed in the previous studies. In addition, there is no information to explain how the effectiveness of the maintenance organization is measured in carrying out the maintenance activities.

Better management of the facility processes including building maintenance help to improve the operational processes. Furthermore, there is a general perception that cost saving for outsourcing activities in the facility management context is the priority. Previous studies demonstrated that there are unsuccessful cases (Brown 2002; Copeland 2001; Crocker 1999; James 2000; Van der Werf, 2000). Facility management influences not only cost but also the processes and quality. There is no such information about how the building maintenance is affected in terms of quality and processes. As there are different ways of influencing among three major aspects on building maintenance, therefore understanding about the ways influencing among the three major aspects on building maintenance is important to the operational level for providing facility management services.

Building maintenance is under the strategic management of facility management and has impacts on the development from facility management strategy. Most of the previous studies indicate some organizations are focusing on cost saving only and do not concern about quality and processes, which does not help to the improvement of facility management services (Amaratunga et al., 2000). Quality concerns with building users while processes are related to the different approaches to manage different levels of strategy for implementation the facility operation. Majority of previous studies investigate the methods for cost saving including outsourcing activities (Pitts and Hinks, 2001; Chotipanich, 2004).

However, there are limited studies to address the management of quality and the operation process. Process improvement is important to the building maintenance in the context of facility management. It is sensitive particularly to the types of hospitality buildings. There are lacks of information on what the impacts on building maintenance are in the context of facility management in terms of the three major aspects. Cost is related to the facility operation and maintenance cost. Process considers with the long term strategy. However, facility management also concerns with short term and daily issues and require contingency approaches.

## IMPROVEMENT OF BUILDING MAINTENANCE OPERATION PROCESSES

One of the deficiency areas in the building maintenance operation is inadequate communication between the two different levels, organizational and operational level. Maintenance personnel are too reliant on their field of experience in particular on the technical issue. There is no further investigation to address the problems of building maintenance operation processes in connection with the management of different levels of strategies. This will provide richer information on how the process is improved at the operational level. The more understanding of the two levels strategies, the more opportunities there are to reduce the two barriers at the strategic and operational level for accomplishing common goals. There is also the question of how maintenance planning links with the measuring process such as management of measuring approaches (Tangen, 2003; Coetzee, 1999).

There is little understanding from previous studies about the types of factors and criteria influencing the relationships between strategic and

operational issues as well as the reasons behind them. Understanding internal factors influencing the facility management operation process helps improvement when an item in the building maintenance operation is identified. Knowing more about facility management processes helps to improve the operation process. However, there is no such information available about the ways to manage the facility management function better. There has been no investigation to address the ways of the management of the processes if improvement opportunity is identified. The improvement strategy may come from top management at strategic level. The study of influencing characteristics by the three aspects of facility management function (cost, quality and process) is not known. These are related to physical, functional and financial, which is important for minimizing the misunderstanding between the two levels (Loosemore and Hsin, 2001).

In the context of facility management, maintenance activities are no longer stand-alone activities. Facility management and building maintenance are required strategic directions with consideration of not only of cost effectiveness, but also concern with quality of building performance. However, there is the question of the management of operational processes, which requires more input from the maintenance personnel at the operational level. The process involves strategic planning of maintenance strategy, implementation, supervision, monitoring, measurement and reporting. Therefore most of the previous studies were concerned with the performance management, which is important to the building maintenance operation. It identifies where the processes need to be improved. The result of the measurement is important to the building maintenance operation. Otherwise, it does not help the organizational effectiveness.

There is a link between performance and buildings users (Wood 2003a). There are various developments for establishing the key performance indicators in the building maintenance. The measuring of the efficiency of the building in the performance management is to justify if the building user is satisfied, the results may show areas for improvement. However, the fundamental elements are to improve the strategic process and the operational process. Moreover, there may be variations, conflicts from the organizational level's internal processes and maintenance personnel during the improvement processes. It is essential to integrate these for better improvement. However, there is no information about how the appropriate processes and procedures are formulated.

## CONCLUSION AND RECOMMENDATION

The previous work related to building maintenance and its deficiencies between the operational and organizational levels are summarized. These include challenges of maintenance decisions and its influences due to lack of justification on building maintenance objectives. In the main aspects in the building maintenance operation, there are challenges from the top management on the maintenance efficiency and allocation of maintenance resources. With the development of facility management, it has more expectations from the organization and the customers. The challenges of maintenance strategy are influenced by the three major aspects of facility management as well as

the impact on building maintenance operation processes. The performance management helps to improve building operational processes. Based on the development of a conceptual framework and the subsequent discussions, the following are the recommended objectives for further studies:

- Define and identify problems in the building maintenance operation processes
- Understand how the maintenance personnel plan / justify building maintenance objectives
- Identify the categories of challenges of maintenance strategy
- Identify the categories of the impact on building maintenance operation processes due to facility management
- Improvement of maintenance operation processes from building performance management
- Develop ways for improvement of gaps between top management at strategic level and maintenance personnel at operational level

As discussed earlier, there are gaps between the top management at the strategic level and maintenance personnel at the operational level in managing building maintenance operation processes. The maintenance operation processes are also influenced by the aspects of facility management. The recommended research objectives could specifically study these areas to identify the types and characteristics of the gaps between the top management and the maintenance personnel. The findings could be grouped, categorized and summarized as follows for closing the gaps so as to improve the building maintenance operation efficiency.

- How do maintenance people at the operational level develop the maintenance objectives?
- Which types of maintenance strategy are more challenged by the top management and why?
- What is the impact of the building maintenance (BM) operation process in the context of facility management (FM)?
- How to improve the operational process if the performance measurement identified that there is an opportunity for improvement?

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