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Adaptive Reuse Potential: An examination of differences between urban and non-urban projects

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Abstract

Adaptive reuse of existing building stock is an important ingredient in the necessary adaptation of the constructed environment due to the impact of climate change and the need to conserve valuable resources into the future. This paper advances previous research that has developed a means to predict adaptive reuse potential (ARP) by obsolescence modelling, and compares this potential between urban and non-urban settings drawn from case studies in both Hong Kong and Australia. Through application of the ARP model, mean values are determined for a number of variables that suggest that the model relates equally well to different contexts. However, the data further suggests that the twelve urban cases in Hong Kong have a lower ARP score on average than the twelve non-urban cases in Australia, yet the maximum ARP score possible at the optimum intervention point is higher. This suggests that adaptive reuse intervention in Hong Kong is too late and has foregone an opportunity for economic, social and environmental gain. The results are also compared to a database of sixty-four completed adaptive reuse case studies worldwide to provide a comparative benchmark against which to assess the findings.

Keywords: adaptive reuse potential, obsolescence, intervention, existing building stock, Australia, Hong Kong

1. Introduction

Existing buildings that are obsolete or rapidly approaching disuse and potential demolition are a 'mine' of raw materials for new projects; a concept described by Chusid (1993) as 'urban ore'. An even more effective solution than raw material recovery is to leave the basic structure and fabric of the building intact, and change its use. This approach is called 'adaptive reuse'. Breathing 'new life' into existing buildings carries with it environmental and social benefits and helps to retain our national heritage. To date, a focus on economic factors alone has contributed to destruction of buildings well short of their physical lives.

This study extends the development of an integrated model for the assessment of adaptive reuse potential (ARP) by comparing case studies that are characterised as having an urban or non-urban setting. In the former instance, these cases have been collected from Central, Sheung Wan, Wan Chai and Mong Kok districts of Hong Kong SAR. In the latter instance, the cases have been extracted from a database of fifty project examples sited in Victoria, Australia.

Specifically this paper aims to:

1) compare the application of the ARP model in different settings, and
2) determine what lessons the application of the model points to that may provide insight into the practices that occur in both settings.

To achieve these aims this paper first provides an update on the integrated model that has been developed over the past two years, then outlines the method to be applied, describes the results obtained, and then provides some discussion and concluding remarks. The paper contributes not only to an analysis of urban and non-urban settings, but also highlights the fact that Hong Kong and Australia exhibit different performances in relation to adaptive reuse take-up.

2. Adaptive Reuse

The key concept embedded in the integrated model for predicting adaptive reuse potential, as developed primarily by the authors, is that opportunity rises and falls within the confines of a negative exponential decay function linked to a building's physical life expectancy. Maximum potential for adaptive reuse intervention is reached when building age and useful life coalesce, and around this point potential is either increasing or decreasing and can be quantifiably described as high, medium, low or no potential.

Figure I illustrates the conceptual framework that identifies adaptive reuse potential as first described in Langston and Shen (2007) and Langston et al. (2008), and provides some of the key mathematical descriptors. Readers are referred to the above papers for further information on the underpinning model.

<insert Figure I here>

Predicted useful life is determined as discounted physical life, where the discount rate is the annual obsolescence rate; itself made up of a series of physical, economic, functional, technological, social, legal and political attributes. The last four of these attributes also include aspects of environmental obsolescence. The predicted physical life is determined using a ‘calculator’ that rates a further series of environmental, occupancy and structural attributes. The outcome of these algorithms is translated into effective useful life, and represents the optimum point at which adaptive reuse intervention should occur.

Obsolescence is advanced as a suitable concept to objectively reduce the expected physical life of a building to its expected useful life. A discounting philosophy is adopted, whereby the annual obsolescence rate across all criteria is the ‘discount rate’ that performs this transformation. An algorithm based on a standard decay (negative exponential) curve produces an index of reuse potential (known as the ARP score) and is expressed as a percentage. Existing buildings in an organisation’s portfolio, or existing buildings across a city or territory, can therefore be ranked according to the potential they offer for adaptive reuse at any point in time. The decay curve can be reset by strategic capital investment during a renewal process by the current owner, or a future developer, at key intervals during a building’s life cycle.

ARP scores in excess of 50% have high adaptive reuse potential, scores between 20% and 50% have moderate potential, and scores below 20% have low value, representing about one-third of the area under the decay curve in each case. The word “potential’ here means that there is a propensity for projects to realise economic, social and environmental benefits when adaptive reuse is implemented. ARP is conceptualised as rising from zero to its maximum score at the point of its useful life, and then falling back to zero as it approaches physical life. Where the current building age is close to and less than the useful life, the model identifies that planning activities should commence.

Adaptive reuse is not a new concept, but it is a very powerful and pervasive one. The literature contains a number of examples of successful adaptive reuse, including defence estates (e.g. Doak, 1999; van Driesche and Lane, 2002), airfields (e.g. Gallent et al., 2000), government buildings (e.g. Abbotts et al., 2003), and industrial buildings (e.g. Ball, 1999; Anon. 2006). Around the world, adaptive reuse of historic buildings is seen as fundamental to sound government policy and sustainable development – e.g. in Atlanta, US (Newman, 2001), Canada (Brandt, 2006), Hong Kong (Poon, 2001), North Africa (Leone, 2003) and Australia (Maggs, 1999; McLaren, 1996).

The ARP score serves as a means of benchmarking (identifying low, moderate or high potential for reuse in individual buildings), timing (understanding increasing or decreasing reuse potential and prioritising work) and ranking mutually exclusive projects (the higher the score the more potential for reuse). Application of this integrated model makes it possible to quickly scan the stock of existing buildings within an organisation’s property portfolio or a specific location and to determine which buildings are worthy of further more detailed investigation for possible reuse.

The ARP model identifies and ranks potential for adaptive reuse in existing buildings, and therefore can be described as an intervention strategy to ensure that collective social value is optimised and future redundancy is planned.

3. Method

This study draws on work from two concurrent research projects. One project, funded by the Australian Research Council, involves a partnership between Bond University, Deakin University, Williams Boag Architects and the Uniting Church in Australia. The other project, funded by the Hong Kong Polytechnic University and based on a fundable but not funded Research Grants Council proposal, represents an internal grant with both authors as investigators. Each research project is actively collecting case study data concerning identification of potential opportunities for adaptive reuse in existing building stock.

To date, the Australian research project has collected information on fifty case studies in Victoria, Australia. Of these, twelve are based in rural areas well away from the city centre of Melbourne and key regional centres such as Ballarat and Bendigo. They comprise a mix of use but are all owned or occupied by the Uniting Church in Australia. The case studies include churches, worship centres, community halls, manses and shopfronts. All cases can be described as rural (non-urban).

Likewise, twelve case studies were collected from Hong Kong. This location was selected for two reasons. First, Hong Kong is an example of one of the most highly urbanised areas in the world, with a population density of 25.70/m^2 of land area[1], plus most existing building stock in Hong Kong is multi-storey with minimal land footprint and with constant pressure for demolition and redevelopment. Second, the use of a non-Australian urban environment adds further weight to the general notion that the ARP model is unaffected by geographic location and context. The case studies comprise shophouses (retail plus residential), marketplaces, and other properties that have commercial characteristics – all cases can be described as high density (urban).

Twelve cases per context sets up an interesting comparison. The ARP model is applied without modification to both urban and non-urban environments to test whether there is any obvious failure of application. The international aspect of the study will further expose any related weakness. In addition, a key question is what lessons can we learn from the adaptive reuse potential of projects across these different contexts.

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[1] Hong Kong SAR has a population of 7,018,636 and a land area of 1092 km^2, yet 75% of this land area is open countryside, so the urbanised component has a density of 25.70/m^2 and therefore represents one of the most densely populated urban environments in the world (www.worldatlas.com; en.wikipedia.org; www.citymayors.com).

Data analysis of the case studies was benchmarked against a database of sixty-four completed adaptive reuse case studies from across the world. These have been reported already in Langston (2008). Case studies comprise a wide mix of building type and location and hence can be considered as a 'baseline' for the purposes of interpretation of the new data in this paper.

4. Results

The mandatory ARP model data for each case study comprise:

- Date of original construction
- Date of subsequent major refurbishment
- Forecast of physical life
- Obsolescence score for each of physical, economic, functional, technological, social, legal and political criteria

This information enables the following additional items to be calculated:

- Building age
- Annual rate of obsolescence
- Predicted useful life
- Current ARP score and trend
- Maximum ARP score
- ARP risk exposure

Each Australian and Hong Kong case study is supplemented with field trip observations and inspections to verify the obsolescence estimates and other data. Some base information is derived from archival records held by the Uniting Church in Australia and from the Urban Renewal Authority in Hong Kong. The international baseline cases were compiled using an Internet-based desk survey.

Table I lists the key results from the investigation.

<insert Table I here>

5. Discussion

Four main observations are drawn from the results. Discussion of these observations leads to a better understanding of how effective the ARP model is in reality. The case studies should be treated as effectively random and hence there is no intentional bias in the mix.

Firstly, the mean building age is lower in Australia (75 years) than Hong Kong (83 years), and both are lower than the international average (100 years). This is probably a reflection of the respective age of various societies and, particularly over more recent times, the manner in which their built environments are treated. It is typical in Hong Kong for buildings to be kept in poor condition. Hong Kong is in fact well understood as a unique mix of old and new, of future and past, of clean and dirty. But heritage conservation in Hong Kong is not well advanced, and the level of protection available in most modern economies is not present here. Buildings designated as ‘declared monuments’ are given some level of protection, but all other projects (whether formally graded or not) are vulnerable. In Australia it is more likely to maintain buildings to a higher standard, and combined with the country’s relative youthfulness, it is not surprising that the mean building age is lower. The international case studies tend to be more prominent examples and in many instances are drawn from countries with longer histories.

Secondly, despite the above, the mean forecast of physical life is lower in Hong Kong (108 years) than Australia (135 years), and both are lower than the international average (154 years). This is a function of environmental context, occupancy profile, and structural integrity. Older buildings in Hong Kong were often not constructed to the same quality standards as found commonly in western countries, and the high-density urban setting can also accelerate their decay. Nevertheless, the physical life calculator appears equally applicable to urban and non-urban cases, with at least 93% of the criteria being assessable.

Thirdly, the mean annual rate of obsolescence, which is a function of score and physical life, is within the range of 0.34 (international) to 0.59 (Australia), with Hong Kong averaging 0.53. The coefficient of variation for urban cases is a very low 21%, indicating that the projects have very similar characteristics, while this rises to 70% for the non-urban cases and 53% for the international cases. It should be noted that in the latter instances, both datasets contain some cases with high annual obsolescence rates that increase the dispersion. It can be concluded, however, that the determination of obsolescence, by itself, is not a significant factor in the research outcomes. In the urban cases, economic obsolescence is rated at the minimum value of 0% due to proximity to market and population centres, whereas in the non-urban cases this is rated near the maximum value of 20% (i.e. all cases fall between 15-20%). Economic obsolescence is measured by the "*location of a building to a major city, central business district or other primary market or business hub* [and …] *useful life is effectively reduced if a building is located in a low density demographic*" (Langston, 2008: p.2-3). To some extent physical obsolescence, which is higher in Hong Kong where buildings appear to be allowed to decay more, and social obsolescence, which is higher in rural Australia due to changing social demographics and less observance of religious practices, tend to balance each other and leave economic obsolescence as the key difference.

Finally, the mean current ARP scores were lower in Hong Kong (36.2) than internationally (43.0) and in Australia (46.3), suggesting that the non-urban cases attracted more adaptive reuse potential. This is interesting because these same cases had a lower mean maximum ARP score. In other words, the mean maximum ARP score in Hong Kong was higher (66.8) than Australia (64.7), yet the mean current ARP scores give a reverse ranking. The mean maximum ARP score internationally is even lower at 56.9. So it can be concluded, at least based on the case study mix presented in this paper, that the urban projects have more potential for reuse but this is not realised as the point of intervention for renewal is too late. This is highlighted in the ARP trend comments that show that in Hong Kong all but one case has potential in decline. Indeed, the data shows that on average the intervention point for Hong Kong projects is 21 years too late, compared to Australia (3 years too late) and internationally (2 years too late). Having said that, many of the targeted case studies in Hong Kong and Australia have yet to undergo transformation, and so the intervention point may be even later than reported.

The twelve case studies in each of Hong Kong and Australia also indicate that the results obtained are quite robust, as all estimates have a low or negligible risk of influencing change to the ARP scores when either optimistic or pessimistic obsolescence values are introduced. The approach adopted in this paper is applicable to any country and can be used to model other contextual differences concerning management and setting.

6. Conclusion

From this research it was found that the ARP model developed previously by the authors is applicable to urban and non-urban cases, as typified by an essentially random selection of buildings from Hong Kong and Australia, and as benchmarked against international exemplars. The differences discovered were not so much a function of urban or non-urban, but of the cultural setting and practice between Hong Kong and Australia. Generally speaking, the cases studied in Hong Kong had more potential for adaptive reuse but this potential was to some extent wasted due to delay in actions, resulting in lost opportunity and accelerated decay. This finding suggests to the relevant authorities in Hong Kong that action should be taken sooner to reap the benefits that building reuse has to offer to both the economy and to social and environmental objectives. Australia seems to be dealing with this issue better than Hong Kong, and is indeed ahead of the international benchmark derived from completed adaptive reuse cases. The methodology adopted in this paper also presents guidance to similar studies in other countries or regions.

7. Acknowledgements

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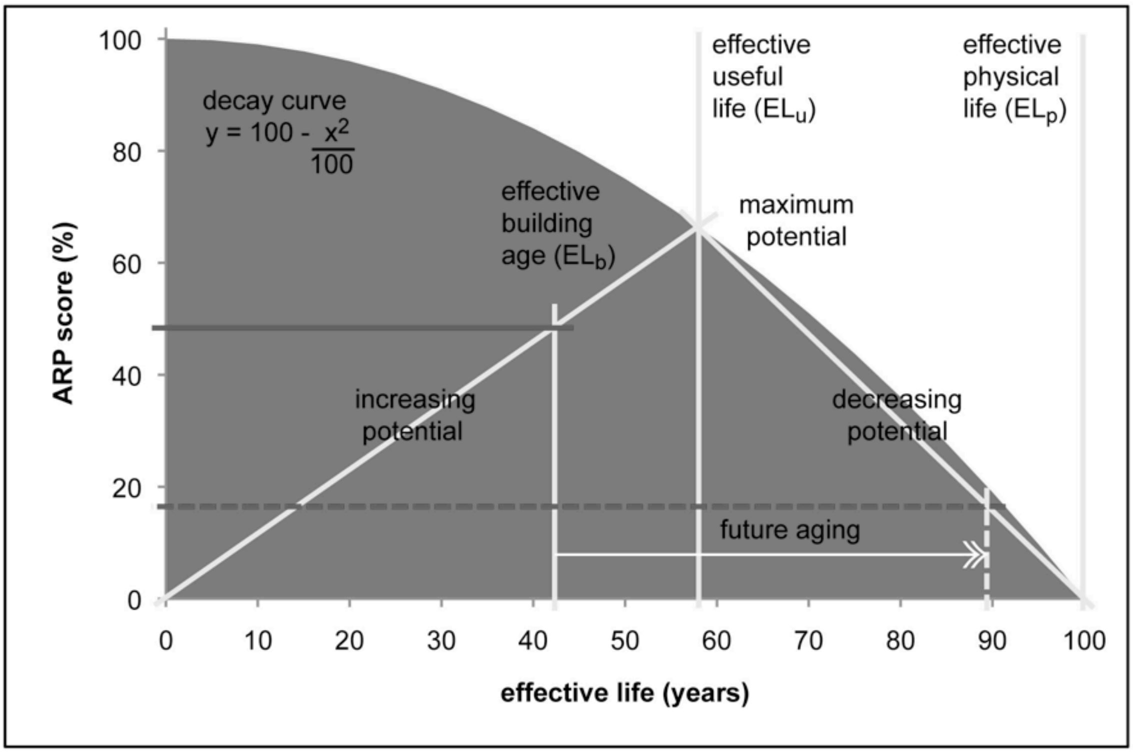
Figure I: Adaptive Reuse Potential Model



$$\text{ARP (increasing)} = \frac{100 - \frac{EL_u^2}{100} \cdot EL_b}{EL_u} \qquad \text{ARP (decreasing)} = \frac{100 - \frac{EL_u^2}{100}}{100 - EL_u} \cdot (100 - EL_b)$$

Table I: Adaptive Reuse Projects

Comparative database summary

today's date = 2009 (current building age reference point)

ID	date of construction	date of last refurbishment	building age	forecast of physical life	% of calculator completed	annual rate of obsolescence	predicted useful life	ARP score	years to useful life reached	ARP comments	maximum ARP score	ARP risk exposure	Street address and precinct
HONG KONG URBAN PROJECTS													
1	1906		103	150	100	0.43	78	47.7	-25	adaptive reuse potential is moderate and decreasing	72.7	nil	Western Market, 323 Des Voeux Road, Sheung Wan: Marketplace
2	1932		77	100	100	0.55	58	36.3	-19	adaptive reuse potential is moderate and decreasing	66.6	nil	Lui Seng Chun, 119 Lai Chi Kok Road, Mong Kok: Shophouses
3	1888		121	150	100	0.27	101	32.3	-20	adaptive reuse potential is moderate and decreasing	55.0	nil	60-66 Johnston Road, Wan Chai: Shophouses
4	1930	1946	63	100	100	0.60	55	57.3	-8	adaptive reuse potential is high and decreasing	69.8	nil	18 Ship Street, Wan Chai: Shophouses
5	1930		79	100	100	0.60	55	32.5	-24	adaptive reuse potential is moderate and decreasing	69.8	nil	186-190 Queens Road East, Wan Chai: Shophouses
6	1930		79	100	100	0.55	58	33.1	-21	adaptive reuse potential is moderate and decreasing	66.6	nil	190-204 and 210-212 Prince Edward Road East, Mong Kok: Shophouses
7	1920		89	100	100	0.70	50	16.5	-39	adaptive reuse potential is low and decreasing	75.2	nil	600-626 Shanghai Street, Mong Kok: Shophouses
8	1930		79	100	100	0.55	58	33.1	-21	adaptive reuse potential is moderate and decreasing	66.6	nil	1-2, 9-10 and 11-12 Yu Lok Lane, Sheung Wan: Shophouses
9	1930		79	100	100	0.55	58	33.1	-21	adaptive reuse potential is moderate and decreasing	66.6	nil	120 Wellington Street and 26A-C Graham Street, Central: Shophouses
10	1950		59	100	100	0.50	61	61.3	2	adaptive reuse potential is high and increasing	63.1	low	Bridges Street Market, Sheung Wan: Marketplace
11	1872	1925	84	100	100	0.60	55	24.8	-29	adaptive reuse potential is moderate and decreasing	69.8	nil	72-74A Stone Nullah Lane (Blue House), Wan Chai: Mixed development
12	1925		84	100	100	0.45	64	26.2	-20	adaptive reuse potential is moderate and decreasing	59.3	nil	1-11 Mallory Street and 6-12 Burrows Street Project, Wan Chai: Shophouses
averages:			83	108	100	0.53	62	36.2	-21		66.8		
					coefficient of variance =	21%							
AUSTRALIAN NON-URBAN PROJECTS													
19	1914		95	150	73	0.43	78	55.8	-17	adaptive reuse potential is high and decreasing	72.7	nil	167 Deakin Avenue Mildura: Worship Centre
20	1980		29	100	93	0.55	58	33.4	29	adaptive reuse potential is moderate and increasing	66.6	low	181 Esplanade Road Lakes Entrance: Worship Centre
29	1857		152	200	97	0.30	110	37.2	-42	adaptive reuse potential is moderate and decreasing	69.8	nil	52 Ebden Street Kyneton: Church
30	1901		108	200	97	0.30	110	68.6	2	adaptive reuse potential is high and increasing	69.8	nil	52 Ebden Street Kyneton: Community Hall
31	1857		152	200	97	0.30	110	37.2	-42	adaptive reuse potential is moderate and decreasing	69.8	nil	52 Ebden Street Kyneton: Manse
32	1980		29	75	93	0.80	41	49.0	12	adaptive reuse potential is moderate and increasing	69.7	low	1-3 Banool Road Tallangatta: Opportunity Shop
33	1970		39	100	93	0.50	61	40.5	22	adaptive reuse potential is moderate and increasing	63.1	nil	39 Vincent Street Wangaratta: Opportunity Shop
34	1961		48	150	93	0.47	75	48.4	27	adaptive reuse potential is moderate and increasing	75.3	nil	Corner Pearson and Church Streets Maffra: Community Hall
35	1958		51	50	93	1.80	20	0.0	-31	no adaptive reuse potential	0.0	nil	Church Street Rutherglen: Community Hall
36	1960		49	100	93	0.55	58	56.5	9	adaptive reuse potential is high and increasing	66.6	low	Beveridge Street Swan Hill: Community Hall
37	1918		91	200	97	0.35	99	68.9	8	adaptive reuse potential is high and increasing	75.3	low	Corner Beveridge and Rutherford Streets Swan Hill: Church
38	1950		59	100	93	0.75	47	60.4	-12	adaptive reuse potential is high and decreasing	77.6	nil	32 Ridgeway Street Mirboo North: Worship Centre
averages:			75	135	93	0.59	72	46.3	-3		64.7		
					coefficient of variance =	70%							
INTERNATIONAL COMPLETED PROJECTS (ENTIRE DATABASE)													
1-64													worldwide
averages:			100	154	100	0.34	98	43.0	-2		56.9		
					coefficient of variance =	53%							