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Developing an Effective Service Life asset management and valuation model

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Abstract: *This paper describes the development and testing of a depreciated replacement cost model for a portfolio of corporate real estate assets. In relation to corporate real estate, the model was found to be a useful catalyst for constructing a meaningful real estate database; it provides a ready reference schedule for CRE capital expenditure planning; it facilitates calculation of sums insured for replacement and indemnity insurance; it greatly reduces the time and cost of real estate value calculation for balance sheet and other purposes. In the general real estate market context, the model also has potential to assist in the valuation of non-residential properties in real estate markets where market sales data is non-existent or unreliable.*

Keywords: *real estate database, depreciated replacement cost, effective service life, depreciated cost method of valuation*

Introduction

Accurate, detailed, up-to-date information about corporate real estate assets has for many years been accepted in principle by CRE practitioners as the minimum requirement for effective management of real estate portfolios of every size. Ideally, the role of a database of CRE assets is to provide information that assists the CRE department in its day-to-day facility management function (whether in-house or outsourced), while contributing to the organisation's overall financial planning and asset decision-making - giving the CRE department something useful to bring to the table and thus to influence corporate strategy.

While the asset information held will vary between firms, possession of usable information concerning physical lives of assets, the likely amount and timing of major capital and maintenance expenditure and asset replacement values enables life-cycle maintenance and renewal to become an integral part of the organisation's strategic planning. Asset managers are therefore able to influence corporate decisions that affect their operations and, in a competently run organisation, have access to the necessary cash-flows without giving the CFO unpleasant surprises.

While most very large organisations have their CRE act together, industry practice in smaller organisations frequently departs from the principle for a variety of reasons that may be conveniently summarised as either lack of awareness of the benefits on the part of the organisation and or its CRE practitioners, or lack of resources for the (frequently daunting) task of putting together a useful working real estate database.

The purpose of developing the model in question was to provide a template for CRE managers to collate, calculate and maintain financial information about CRE assets. A major problem for the CRE manager is in demonstrating that the real, present-day expenditure necessary to set up an information base will be outweighed by less-measurable things like improved productivity and decision making. It was therefore considered an important part of the study that the time-cost of collecting the necessary information to build the model be documented and to demonstrate that this cost could be recouped in a tangible way over a relatively short period of time.

The Effective Service Life Asset Management and Forecasting Model needed to provide a forecast of the future replacement costs for a building's components when they occur and the depreciated replacement cost for the building based on the summation of the depreciated value of the building's components. To that end, the following issues needed to be addressed:

- definition of the building component structure and determination of the building components' expected service life and selection of appropriate data sources and reference guides;
- a method to adjust the effective service life of building components and address issues such as quality, environment and in use operating conditions;
- an estimating method to determine the replacement or reproduction cost of the building; and how the building and its component parts would be depreciated.

Definition and expected life of building components

Before the 1990s, research into the expected service life of building components and materials had been quite limited. Frohnsdorf and Martin (1996) highlighted this fact in their paper *Towards Prediction of Building Service Life: The Standards Imperative*, presented at the 7th International Conference for Durability of Building Materials and Components. They argued that

> "... twenty years ago, predicting the service lives of building materials and components was only a distant vision. Today, the possibility of incorporating predictions of service lives of materials and components into the design process for whole buildings is being given serious attention"(p.1417).

Since then, a considerable body of research into the lives of building components has been independently built up by government and professional organisations, particularly in the US and the UK.

The pursuit of a standard method for determining the durability and expected service life of building components and materials has come from the efforts of many internationally recognised organisations, such as the American Society for Testing Materials (ASTM), RILEM and the International Council for Research and Innovation in Building Construction (CIB). Significant progress was marked by the issue of the British Standards Institute BS 7543:1992 *Guide to Durability of Buildings and Building Elements, Products, and Components*, and the publication of the Architectural Institute of Japan's (1993) *Principal Guide for Service Life Planning of Buildings (English Edition)*, and the release of Canadian Standard S478-1994, *Guideline on Durability in Buildings*.

The culmination of the standardisation work in the durability and expected service life of building components and material was the issue of the International Standard ISO 15686 (2000), "Building and constructed assets – Service life planning" – Part 1: "General principles" and Part 2: "Service life prediction procedures" which "…deals with the general principles, issues and data needed to forecast service lives, and gives a method of estimating the service life of components or assemblies for use in specific building projects" (ISO 15686:2000 part 1, p. vii). ISO 15686 also provides a factor method to determine the estimated service life of a component by adjusting the reference service life by its quality, design level, work execution level, type of environment, in use condition and maintenance level.

It was decided to apply the ISO 15686 standards to the model and to test for the applicability of those standards to the sample portfolio.

Before the model could be developed, it was necessary to decide on the level of detail into which the building's component parts should be broken, striking the right balance between usefulness and expensive over-complication. The components had to be consistent with ISO 15686 and a method of measurement for each of the component parts had to exist. To ensure transportability and uniformity, the building structure was broken down into individual components or elements as provided by the Australian Institute of Quantity Surveyors (AIQS) *Australian Cost Management Manual Volume 1* July 2002. The AIQS manual's elemental convention and description provides the base definition and method of measurement for Australian building projects and has been adopted by the AIQS and Royal Australian Institute of Architects (RAIA). The AIQS definition of building structure provides for a breakdown into four levels, i.e. element, sub-element, sub-element divisions and further sub divisions. The model developed has, in the interests of simplicity, provided for a breakdown only to the 3rd level.

The following table provides the breakdown of the first two levels for the building components that was used:

TABLE 1	
Building Components 00-29	
00 Proportion of Preliminaries Total	16 Special Equipment Total
01 Substructure Total	17 Sanitary Fixtures Total
02 Columns Total	18 Sanitary Plumbing Total
03 Upper Floors Total	19 Water Supply Total
04 Staircases Total	20 Gas Service Total
05 Roof Total	21 Space Heating Total
06 External Walls Total	22 Ventilation Total
07 Windows Total	23 Evaporative Cooling Total
08 External Doors Total	24 Air Conditioning Total
09 Internal Walls Total	25 Fire Protection Total
10 Internal Screens and Borrowed Lights Total	26 Light & Power Total
11 Internal Doors Total	27 Communications Total
12 Wall Finishes Total	28 Transportation Systems Total
13 Floor Finishes Total	29 Special Services Total
14 Ceiling Finishes Total	
15 Fitments Total	
Site Components 30-42	
30 Centralised Energy Systems Total	37 External Stormwater Drainage Total
31 Alterations and Renovations Total	38 External Sewer Drainage Total
32 Site Preparation Total	39 External Water Supply Total
33 Roads, Footpaths and Paved Areas Total	40 External Gas Total
34 Boundary Walls, Fencing and Gates Total	41 External Fire Protection Total
35 Outbuildings & Covered Walkways Total	42 External Electric Light and Power Total
36 Landscaping and Improvements Total	

(AIQS 2002, p. A1-5)

Estimation of replacement or reproduction costs

Whether replacement cost or reproduction cost is used will largely depend on technology and on building and planning legislation applicable to a given building. It may be that when a building component needs replacement, only a technologically superior (and more expensive) component is available; or building regulations may require a fire-safety upgrade in the event of a major component replacement.

To estimate the replacement or reproduction cost, the unit in place method (Whipple 1995) was selected. The building is broken down into its component parts (as described in Table 1 above), measured as described in AIQS: 2002, then multiplied by the current cost per unit rate.

Current Component Replacement/Reproduction Cost ($) = Unit Rate ($/unit) x Quantity (units)

Cost per unit rate for the majority of the building components may be sourced from any current published construction cost guide. For the purposes of model development, Rawlinsons *Construction Cost Guide 2005* was selected as the reference source for costs per unit rate, although other readily available construction cost guides could have been used.

Forecasts for the cost of components that will be replaced in the future must be based on the proposed timing of these events. Therefore, the estimator must specify the year in which the components are to be replaced and then establish the current replacement/reproduction cost of the components.

Forecast Year of Replacement =Audit Year + Remaining Service Life

Audit Year = Year the forecast was undertaken

Remaining Service Life (Years) = Adjusted Expected Life (Years) – Age (Years)

Forecast replacement cost = Current Replacement Cost compounded at a general annual rate such as the Building Price Index, or a rate specific to the type of component if available, for the Remaining Service Life

Depreciated replacement cost

The 6th edition International Valuation Standards Committee (IVS) states that the depreciated replacement cost approach is;

> "…[a]n acceptable method used in financial reporting to arrive at a surrogate for the Market Value of specialised and limited market properties, for which market evidence is unavailable. DRC is based on an estimate of the Market Value for the Existing Use (MVEU) of the land plus the current gross replacement (or reproduction) costs of improvements less allowances for physical deterioration and all relevant forms of obsolescence and optimization (IVS 2, Valuation Bases Other Than Market Value, p. 382)

It provides a definition of depreciation as the:

> "Loss in value from the cost new and caused by physical deterioration, functional (technical) obsolescence, and/or economic (external) obsolescence" (IVS 2003, p. 282).

The model uses the breakdown method. The estimated replacement or reproduction costs for a building's components parts are determined and the individual components have an effective life assigned as described above. The depreciation rate is then derived based on straight-line depreciation. The model could be adapted to use other than straight-line depreciation methods such as the 'S' curve. However in testing the model it was found that the adjustment factors could successfully be used to account for items that were still going strong at the end of their depreciated lives.

$$\textit{Component Depreciation Rate} = \frac{\textit{Remaining life (Years)}}{\textit{Adjusted Expected Life (Years)}}$$

Adjusted Expected Life (Years) = Expected Life (Years) x ISO 15686 Factor

Depreciated Replacement Cost (\$) = Σ Current Component Replacement Cost (\$) x Component Depreciation Rate

A note on functional obsolescence

The issue of functional obsolescence is of great importance to CRE managers and their business unit clients. It is peculiar to the individual use in the specific building in a given place at a given time and vulnerable to all manner of external shocks and internal decisions, making general modelling problematic to say the least.

To some extent, the issue of technological obsolescence is resolved by the fact that, when building components are replaced, the new component meets the technological requirements of the day; i.e. generally components are replaced with their modern version, which reverses any pre-existing effects of technological obsolescence.

Functional obsolescence has not therefore been addressed in the development of the model, but should be accounted for by the CRE manager as a separate issue.

Development and testing of the model

Because ease of adoption was an important criterion, it was decided to use Microsoft Excel as the software platform. It is most widely used in business and enables the whole model to be accessed from the one reference sheet. The main limitations would be capacity and speed for very large portfolios, but the model could be quite simply adapted or redeveloped for other spreadsheets or databases.

The model was tested on a portfolio of 49 buildings of varying uses on five sites in three cities, with a 38,570 m^2 total gross floor area and 55.5 Hectare combined site area. Some buildings were on leased land and some sites were owned.

The model fit was tested against the number and variance in the ISO adjustment factor, which highlight the number of expected lives adjusted with respect to the listed reference lives. That is, if the reference life for a component is equal to its actual or estimated life determined following the audit, then the ISO 15686 adjustment factor would be set at the value 1 (one), representing no change between the reference life and the actual life of the component in use. Across the whole portfolio, there were few adjustment factors varying from the value one, with significant variances being even fewer. This leads to the conclusion that the expected lives from the global reference list provide a good fit with the specific portfolio's building components' actual expected lives determined by expert inspection.

Costs and benefits of the model

Data collection is carried out for every floor in every building. The categories shown in Table 1 represent a typical building and associated site improvements broken down so that all elements can be costed and condition assessed for Current Depreciated Value and remaining life.

A key consideration in the development of the model was the cost-effectiveness of data collection and input. Could the resources necessary to build the initial database be justified by the end benefits of the model? On completion of the data collection and input, the actual resources used were approximately 670 person-hours. Table 2 (below) provides an analysis of the resources in hours required for each stage of the data collection and input needed for the three main functional areas found in the test portfolio.

Table 2 Resources for data collection, tallying, entry and checking

Functional Area	Data Collection	Tallying	Data Entry	Checking
Administration	300m^2/hr	150 m^2/hr	1000 m^2/hr	500 m^2/hr
Storage	220 m^2/hr	110 m^2/hr	1000 m^2/hr	500 m^2/hr
Workshop/Laboratory	150 m^2/hr	75 m^2/hr	1000 m^2/hr	500 m^2/hr

Maintenance of the data subsequent to initial database set-up should be a by-product of accounting information gathered during development, replacement etc. and thus have little or no marginal cost, depending on the sophistication of the system. Modern relational databases can automatically capture and disseminate this type of information.

Potential savings would vary with the property and the organisation; some would be immediately quantifiable, while some would not. The major benefit of the system to corporate real estate executives is the ability to predict capital expenditure and estimate service life, which potentially enhances corporate decision-making that involves real estate assets. Credibly predicting the effects of better decision-making on the corporate bottom-line is, however, virtually impossible in most cases. It is the same situation CRE executives find themselves in when advocating spending money on a building to improve productivity – the construction cost is obvious and immediate, but the productivity benefit is in most cases difficult to estimate in terms of both dollars and timing. Still, measures of productivity (such as fewer work-days lost to illness) do exist; depending on the organisation, it may well be possible to put some numbers on the benefits of better asset deployment.

The harsh reality in most organisations is that a case that shows quantifiable benefits exceeding costs has a greater chance of success. Bearing that in mind, the case-study portfolio was examined for such potential savings. The portfolio requires valuation at two-yearly intervals for statutory purposes, which may be done externally or internally. Estimates from real estate valuers familiar with valuation of large portfolios of commercial and industrial real estate showed that valuing the case study portfolio would take approximately 160 professional hours, whereas the model produces appropriate values automatically. Insurance valuation, for the purposes of replacement and indemnity ISR insurance, must be carried out annually, with approximately 40 hours expended; again, the model produces these values automatically. A case can be mounted from this that the data collection would pay for itself in three or four years, with the potentially far greater benefits of informed property decision-making being the "cream on the cake".

Conclusions

Development of the Effective Service Life asset management and valuation model in question has been demonstrated to be useful in managing and in valuing a diverse portfolio of real estate assets, while providing reliable data to assist in making corporate decisions that depend to any extent on understanding the issues of life-cycle maintenance and renewal.

The cost of assembling a comprehensive property database was amortised in a fairly short time by use of the model, which may give encouragement to corporate real estate managers who have had trouble justifying their own database.

While it is not claimed that the model developed model is the answer to every corporate real estate manager's problems, it has proven adaptable to different types of property and has the potential to be tailor-made to any organisation's property portfolio and strategic management style. Its importance lies not in the detail, although the detail may be helpful to those who do not know where to begin, but in the demonstration of a principle with practical application.

If the exercise provides food for thought and inspires other corporate real estate managers, then it has justified the effort beyond its direct usefulness to the CRE managers of the case study portfolio.

References

Australian Institute of Quantity Surveyors & Master Builders Australia Inc, 1994, *Australian Standard Method of Measurement of Building Works,* Australian Institute of Quantity Surveyors & Master Builders Australia Inc, Deakin, ACT

Frohnsdorff, GJ & Martin, JW 1996, *Towards Prediction of Building Service Life: The Standards Imperative*, Building and Fire Research Laboratory, National Institute of Standards and Technology, Gaithersburg, Maryland, USA, viewed 23 July 2004, http://fire.nist.gov/bfrlpubs/build96/art047.html

International Organisation for Standardization 2000, *Buildings and constructed assets – Service life planning – Part 1: General principles* (ISO 15686-1:2000), ISO, Switzerland.

International Organisation for Standardization 2000, *Buildings and constructed assets – Service life planning – Part 2: Service life prediction procedures* (ISO 15686-2:2000), ISO, Switzerland.

Rawlinsons, 2005, *Construction Cost Guide 2005*, Rawlhouse Publishing, Perth, WA.

Whipple, RTM 1995, *Property Valuation and Analysis,* The Law Book Company, Sydney, NSW

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Appendix 1 – Overall Summary (replacement forecast extends for 25 years)

SITE NAME: City Central

Element (Building)	Current Replacement Cost	Building Area (sqm)	Rate / Sqm	Depreciated Replacement Cost	Adjusted Depreciated Replacement Cost	Overall Condition Index	REPLACEMENT FORECAST 2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Building 1	$4,582,276	2250	$2,037	$2,608,451	$2,626,631	1.0	$111,062	$0	$0	$0	$347,615	$169,357	$12,500	$34,500	$34,500
Building 2	$3,306,731	1500	$2,204	$2,263,964	$2,265,586	1.0	$60,782	$0	$0	$0	$425,590	$66,727	$236,995	$0	$0
Building 3	$2,540,708	1200	$2,117	$1,445,154	$1,476,613	1.0	$65,568	$0	$0	$0	$152,165	$56,578	$23,700	$338,060	$0
TOTAL	**$10,429,715**			**$6,317,569**	**$6,368,830**	**1.00**	**$237,412**	**$0**	**$0**	**$0**	**$925,370**	**$292,662**	**$273,195**	**$372,560**	**$34,500**

Element (Site)	Current Replacement Cost	Site Area	Rate / Sqm	Depreciated Replacement Cost	Adjusted Depreciated Replacement Cost	Overall Condition Rating	REPLACEMENT FORECAST 2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Building 1	$0			$0	$0	0.0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Building 2	$0			$0	$0	0.0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Building 3	$0			$0	$0	0.0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL	**$0**			**$0**	**$0**	**0.00**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Element (Land Area)	Fair Market Value	Comparable rate for land $/m²
	$0	
TOTAL	**$0**	

	Current Replacement Cost			Depreciated Replacement Cost	Adjusted Depreciated Replacement Cost	Overall Condition Index	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
TOTAL	**$10,429,715**			**$6,317,569**	**$6,368,830**	**1.00**	**$237,412**	**$0**	**$0**	**$0**	**$925,370**	**$292,662**	**$273,195**	**$372,560**	**$34,500**

Appendix B – Building 1 (first building element shown expanded)

BUILDING NO: 1 BUILDING NAME: One	AREA: 2,250 YEAR BUILT: 1949 / 1996	AUDIT YEAR 2004	Regional Adjustment Factor 1.00

Element (Building)	Item / Plant / Equipment	Elemental			Current Replacement Cost	Approx Year of Installation	Age (Yrs)	Inhere chara
		Quantity	Unit	Rate				A
00 Proportion of Preliminaries	0	$4,582,276		14.70%	$673,595		0	1.0
00 Proportion of Preliminaries	0				$0		0	1.0
00 Proportion of Preliminaries					$0		0	1.0
00 Proportion of Preliminaries Total					**$673,595**			
01 Substructure Total					**$118,125**			
02 Columns Total					**$65,250**			
03 Upper Floors Total					**$313,984**			
04 Staircases Total					**$86,840**			
05 Roof Total					**$92,024**			
06 External Walls Total					**$496,050**			
07 Windows Total					**$102,000**			
08 External Doors Total					**$22,900**			
09 Internal Walls Total					**$314,722**			
10 Internal Screens and Borrowed Lights Total					**$17,347**			
11 Internal Doors Total					**$46,700**			
12 Wall Finishes Total					**$79,412**			

Appendix B continued across sheet

ISO1586													
Inherent quality characteristics			Environment		Operation conditions		ISO15686 Adjustment Factor	Reference Service Life (Yrs)	Remaining Service Life (Yrs)	Estimated Remaining Service Life (Yrs)	Depreciated Replacement Cost	Adjusted Depreciated Replacement Cost	Condition Index
A	B	C	D	E	F	G							
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	100	100	100	$673,594.54	$673,594.54	
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	100	100	100	$0.00	$0.00	
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1	1	0	$0.00	$0.00	
											$673,594.54	**$673,594.54**	**1.0**
											$59,062.50	**$59,062.50**	**1.0**
											$20,390.63	**$20,390.63**	**1.0**
											$90,597.06	**$90,597.06**	**1.0**
											$49,729.57	**$49,729.57**	**1.0**
											$43,679.66	**$43,827.57**	**1.0**
											$193,195.06	**$193,195.06**	**1.0**
											$2,040.00	**$21,420.00**	**10.5**
											$16,086.67	**$15,960.00**	**1.0**
											$148,111.61	**$148,111.61**	**1.0**
											$13,877.60	**$13,877.60**	**1.0**
											$34,246.67	**$34,246.67**	**1.0**
											$15,882.48	**$15,882.48**	**1.0**

Appendix B continued across sheet (forecast extends for 25 years)

REPLACEMENT FORECAST												
2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$5,547	$0	$0	$0	$0	$0	$0	$0
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$102,000.00	$0.00	$0.00	$0.00
$1,900.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$79,412.40	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$79,412.40	$0.00	$0.00

Appendix C – Standard rates sheet

Element (Building)	Item / Plant / Equipment	Unit	Rate ($/m2)	Expected Life (Yrs)
00 Proportion of Preliminaries		$	14.7%	100
00 Proportion of Preliminaries		$	14.7%	100
00 Proportion of Preliminaries Total				
01 Substructure	Foundations office/lab	GFA	52.5	110
01 Substructure		GFA	52.5	110
01 Substructure		GFA	52.5	110
01 Substructure Total				
02 Columns	Reinforced Concrete	GFA	29	80
02 Columns	Reinforced Concrete	GFA	29	80
02 Columns	Reinforced Concrete	GFA	29	80
02 Columns Total				
03 Upper Floors	Timber	m2	195.9	70
03 Upper Floors	Concrete	m2	159	80
03 Upper Floors		m2		
03 Upper Floors Total				
04 Staircases	Timber	GFA	19.75	75
04 Staircases	Reinforced Concrete	GFA	19.75	75
04 Staircases Total				