EXPOSING THE MYTH OF THE 1:5:200 RATIO RELATING INITIAL COST, MAINTENANCE AND STAFFING COSTS OF OFFICE BUILDINGS

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In an attempt to focus clients' minds on the importance of considering the construction and maintenance costs of a commercial office building (both as a factor in staff productivity and as a fraction of lifetime staff costs) there is an often-quoted ratio of costs of 1:5:200, where for every one pound spent on construction cost, five are spent on maintenance and building operating costs and 200 on staffing and business operating costs. This seems to stem from a paper published by the Royal Academy of Engineering, in which no data is given and no derivation or defence of the ratio appears. The accompanying belief that higher quality design and construction increases staff productivity, and simultaneously reduces maintenance costs, how ever laudable, appears unsupported by research, and carries all the hallmarks of an "urban myth". In tracking down data about real buildings, a more realistic ratio appears to depend on a huge variety of variables, as well as the definition of the number of "lifetime" years. The ill-defined origins of the original ratio (1:5:200) describing these variables have made replication impossible. However, by using published sources of data, we have found that for three office buildings, a more realistic ratio is 1:0.4:12. As there is nothing in the public domain about what comprised the original research that gave rise to 1:5:200, it is not possible to make a true comparison between these new calculations and the originals. Clients and construction professionals stand to be misled because the popularity and widespread use of the wrong ratio appears to be mis-informing important investment and policy decisions.

Keywords: occupancy costs, staffing costs, maintenance costs, offices, urban myths.

INTRODUCTION

The often-quoted ratio of 1:5:200 (1 = construction cost; 5 = maintenance and building operating costs; 200 = business operating costs) for commercial office buildings over their lifetime appears to have originated from a Royal Academy of Engineering paper, "The Long Term Cost of Owning and Using Buildings" by Evans, Haryott, Haste and Jones (1998: p5). But this ratio is not supported by any research, information, data or analysis in the original article, which, in fact, merely mentions this ratio in passing, in an introductory comment, as having been derived elsewhere. This would not be particularly remarkable, but for the way that this idea has taken hold of a multitude of writers and analysts in our field. The ratio has not only become accepted by a large number of people, it also seems to have been adopted for informing major investment decisions. It frequently turns up with acknowledgement to Evans *et al.* (e.g. Pearce, 2003: p52) but occasionally is used unacknowledged (e.g. CABE, 2002: p19). The ratio appears to have been simply absorbed into conventional wisdom, without challenge as to its origins or accuracy. However, six years after the ratio was first published, there is still no evidence of data to support it.

Sir Peter Gershon (2002), in a speech at a Defence Estates Conference, referred to this ratio as follows: "the UK's Royal Academy of Engineering has analysed that the typical costs of owning a building are in the ratio of 1 part construction costs to 5 parts maintenance costs to 200 building operating costs". Similarly, Lord Sainsbury (2002) is under the impression that the Royal Academy of Engineering "found that" this ratio was typical. But the paper by Evans *et al.* clearly contains no analysis.

Bamfield (2002), in writing about the importance of whole life costs, refers to the "recent and widely reported research into office accommodation" curiously adding that the relationships work in reverse, and uses the 1:5:200 ratio to claim that a £100k *reduction* in capital cost *increases* a business's operating costs by £20m.

The ratio is recommended for use at the design stage of a building when the life cycle costs (LCC) of the building are considered (Pearce, 2003: p52). What is not clear, though, is whether LCCs become the future determinants of the "5" for maintenance costs or if the "5" is an elastic/balancing figure determined by the "200"(i.e. costs of operating the business determine what is available for building maintenance) or if "5" becomes a budget figure unrelated to the projected LCC figure.

We wrote to the authors of the Evans *et al.* paper and they told us that they no longer had the data, recalling that it had been provided by a major contractor from mainly US sources. Although the original data is no longer available, Ray Evans, one of the authors, has emailed his recall of the definitions of the terms used:

> *"the construction cost was the total construction cost, including land acquisition and professional fees, but excluding finance costs; maintenance costs included energy costs general maintenance repairs and decoration/refurbishment; operating costs included staff, equipment, consumables and all other business overheads. The building life was I think, 25 years."*

He also said that he thought that Chase Manhattan Bank had developed a similar ratio. This is confusing as in their paper Evans *et al.* used the phrase "operating costs" twice, in both the second (maintenance and building operating costs) and the third categories (business operating costs), whereas Evans' clarification uses the phrase in only the third category. It is also very strange to exclude the cost of finance from the first category, as this has a huge impact on the price paid for a building. Since there was no historic data available from the authors on the original ratio, it was clearly important to establish definitions of the terms used in the original ratio, i.e. construction cost, maintenance and building operating costs, and business operating costs.

If the ratio of 1:5:200 was correct, using the definitions of each term given by Evans *et al.*, then some very strange numbers emerge about the costs of staff housed in office buildings. For example, a building for 308 office staff was built for an initial capital cost (excluding finance) of approximately £3.5m (Brooks and Quirk 1999). The ratio would indicate that over 25 years, the business would spend 200 times the initial cost of the building on occupying and using the building, i.e. £700m, which is £28m per annum, or £91k *per office worker per year*. Another office building, with a total capital cost (excluding finance) of £24m houses 1,600 occupants. If the ratio is correct, their costs would be £120k, *per person, per year*. These figures indicate that the costs of occupation may have been over-estimated in the original ratio.

Turning to the maintenance part of the ratio, indicating that over its 25 year life we can expect to pay five times the capital cost of the building in maintenance costs, it is interesting to note that gross construction activity for the whole sector indicates that the UK spends less on repairs and maintenance than it does on new buildings

(Department of Trade and Industry 2003), not five times as much. The DTI's construction statistics are based on contractors' orders, so, like Evans *et al.* also do not take account of the cost of finance, and therefore one would expect an approximate match.

These approximations lead us to question how this ratio of 1:5:200 came about, and whether there is a more accurate ratio available, as the ratio seems to be wildly exaggerated.

THE MISSING CONTEXT

A simple internet search on UK sites reveals many uses for the ratio – ranging from industry (e.g. Building Design Partnership 2004) and government (e.g. Gershon 2002, Ministry of Defence 2002, etc.) through to various authoritative publications (e.g. a Guide to Risk Management from Collaborating for the Built Environment (2003), and the Client Guide for Arts Capital Programme Projects (CABE 2002: p19). Although not an accurate reading of the frequency with which these statistics are used, it shows how a simple "rule of thumb" has become "the norm", apparently without question. It is discussed by various government agencies and taken as authoritative and appears to be used in PFI project thinking. The spread of the ratio is like a game of "Chinese whispers", and few who quote the ratio pause to calculate what it really means. Hutcheson (1994) wrote about the need for building managers to develop a maintenance programme which optimized the building operating costs and the need for "tenants to occupy buildings on the basis of the cost-effectiveness of facilities, location, fit-out, and aesthetics balanced with rent". This implies that any fixity between the three parts of the ratio can be realigned depending on the tenant and his or her needs and building operating costs could become a "balancing" item and flexed with available funding. Riley and Cotgrave (2004) stress that lifecycle, refurbishment and maintenance costs are important with planned maintenance reducing the need for reactive maintenance. They note that refurbishment can be triggered by poor maintenance – i.e. not tied to any construction cost or business operating cost. Saxon (2002) picks up the idea of the ratio, and asserts that Evans *et al.* assumed a 20 year building lifespan, whereas Evans' e-mail to us claims it is based on 25. Moreover, he asserts that in Net Present Value terms, the ratio is a far less dramatic 1:1.5:60, but, like Evans *et al.*, he shows no data to support this calculation. Moreover, the ratio is now applied to all building types, not mentioning offices, but in the same paragraph, mentioning the significance of this ratio for hospitals, schools and laboratories. In a later paper, Saxon (2003: p2) returns to the 1:5:200 ratio and stresses the importance of "improving value by lowering costs" and concentrating on best serving the customer (i.e. tenant) and considering "benefit definition". He further adds to the 1:5:200 ratio by including a fourth term, design, at 0.1 of the original construction cost and then a fifth term, the performance for the occupying activity, which he pitches in a range from 250 to 2000. This extended ratio means that over the life of the facility the benefit generated from design runs from 1:2500 upwards. This is done to support the view that by putting emphasis on design there is greater performance benefit from the occupying organisation later; good design creates buildings which have no net cost! Again, there is no data to support these statistics and by taking the 0.1 out of the "1" the "1" is reduced to 0.9 and thus the original ratio is altered (or was the 0.1 supposed to have been excluded from the 1? It is impossible to say).

The inflated claims that follow in the wake of the simple ratio are in stark contrast to the wider literature. For example, Seeley (1996), in his text on cost modelling,

stresses that no two projects are identical and that using the historic data from one can be dangerous as a predictor of another. This would undermine the case for a fixed ratio of construction to building maintenance to business operating costs. Skitmore and Marston (1999) examine all the inputs of cost modelling, and the various available models show that, depending on which is used, the data and information output will vary. This is endorsed by the BMI (2003: p5) noting that when considering the occupancy costs one should consider the building size, shape and layout, specification, intensity of use, location and orientation and noting that "the actual cost and ratio of the costs between these elements can vary from building to building…"

It is not as if this were a new idea. Stone (1980) deserves considerable comment. He provides alternative ratios as well as a guide to initial cost and building operating costs. He suggests that "often the running costs of a building are three times as great as the first costs" (p xii), conflicting with the notion of 1:5 in the ratio under review. Stone also states that "Energy costs are two or three times as great as maintenance costs and equivalent to a substantial proportion of structural costs." (p xiv) He also stresses "…the cost of construction is only the first cost and far less important than the subsequent costs associated with running the building and operating it." (p 3) He also considers such issues as rates of interest which could affect a ratio and the sensitivity of interest rates on the life of the building, as well as inflation and other resource costs. Short lifetimes reduce a building's value without reducing costs – simply because there is no way of economically constructing a building for a short life. Stone also sets out a cost table (p15) which shows that the initial cost of offices is 53%, with maintenance at 14% and fuel and attendance for heating and lighting at 33%, at a net discount rate of 5%. "The proportions of running costs tends to be lower the higher the initial cost of the building and the fewer the hours per year for which the building is used" (p15). Stone also examines the cost of multi-storey buildings, the costs of which can be affected by the country in which the building is constructed. Running costs too, increase with storey numbers because of the additional services needed to access the upper levels.

Wong (2000) examines a method for assessing the value of commercial property in order to be able to cost and time the refurbishment most economically. This, too, could affect a ratio: higher quality in the construction process (but not necessarily at higher cost) should reduce the costs of maintenance.

From the literature search we found that the ratio was widely reported, always with approval and always without question. Further, the literature provides plenty of possibilities for determining key building factors to consider when constructing a ratio of this kind (e.g. Axcell, Procter and Fennell 2001, Baum 1994, Jones Lang Lasalle 2003), and indicates that 1:5:200 seems to be either a gross exaggeration, or a simple error, as most of the real estate literature argues that property, in total, constitutes between 10 and 30% of the costs of running a business.

DEFINITIONS

(a) The original definitions

For defining the various costs included in a calculation of ratios, we started with Ray Evans' definition, as e-mailed to us. Our purpose was to see if we could calculate a ratio using data on real buildings. In the process of researching we discovered that there were numerous other ways of defining these components and that the data was not always available to fulfil all three categories from a single source e.g. the construction cost might be available but the business operating costs were not. Some of the research is summarised in Table 1.

(b) Our Definitions

Table 1 highlights discrepancies in definitions and shows the difficulty of replicating the original research and tracing comparable data. During preliminary research it became apparent that there were difficulties in finding the business operating costs where we could find the matching building (construction and maintenance) costs. In other words, it was challenging to find all the components of the Evans *et al.* ratio in one building. Indeed, this is a problem also encountered by others who have tried to calculate the impact of property costs on the operation of a business (Axcell *et al.* 2001 deal with this problem extensively).

RESEARCH

The two hypotheses that flow from this discussion are:

- The ratio of 1:5:200 is realistic and repeatable.
- 3% is a reasonable proportion for a building operator to spend on procuring and maintaining the building, compared to the cost of people working in the building.

Initially, we did some preliminary testing by telephone with three facilities management companies to see what information might be available. We then emailed eight consenting companies who had new buildings and knew their maintenance and operating costs – but none knew the business operating costs for their buildings because, although they were sole occupants of new buildings, they were but one portion of large international companies which did not allocate operating costs to particular buildings. Thus we sought out secondary data sources to provide indicative numbers for calculating likely ratios.

RESULTS

Using the definition as supplied by Evans in our preliminary testing, we discovered that the respondents neither knew the financing costs of the building, nor the planning costs. They were all rolled in to the heading of "construction costs". Similarly, there were other categories to be entered under Building Operating Costs and Business Operating Costs. This was why we redefined the three categories as in Table 2. We did secure data on two buildings, as shown in Table 3, but this only confirms what much of the literature had told us, that businesses do not know their operating costs. Even so, this provides data for the ratio relating capital spend to maintenance, and assuming a 25 year life, we can see that 1:5 is way over the mark, the first building will cost £165m to maintain throughout its life (1:1.2), and the second £113m (1:0.4).

Table 1: Various definitions of the prime components of the 1:5:200 ratio

Author(s)	Construction	Building operating costs	Business operating costs	Building lifetime
Evans *et al.* (1998)	Total construction cost including land acquisition, professional fees – excluding finance costs	Energy costs, general maintenance repairs, decoration/ refurbishment	Staff, equipment, consumables and all other business overheads	25 years
Williams (1999)		Premises occupation costs: operating costs, maint., cleaning, housekeeping, energy, water, sewerage, waste mgmt, interior and exterior landscaping, fitting out, alterations (fitting out and procurement) PLUS support services: security, storage, stationery, printing and reprographics, IT, communications, office furniture, churn, motor fleet mgmt, disaster prevention and recovery.	Staff support costs: catering, health and safety, sports, social and welfare facilities	
Jones Lang Lasalle (2003)		Energy, security, heating and aircon maint, building mgmt fees, cleaning, repairs and maintenance, building staff costs, lifts, sundries, insurance, water		
Bulding Maint Info (2003)		Cleaning, utilities, admin costs, overheads		
Brooks and Quirk (1999)	Build cost, less capital allowance, plus finance cost	Occupancy: M&E maint, lifts, fabric, external land, internal planting, cleaning, wastes, electricity, gas, water, reception, comms, post room, porterage, internal moves, security, catering, mgmt, replacement.	Cost $£/ft^2/$ number of occupant=cost £/head	Whole life cost over 25 years
Building Cost Information Service (2003)	"Rate per m^2 gross internal floor area for the building excluding external works and contingencies and with preliminaries apportioned by cost".			

Since both buildings were fairly new, neither had undergone major refurbishment. Neither of the respondents had access to any original life cycle costing information. Moreover, neither could say what their business operating costs were, rendering the direct calculation of the third term of the ratio impossible. However, it is interesting to note that, by comparison with the cheaper one, the more expensive building housed fewer employees and cost less to maintain. If nothing else, this confirms that ratios relating these factors must vary by a huge amount.

Table 2: Definitions used to re-test the ratio of 1:5:200

Evans *et al*. (1998) category	Defined in this paper as
Construction costs	Land, financing, planning, design, construction
Building operating costs	Operating costs, maintenance, cleaning, housekeeping, energy, water, sewerage, waste management, interior landscaping, exterior landscaping, fitting out, alterations
Business operating costs	Business support services (security, storage, stationery, printing and reproduction, IT, communications, office furniture, churn, motor fleet management, disaster prevention and recovery, staff support costs (catering, health and safety), sports, social and welfare facilities), staff direct costs (salaries and wages)
Lifetime	To be defined according by building selected

One of the magazine articles encountered during this research (Brooks and Quirk 1999), produced by a major national QS practice, carried cost data for three office buildings which covered capital, maintenance and running costs, as well as the number of people employed in each building. This provided a basis for a rough and ready calculation of a ratio for three different buildings. The data shown in Table 4 is based on that provided by Brooks and Quirk, and the labour costs for the staff employed in these buildings are derived from the Labour Force Survey (Office of National Statistics 1999) for the same period, to ensure that the prices are all calculated at 1999 levels, first quarter. It is important to note that all the numbers in Table 4 are for 25 years of operation, and have been discounted back to the same base date, but we have also included the cost of finance, in accordance with our definition and in accordance with Brooks and Quirk's data. But the finance costs in Brooks and Quirk's data were very large, roughly the same as the initial capital cost of the building (i.e. price paid to the contractor). But even if the finance costs are omitted, and the money flows are not discounted, the resulting ratio for Building A would be in the order of 1:1:30, which is still nowhere near 1:5:200.

DISCUSSION

The initial attempts to get data directly from firms revealed just how difficult it is to find consistently recorded financial data from such firms. Each has its own ideas about how to monitor and report their financial data. The discovery that there was plenty of data already published was interesting, and brings three things into sharp relief: first, there is clearly tremendous variability in such numbers, rendering a single ratio completely inappropriate. Second, there is no need to pluck arbitrary figures out of the air. Third, the omission of finance costs and discounting the money flows render the original ratio meaningless. This ratio does not certainly prove that more money spent on design and/or construction can reduce expenditure in the long term.

Table 3: Two buildings for initial case studies

	Building 1	Building 2
Structure	Concrete frame, air conditioned	Concrete frame, air conditioned
Capacity	5,000 employees	4,000 employees
Construction cost (incl. design)	£141m	£320m
Year of opening	1999	2003
Building maintenance costs	£6.6m	£4.5m
Business operating costs	Not available	Not available

Table 4: Ratio calculation based on three UK office buildings

Whole life cost model		Building A	B	C
Number of occupants		308	787	1600
Size of building (sq ft)		40,000	100,000	200,000
Total cost of building (X)		7,712,937	18,684,676	51,477,744
M&E maintenance (for 25 yrs)		2,025,000	3,000,000	5,500,000
Replacement (over 25 yrs)		1,890,766	4,117,241	7,670,912
Total annual maintenance 25 yrs (Y)		3,915,766	7,117,241	13,170,912
Other occupancy costs (over 25 yrs)		19,189,175	39,943,190	68,353,000
Agg. Annual wages (in adv, over 25 yrs)		79,624,677	203,456,560	413,634,684
Occ. costs plus salaries for 25 yrs (Z)		98,813,852	243,399,750	481,987,684
Ratio calculation	X:Y	0.508	0.381	0.256
	X:Z	12.811	13.027	9.363
	X:Y:Z	**1: 0.5: 12.8**	**1: 0.4: 13**	**1: 0.3: 9.4**
Proportion of business costs	**(X+Y)/Z**	**12%**	**11%**	**13%**

Extrapolated from Brooks and Quirk (1999) and Office of National Statistics (1999)

Hypothesis I

Clearly, the popular ratio of 1:5:200 is hugely overstated. Of course, we acknowledge that there are weaknesses in our own, perhaps incomplete, calculations. For example, weaknesses include the fact that there is no consideration of regional variations in construction, location or staff costs, all of which have been shown to be highly significant (Axcell *et al.* 2001). Our ratios may not account for all business costs, such as employer's contributions to National Insurance, etc. But all of our data is from the same period and it has all been discounted back to a common base date. On the other hand, the weaknesses and gaps are clear and explicit and the calculations are replicable. These are two very desirable factors for such calculations and factors that do not apply to the Evans *et al.* paper. As a guideline, we have been able to provide an important and repeatable calculation for strategic decision-making such as whether to procure a building or not, but one which is open to critique and refinement. Taking the average of each term in the three ratios, we can see that an approximate ratio is 1:0.4:12.

One worrying fact is the use apparently made of the Evans *et al.* ratio in assessing life cycle costs at the early stages of decisions on PFI projects (Office of Government Commerce 2004) and its use can have implications for the eventual costs of running the building. For example, if a building is of higher quality, the maintenance costs should be less over the lifetime. Therefore any ongoing rentals/leasing costs should reflect this and not the higher "5" value. Many on-going leases are fixed early in the construction phase (when there is the least project certainty and the high risk reflected in the financing) and are reviewed after pre-determined time e.g. five years. But under PFI projects the special purpose vehicle (SPV) may refinance at a more favourable rate of interest (when the risk has reduced) but the costs of the project are often still financed by the original contract terms. If the ratio has been used in the decision to build this could have a material effect on significance on the cost of ownership and can heavily unbalance this ratio.

Hypothesis II

The second hypothesis was to test was whether 3% was a fair test of the relationship between the cost of operating the building and the business costs as defined in this paper. There is clear evidence from the simple calculations in this paper the relationship is very different. While our figures show that owning and maintaining a building may account for 11-13% of the costs of running a business, the discussions in the academic real estate literature place the same costs somewhere between 10 and 30% of the costs of running a business (see Axcell *et al.* 2001 for more detailed discussion of previous work on calculating these proportions, but where different ways of accounting for the "soft FM" costs would account for their higher proportions). Clearly, the costs are highly variable and very difficult to measure.

CONCLUSIONS

It was not possible to reproduce the original (Evans *et al.*) ratio because (a) the original data no longer exists and (b) the original definitions could not be applied. Perhaps the original 1:5:200 ratio was simply meant to be a statement to focus clients' attention on the importance of looking at the lifetime cost of the building in relation to obviously higher staff costs. If this was the purpose of the original ratio then subsequent users of the ratio have misused it. It is not so much the frequency of use of this ratio, but rather the authority and gravitas assigned to it that is a problem.
The newly-calculated ratios are based on real data and differ widely from each other, but most of all they differ by orders of magnitude from the 1:5:200. The idea of a ratio for a particular building may help clients' focus on improving building quality to reduce lifetime maintenance costs without intimidating them from the expense of including quality in the original construction. But every building is affected by its location, height, composition, energy consumption and a plethora of other differentiation points – all of which give each building a unique ratio.
The first two terms of the ratio indicate the overall proportion of a company's expenditure that is spent directly on the building. While Evans *et al.* were pitching this at 3%, everyone else who deals with real numbers is arguing about where it lies in a band that varies from 10% to 30% of the costs of running a business. The three ratios that we have calculated show that this is around 12%, from which we can conclude that there is clearly a great deal of variability in how to account for the operating costs of a business, and there is a lot to be done in bringing some consistency to this area of business accounting.
Finally, perhaps the most worrying feature of this whole discussion is how this passing introductory remark in the paper by Evans *et al.* has gained the status of a finding from research carried out by the Royal Academy of Engineering, which it most certainly is not!

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