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ICCEPM 2024 https://dx.doi.org/10.6106/ICCEPM.2024.0738
The 10th International Conference on Construction Engineering and Project Management
Jul. 29- Aug. 1, 2024, Sapporo

Problems of construction cost measurement models from the aspect of users in England.

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Abstract
Cost measurement plays the fundamental role within the modern construction and project management models, where not only materials, labors and services are measured by cost but also programme delays, quality defects and project risks are converted to be measured as cost. However, the problems of cost measurement models have been analyzed only from the aspect of owners and contractors who construct the buildings, not from the aspect of users who use buildings. In this article, analysis of data surrounding the current high inflation of construction costs in England is conducted, to find out its route causes within the current and historical development of construction cost measurement models. The conclusion is that current cost measurement models are based on the aspect of owners and contractors, which is to assess buildings as monetary asset for short-term taxation purpose, without due regard how buildings are used by users for long-term. Alternative cost measurement models based on the aspect of users are proposed, which assess buildings as functional asset for its long life-cycle. Pros and cons of these two adverse models are discussed in details, and harmonization between owners, contractors and users are sought, in order to arrive at a more consistent cost measurement approach which can be equally applied to buildings and built-environment by all stakeholders involved.

Intro-literature review-research method

The appraisal practices and performance measurement were discussed by Crosby, N. et al [1], New Rules of Measurement for building maintenance works (NRM3)[2] and ICMS Standards for life-cycle costs[3] were published, and the delay and disruption protocol was issued by Society of Construction Law (SCL)[4] around the extension of time and monetary compensation. However, a simple question how the value and cost of buildings are measured requires further investigation not only from the aspect of owners and contractors but also users. As a background, Tanaka, K explained[5] the historical evolution of measurement models in England, where Domesday Book in 1086 states the first physical measurement of land and buildings for the new King William, whereas poor laws in 16th century developed the measurement as survey and valuation for taxation, which over the years evolved into the current monetary measurement established in 19-20th century[6] [7].

In this paper, actual data of London projects are used to explain the current measurement model, and macro data of economy[8] and land registry[9] house prices in London South East are examined from users' perspectives. Further, referring to the actual cost of operation of a residential property, alternative models are proposed, and pros-and-cons analysis are conducted around the life cycle, timing, and cost of operation, maintenance and tax.

1 Current measurement model of value and cost

Current measurement model of value and cost is shown below (Table1), where the development project of an office building in London is measured based on 10 items (1 to 10). Value(B) is calculated from gross rent income(A), and profit(H) is calculated as difference between value(B) and total cost (C, D, E, F and G).

First, the cost of operation stage is not measured, although the rent income of operation stage is measured. This is because the cost of operation is "assumed" to be fully paid by users (tenants) and not by owners or contractors. As an industry practice, this assumption may be valid to be applied to office buildings in England, but not necessarily to residential buildings.

Second, risks of delay and defects are not measured individually, beyond contingency included in finance cost on land and construction (F, G), and construction cost(E).

Table 1. Measurement of value and cost (London office building)

Items to be measured				
	Items	Amount	Unit	Formuka
1	net floor area	76,943	sf	internal dimension, excl common area
2	rent unit price	90	£/m2	annual rent, excc service charges
3	discount rate	4.3	%	inflation and country risks
4	gross floor area	103,290	sf	internal dimension, incl common area
5	development&design	67	£/m2	cost for development and design
6	construction	291	£/m2	cost for construction
7	finance rate	5.0	%	interest rate for financing
8	development programme	27	months	land purchase to commencement
9	construction programme	27	months	commencement to practical completion
10	void and rent free period	21	months	practical completion to rent payment
A	gross rent	6,927,840	£	net floor area × rent unit price
B	value	146,478,950	£	gross rent/dicount rate - void period
C	land cost	78,347,500	£	purchase price of land
D	development cost	6,952,934	£	gross floor area × development & design unit price
E	construction cost	30,058,825	£	gross floor area × construction unit price
F	finance cost on land	15,669,500	£	land cost ×finance rate ×project period
G	finance cost on consutriction	5,263,960	£	construction cost ×finance rate×construction period
H	profit	10,186,231	£	value - total cost
I	profit ratio against cost	7.5	%	profit/total cost
J	rent ratio against cost	5.1	%	gross rent/total cost

Therefore, to clarify impact and probability of assumptions and risks included in the assessment of value and cost, risk measurement is separately conducted (Table2), where the risks of a London mixed-use building(Table2) are measured based on 35 risk events.

Out of 35 risk events, at least 11 events are associated with delays, 7 events are associated with defects, 8 evetns are associated with markets, where delay contributes 23.7% of total risks, whereas defects 11.1% and markets 64.5% respectively.

Delay and disruption protol states that "entitlement to extension of time (EOT) does not automatically lead to entitlement to compensation". As such, even if the risk of delays is matealised and EOT is awarded as a result, construction costs(paid to contractors) may not increase. However, finance costs(paid to banks) increase under the current measurement.

Likewise, even if the risk of defects is materialised and monetary compensation is awarded as a result, construction costs(paid to contractors) may not increase. However finance costs(paid to banks) increase as(if) the remedy of defects causes delay of programme.

Anyway, the cost increase of users(tenants) has no place to be reflected into the current measurement of value and cost, even if it increases(or decreases) as a result of materialised risks of delay or defect of land, development and construction stages, unless it is measured as costs for owners and contractors.

Table 2. Measurement of risks (London mixed-use building)- delay, defects and markets

Project stage	Risk Category			Note	Measurement			
Risk items	delay	defect	market		Impact	Probability	Total	Cost
land stage								**24,594,176**
1 Floor area		defect		reduction in floor area	5	5	25	2,700,000
2 office rent			market	reduction in rent	5	5	25	-
3 residential rent			market	reduction in rent	5	5	25	-
4 hotel rent			market	reduction in rent	5	5	25	13,500,000
5 discount rate			market	reduction in rent	5	5	25	7,941,176
6 finance rate			market	increase in finance rate	5	5	25	160,000
7 insurance			market	increase in premium	5	3	15	50,000
8 business rate(tax)			market	increase in tax	4	4	16	243,000
9 stanp duty tax					5	5	25	-
10 VAT tax					5	5	25	-
Development stage								**6,375,091**
1 freehold titles					5	4	20	-
2 leasehold titles					5	4	20	-
3 compulsory purchase					5	2	10	-
4 easement titles	delay			delay due to prolonged nego	5	5	25	50,000
5 tenant's titles	delay			delay due to prolonged nego	5	5	25	2,712,000
6 party wall	delay			delay due to prolonged nego	4	3	12	75,000
7 rights of light	delay			delay due to prolonged nego	5	5	25	1,528,091
8 environment permit	delay			delay due to prolonged nego	5	4	20	-
9 development permit	delay			delay due to prolonged nego	5	4	20	10,000
10 construction permit	delay			delay due to prolonged nego	5	4	20	1,750,000
Construction stage								**3,950,000**
1 insolency					5	5	25	-
2 delay	delay			delay in construction	5	5	25	1,125,000
3 defects		defect		remedy of defects	5	5	25	-
4 inflation			mareket	increase in inflation	5	5	25	1,500,000
5 underground obstacles		defect		removal of obstacles	5	4	20	1,125,000
6 third party liability		defect		remedy of damages	5	5	25	-
7 asbestos		defect		removal of asbestos	5	3	15	200,000
8 utility supply capacity		defect		remedy of defects	5	4	20	-
9 access to extension	delay			delay due to prolonged neto	4	4	16	-
10 machinery replacement		defect		remedy of defects	5	5	25	-
Operation stage								**1,350,000**
1 void period	delay			increase in void period	4	4	16	1,350,000
2 rent free period	delay			increase in rent free period	4	4	16	-
3 leasehold titles					5	5	25	-
4 operator					5	5	25	-
5 property manaagement					5	5	25	-
Total risks								**36,269,267**
Delay							23.7%	8,600,091
Defect							11.1%	4,025,000
Market							64.5%	23,394,176

Overall, current measurement model does not reflect costs of users not only in operation stage but also in land, development and construction stages of projects.

2 Macro analysis of current high inflation from “users” perspective

Although the sudden increase of consumer price index (CPI) is recorded as high as 8.8 % in Jan 2023, average annual increase of CPI for five years since 2019 is 4.12%, and the average Bank of England (BoE) interest rate over the same period is 1.97% (Table3).

Further, according to data of Land Registry within a selected area of 0.5-mile radius in South East London, among 70 properties sold in 2023, there are only 23 properties which had been sold within the last five years. Therefore, the average annual increase in house sales prices for these 23 properties is only 1.3% (Table4).

Table 3. Macro-economic benchmarks-annual increase rate over last 5 years

		2019	2020	2021	2022	2023	2024	Note
CPI	%	1.8	1.8	0.9	4.9	8.8	4.2	
BoE Interest rate	%	0.75	0.75	0.1	0.25	3.5	5.25	
GDP	%	-	-1.7	-0.1	2.0	2.0	-0.2	Q1 to Q1 annual basi
		2,233.9	2,002.5	2,176.2	2,270.8	2,274.1	-	
Government Spending	%	-	3.6	24.5	-6.0	10.9	2.9	
	Bil	858.0	889.0	1,107.0	1,041.0	1,155.0	1,189.0	
Construction Output	%	-	-16.9	6.1	-2.0	8.3	-	
	Bil	176.8	151.5	170.5	182.0	185.6	-	

Table 4. House sales prices- increase rates over last 5 years

Property			2018		2019		2020		2021		2022		2023		Increase rates over last 5 years					
	postcode	bed	Month	Price	Month	Price	Month	Price	Month	Price	Month	Price	Month	Price	2018	2019	2020	2021	2022	Total
1	SE23 2LG	2 bed	Aug	351,000									Sep	366,000	104.27%					104.27%
2	SE23 3UJ	2 bed			Nov	408,000							Aug	473,000		115.93%				115.93%
3	SE23 3SU	Flat	Nov	570,000									Aug	610,000	107.02%					107.02%
4	SE23 2AR	Flat					Mar	182,000					Aug	168,000			92.31%			92.31%
5	SE22 8LB	Flat					Mar	194,000					Jul	200,000			103.09%			103.09%
6	SE23 3EA	2 bed	Jun	285,000									Jul	340,000	119.30%					119.30%
7	SE23 3HT	Flat	Jun	345,000									Jul	385,000	111.59%					111.59%
8	SE22 0HB	3 bed					Jul	760,000					Jul	796,000			104.74%			104.74%
9	SE23 3BA	Flat			Oct	175,500							Jun	177,750		101.28%				101.28%
10	SE23 2LG	2 bed	Aug	350,000									Jun	350,000	100.00%					100.00%
11	SE23 3ET	Flat							Jan	480,000			Jun	425,000				88.54%		88.54%
12	SE23 1HG	Flat					Apr	323,000					Jun	346,000			107.12%			107.12%
13	SE23 2UD	2 bed							Jun	482,500			May	444,000				92.02%		92.02%
14	SE23 3DP	Flat	Apr	325,000									May	325,000	100.00%					100.00%
15	SE22 0PQ	Flat			Apr	389,000							May	450,000		115.68%				115.68%
16	SE23 3SX	2 bed							Aug	300,000			Apr	312,500				104.17%		104.17%
17	SE23 2UW	2 bed	May	300,000									Apr	335,000	111.67%					111.67%
18	SE23 2NE	Flat					Jan	205,000					Mar	254,000			123.90%			123.90%
19	SE23 2UN	2 bed	Dec	429,000									Feb	455,000	106.06%					106.06%
20	SE23 3DP	Flat	Aug	305,000									Feb	327,500	107.38%					107.38%
21	SE23 3SL	2 bed			Nov	437,500							Mar	485,000		110.86%				110.86%
22	SE23 3DP	Flat	Jun	315,000									Feb	320,000	101.59%					101.59%
23	SE22 0PP	Flat	Sep	250,000									Jan	298,000	119.20%					119.20%
																		5 years increase		106.42%

As a background, due to covid pandemic lockdown introduced in 2020, GDP decreased by £231.4Bil (10.6%) in 2020. To compensate this decrease, Government increased its spending by similar amount of £ 218Bil (24.5%) in 2021, and the same level of additional spending is still maintained in 2024 to boost GDP even post to Covid restrictions.

Against these high volatility of GDP, Government spending and CPI, the average annual increase in house sales prices of 1.3% as above is modest, which endorses the validity of 2% growth policy and historical 4-5% long-term discount rate applied to property valuation.

However, according to RICS residential market surveys [10] et al state followings.

- Increase of rent
- Increase of mortgage interest

This means that although owners (developers) of residential properties did not much suffer due to 1.3% annual increase of the average house prices, users (tenants either rent-paying occupiers or long leaseholders) suffer significantly due to either the increase of rent or increase of mortgage interest. Indeed, benefits appear to go only to financial institutions and nobody else, unless employment pay rise (reflecting CPI increase) for users is achieved.

Overall, regardless of the root cause of current high inflation whether it is high price of imported energy or high government spending, the problem is that users suffer most as a result, which is aggravated as the measurement model does not recognize the cost of users.

3.Alternative measurement models of value and cost

First, considering leasing practice in England, a typical life cycle of buildings is categorized as follows(Table5), which needs to be considered when measuring value and cost of buildings.

Table 5. Life cycle of buildings

Item	Years	Cost Assessment	Note
Land and Constrution	5	Included	Land purchae and construction
Operation	3-25	Excluded, as assumed to be paid by users	Building lease period
Maintenance and Refurbishment	50	Excluded, as assumed to be paid by users	Durability period for building design
Tax and Freehold	250	Excluded, as assumed to be paid by users	Land lease period

Second, the result of measurement of value and cost differs depending on the timing of measurement (Table6). For consistency, it is proposed to measure the value and cost of buildings, not only at the time of planning, construction or completion, but also operation.

Table 6. Timing of measurement

Appraisal			AP1	AP2	AP3	AP4
	Item	Timing Year	Planning 2008	Construction 2010	Completion 2012	Operation 2020
1	Net floor area	sf	55,273	55,136	56,198	56,198
2	Rent unit price	£/sf	119.5	95.0	95.0	97.5
3	Discount rate	%	4.60	4.60	4.75	4.50
4	Gross floor area	sf	86,298	88,837	89,304	89,304
9	Programme	Month	24	22	22	22
A/B	**Value**	Mil £	126.23	110.22	109.25	121.76
C	Land cost	Mil £	59.22	59.22	59.22	59.22
D	Development cost	Mil £	11.5	14.28	15.44	15.44
E	Construction cost	Mil £	28.59	26.12	25.19	25.19
F/G	Finance cost	Mil £	18.58	21.22	15.21	15.21
	Total cost	Mil £	117.89	120.84	115.06	115.06
H	**Profit**	Mil £	8.35	-10.62	-5.81	6.7
I	**Profit ratio against total cost**	%	7.10%	-8.80%	-5.00%	5.80%
Note: Numbering is based on Table1						

Third, the weight of construction cost is not dominant in terms of life cycle cost. It is proposed to measure the costs of operation, maintenance, and tax and ground rent, before deciding values and costs of buildings. Recent changes introduced by Leasehold Reform (Ground Rent) Act 2022 prohibits ground rent for new residential projects, which is desirable.

Table 7. Scope of measurement- Operation, Maintenance and Tax/Ground rent

Income	Category	Income	Annual Rent	£31,800	
-	Operation	Rent		£31,800	
Cost	**Category**	**Cost- Consturuction etc**	**Total**	**£352,000**	
0	Land, Dev, Construction	Land, Development, Construction		£352,000	
Cost	**Category**	**Cost-Operation etc**	**Annual Total**	**£29,344**	Note
1	Operation	Agents		£2,544	Lease agent fee
2	Operation	Mortgage Interests		£18,000	Currently BoE 5.25%
3	Operation	Heating Charges		£1,400	Heating cost
4	Operation	Building Service Charge		£1,800	Building area
5	Operation	Estate Service Charge		£1,800	Land area
6	Maintenance	Reserve fund for refurbishment		£2,000	External element
7	Maintenance	Maintenance&Appliance		£500	Internal elements
8	Maintenance	Building Insurance		£250	Internal elements
9	Tax	Local council		£1,000	Tax for local council
10	Ground rent	Freeholder		£50	Payment for freeholder

4. Pros and cons of two adverse models- current v proposed alternatives

Different measurement models arrive at different results of values and costs (Table8). Current measurement model (OP1) is simply based on the assumption that operation costs is fully paid by users, and proposed alternative measurement models (OP2, 3 and 4) are based on the actual cost reasonably required for users to be responsible to pay for operation, maintenance, tax and ground rent, reflecting individual circumstance of particular buildings.

Table 8. Models and difference in results

	Measurement model	Item	Amount	Note
OP1	Based on Income	Income × multiplier	**£795,000**	income
OP2	Based on Costs	Part operation and maintenance	**£510,750**	minimum costs
OP3	Based on Costs	Full operation, maintenance, tax, ground rent	**£1,085,600**	maximum costs
OP4	Based on Costs(average)	Average of OP2 and OP3	**£798,175**	average costs

Note: OP1: Formula= Rent £31,800 × Multiplier 25 times
OP2: Formula= Cost item 0, 4, 5, 6, 7 and 8
OP3: Formula= Cost item 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 and10
OP4: Formula= Average of OP 2 and OP3

4.1 Pros of proposed alternative measurement models

①Details of cost are broken down and stated clearly. It is easy to understand as there is no need to research and establish an appropriate multiplier (discount rate) to be applied to the income.

②Actual paid-cost is recorded throughout the operation stage. It is accurate.

4.2 Cons of proposed alternative measurement models

①Details of cost need analysis whether a particular cost is reasonably ascribed for users to pay.

②Actual paid-cost needs to be recorded throughout the operation stage, and measurement needs to be done multiple times, whereas the current measurement model relies on the assumption that users pay all the costs and that measurement takes place only once at the time when the rent is assumed or confirmed.

4.3 Overall, it can be said as follows;

①For consistency, the duration for measurement should be the same for both value(income) and cost. As the value during the operation stage are measured, the cost during the operation stage should be measured as well.

②If users pay both the rent and operation cost, they are both same “cost” from the aspect of users, and there is no reasonable ground to measure the rent only.

③Nevertheless, items of large cost during operation stage (e.g. mortgage interest) need careful consideration whether they should be reflected into the value or total cost, as their impact is significant.

④ In practice, the final judgment is often left for valuers to decide, depending on circumstances of each building. However, it is envisaged that the results of both adverse measurement models need to be taken into account to reach the judgment.

Findings and Conclusion

Current measurement model of value and cost does not reflect the cost of users not only in operation stage but also in land, development and construction stages of projects.

Regardless of the root cause of current high inflation whether it is high price of imported energy or high government spending, the problem is that users suffer most as a result, which is aggravated as the measurement model does not recognize the cost of users.

Overall, the current measurement model is based on the aspect of owners and contractors, which is to assess buildings as monetary asset for short-term taxation purpose, without due regard how buildings are used by users for long-term.

The proposed alternative measurement models are based on the actual cost reasonably required for users to be responsible to pay for operation, maintenance, tax and ground rent, reflecting individual circumstance of particular buildings.

In practice, the final judgment is often left for valuers to decide, depending on circumstances of each building. However, it is envisaged that the results of both adverse models need to be taken into account to reach the judgment.

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