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Prototyping Operation and Maintenance System for a Campus Building

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Abstract.

There is increasing awareness of life cycle costing (LCC) by the management who has lengthy experience in the operation and maintenance of the building. Maintenance of buildings includes a replacement, updating, and repair building components by predetermined standards. This paper aim at developing a prototype of building maintenance system for a campus in Yogyakarta. The prototype is referred to ISO 15686 as well as Regulation of Minister of Public Works. The system complements the service life of the building components that can be updated regularly. The system accommodates the 25-years life cycle cost plan to assist campus management office. Research data obtained by Building Maintenance personals, the users of the building as well as previous studies for similar ones. From the results of life cycle costing, the study shows its detail life cycle cost plan.. Finally, a prototype for the operation and maintenance of the building is developed.

Keywords: operation and maintenance, campus building, ISO 15686, life cycle costing

Introduction

Lack of operation and maintenance strategies to maintain building system performance leads to increased operating and maintenance (O&M) costs and less healthy buildings. The first step toward improved practices that take advantage of potential operating savings was to identify the O&M practices routinely performed in buildings. Understanding the LCC and service life of building components has two major benefits. First, the baseline for service life is the benchmark from which to estimate the cost for O&M practices. And second, service life baseline practices can be used as a guide to direct the long terms O&M cost estimate for the assets.
The objectives of the study was to develop a prototype of building maintenance system for a long term of a campus building based on ISO 15686 part 5.

Literature Review

According to the Regulation of the Minister of Public Works No. 24/PRT/M/2008 [10] concerning Guidance on Maintenance and Maintenance of Building, Building is the activity of maintaining the building of building and facility for always building functional (preventive maintenance). According to ISO 15686 part 5, life-cycle costing (LCC) is a valuable technique that is used for predicting and assessing the cost performance of constructed assets. LCC is one form of analysis for determining whether a project meets the client's performance requirements. Analyses can necessitate the use of other parts of ISO 15686 and current economic data from clients and the construction industry. It should be possible to use this part of ISO 15686 without extensive reference to other parts, although a number of the terms and techniques described are covered in more detail in the other parts. Cycle Cost of an item is the amount of all expenditures associated with the item since it was designed until it is no longer used.

Methodology

The location of the research is a building in Campus USD in Yogyakarta. In this location the campus III administration building is the object for this research, this building consists of 6 floors which have a floor area of 7384 m2. The campus III administration building has a variety of spaces with its functions, such as libraries, classrooms, office, and others. The data were collected using questionnaires. List of questions a very important tool, and its statement should be easily understood regarding a particular aspect. Questionnaires in this study were closed questionnaire,i.e., the respondent was only allowed to choose an answer which has been provided. In this research used structural questionnaire. Secondary data of cost regarding LCC were obtained from the Office of the Maintenance for campus building.

Results and discussion

Respondents and the description of the School Sites

Total respondents participated in this study were categorized as direct user category are 3 people, consisting of high officer of Campus Asset Office: the Head of Section for Facilities and two persons from Infrastructure Bureau Administrative Staff and inventory of curtains or curtains, Air conditioning maintenance, Cleaning of wood plywood, Cleaning of floor surfaces, Cleaning of glass and windows, Cleaning the plywood ceiling, Gypsum ceiling maintenance, Pinching of upright water gutter from PVC or iron pipe, Pinching the outer wall of the building, Cleaning ceramic wall in bathroom / WC, Cleaning sanitary fixtures, Check the tap water, Check the water filter (floor drain) on the bathroom floor / WC, Use of disinfectant to kill bacteria on the floor or wall of the bathroom / WC. Trash materials and Restrictions on the smoking area.

Overall LCC of the total building

Cost of life cycle cost planning at the campus building consisted o development cost at 55%, operational cost a proportion of 37%, maintenance and replacement cost at a proportion of 8% The total cost of the life cycle cost plan for 25 years would be Rp. 69,563,125,080. Figure 3 shows the proportion of these costs.

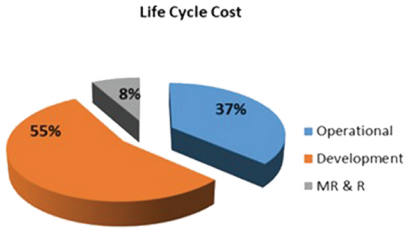

Fig. 1. Proportional LCC of years.

Discussion on depreciation

Depreciation is a decrease in the physical property overtime for its service life. Depreciation is a non-cash cost that affects income tax. Deprecated properties must meet the following conditions: 1) should be used in business or maintained to generate income; 2) must have a certain useful life, and should be longer than a year; 3) the property was decay/destruction, obsolescence, or decreases the value of its original value.

Development of a prototype of the system

The system was developed based on the future worth of budgeting. Some assumptions had to be fixe, such as interest rate, inflation rate, and others. The interest rate was based on the average of three consecutive years published by the Bank of Indonesia. Similarly, inflation also calculated base on the National Statistics Bureau. In the system, inflation was set to 4% per year, and the interest rate set to 6%. See Table 2.

Table 2. A prototype of the operation and maintenance of the building system for the campus.

#NAME?	No	Compon+C3:C18ent of Building Maintenance	LCC of yearly budget for 25 years (Million Rupiah)																							
		Year→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Cleaning	1	Tenaga	180.00	187.20	194.69	202.48	210.57	219.00	227.76	236.87	246.34	256.20	266.44	277.10	288.19	299.71	311.70	324.17	337.14	350.62	364.65	379.23	394.40	410.18	426.59	443.65	461.39
	2	Material	14.83	15.43	16.04	16.68	17.35	18.05	18.77	19.52	20.30	21.11	21.95	22.83	23.75	24.70	25.68	26.71	27.78	28.89	30.05	31.25	32.50	33.80	35.15	36.56	38.02
	3	Equipment	9.97	10.37	10.79	11.22	11.67	12.13	12.62	13.12	13.65	14.19	14.76	15.35	15.97	16.61	17.27	17.96	18.68	19.43	20.20	21.01	21.85	22.73	23.64	24.58	25.56
	4	Sum+20%	245.77	255.60	265.82	276.45	287.51	299.01	310.97	323.41	336.35	349.80	363.79	378.35	393.48	409.22	425.59	442.61	460.32	478.73	497.88	517.79	538.50	560.04	582.45	605.74	629.97
Management	1	Selary	396.65	389.16	381.82	374.62	367.55	360.61	353.81	347.13	340.58	334.16	327.85	321.67	315.60	309.64	303.80	298.07	292.45	286.93	281.51	276.20	270.99	265.88	260.86	255.94	251.11
Utility	1	Energy+water	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04	493.04
MR&R	1	Ceiling coat					49.32					49.32					49.32					49.32					49.32
	2	Ceiling replacement																		664.00							
	3	lightning rod																				49.20					
	4	Exterior wall paint				6.73				6.73				6.73				6.73				6.73				6.73	
	5	Interior wall paint						14.36						14.36						14.36						14.36	
	6	Waterproofing				13.86				13.86				13.86				13.86				13.86				13.86	
	7	External Ceramic Area																									721.82
	8	Floor Drain										0.60										0.60					
	9	Ceramic in toilet																									20.16
	10	water faucet			1.82			1.82			1.82			1.82			1.82			1.82			1.82			1.82	
	11	Urinoir										36.23										36.23					
	12	Wastafel										24.95										24.95					
	13	Seat toilet										12.50										12.50					
	14	Squat toilet										3.60										3.60					
	15	Lift cable									4.00									4.00							
	16	AC															1082.65										
	17	Fans												2.93												2.93	
	18	Camera CCTV								15.02								15.02								15.02	
	19	Neon lamp			40.03			40.03			40.03			40.03			40.03			40.03			40.03			40.03	
	20	Ordinary lamp					5.69					5.69					5.69					5.69					5.69
	21	LCD Projector			53.35		53.35			53.35		53.35			53.35		53.35			53.35		53.35			53.35		53.35
	22	Motorized Screen															3.73										
	23	Router				0.15				0.15				0.15				0.15				0.15				0.15	
	24	Speaker											2.70											2.70			
	25	Switch CCTV						4.13						4.13						4.13						4.13	
	26	Telephon								3.53								3.53								3.53	
	27	Sound System															29.90										
	28	UPS																				29.92					
	29	Dispenser			7.23			7.23			7.23			7.23			7.23			7.23			7.23			7.23	
	30	Printer				12.87				12.87				12.87				12.87				12.87				12.87	
	31	Scanner							3.5							3.5							3.5				
	32	Monitor						55.25						55.25						55.25						55.25	
	33	CPU			143.65			143.65			143.65			143.65			143.65			143.65			143.65			143.65	
		Total Cost			246.09	33.61	108.36	266.48	3.50	105.50	196.74	186.23	2.70	303.01	53.35	3.50	1417.37	52.15		987.83		298.96	196.24	2.70	53.35	321.56	850.34
		Inflation 3,3%			254.207	34.716	111.934	275.275	3.616	108.982	203.228	192.379	2.789	313.012	55.111	3.616	1464.146	53.871		1020.429		308.826	202.712	2.789	55.111	332.167	878.402
Yearly budget to be prepared (million Rp)			1135.46	1137.80	1394.89	1178.83	1260.04	1427.94	1161.44	1272.57	1373.20	1369.38	1187.48	1506.07	1257.23	1215.52	2686.58	1287.59	1245.80	2279.13	1272.43	1595.86	1505.25	1321.75	1391.46	1686.89	2252.53

Conclusion

Based on the results of the research and discussion about the analysis of the life cycle cost plan of the central campus III of USD for 25 years, the conclusions are as follows:

1. Construction of the third campus of the USD administration building, which was recalculated using the highest regional unit price standard resulting in a percentage of LCC at 55%. When calculated for life cycle costs for 25 years, operational costs require a proportion of 37% and maintenance and replacement values of ratio of 8%.
2. In the cost of maintenance and replacement of components of building materials over the next 25 years, the highest values are found for mechanical, electrical items of a proportion of 38%, supporting equipment of 27%, the architectture of 19%, and a roof and its related components of 16%.
3. When calculating the operational costs of campus administration of campus III of USD for the next 25 years, the highest values were in the utility group of a proportion of 47%, cleaning costs of 22 %, and administrative expenses amounting to 31%.

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