

School Age and Building Defects: Analysis Using Condition Survey Protocol (CSP) 1 Matrix

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Abstract—Building condition assessment is a critical activity in Malaysia's Comprehensive Asset Management Model. It is closely related to building performance that impact user's life and decision making. This study focuses on public primary school, one of the most valuable assets for the country. The assessment was carried out based on CSP1 Matrix in Kuching Division of Sarawak, Malaysia. Based on the matrix used, three main criteria of the buildings has successfully evaluate: the number of defects; schools rating; and total schools rating. The analysis carried out on 24 schools found that the overall 4, 725 defects has been identified. Meanwhile, the overall score obtained was 45, 868 and the overall rating is 9.71, which is at the fair condition. This result has been associated with building age to evaluate its impacts on school buildings condition. The findings proved that building condition is closely related to building age and its support the theory that 'the ageing building has more defect than the new one'.

Keywords—building condition; CSP1 Matrix; assessment; school; Malaysia

I. INTRODUCTION

THE building is a major asset for all types of organizations, including the public sector. The important of assets as human, financial and information resources, which can contribute to the success of an organization when it was managed effectively and efficiently. To maintain the value of an asset, it must be professionally managed. It has been proven that not only huge amount of capital to ensure that the assets can be maintained, but the assets also can be increased through a creative and effective asset management. Even so, the maintenance management system in Malaysia is still weak. Furthermore, the public sector in Malaysia is still not really aware that the building is a precious asset. Typically, an obligation to protect public property, including public school in Malaysia have been distributed among several government departments and are often implemented in reactive mode.

This study focuses on assessing the condition of school buildings, which one of the key processes in the life cycle of a comprehensive asset management and facilities management.

This assessment is important that the assets of the building is capable of supporting a school's core operations, which need to operate efficiently and effectively in providing a quality learning environment to the school users. This paper discusses the evaluation of school buildings condition based on CSP1 Matrix's assessment and analysis.

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II. LITERATURE REVIEW

Maintenance of schools building includes activities to maintain school facilities as to keep it in good condition. In Malaysia, school building maintenance usually neglected [1] and there are no comprehensive guidelines for this process [2]. Maintenance work is not only necessary for the ageing building, but as well as new building. New building will not remain constant during its lifetime [3] and always been the process of renovation and refurbishment [2]. Assessment of building condition is one of the proactive steps in managing and maintaining the performance of school facilities.

There is significant impact of school building condition on student achievement [4]-[5]-[6]-[7]-[8]-[9]-[10]-[11]-[12]-[13]-[14]-[15]-[16] because the built environment can influence user's behavior [17]. Schneider [18] stated that physical aspects of school environment can affect teaching and learning, either help or inhibit the process. The relationship between schools building condition with student achievement was explained by [14] who asserts that student from school with the better environment showed higher achievement. Schneider [18] added that school facilities have a direct impact on teaching and learning, while good school facilities can be provided by an efficient maintenance.

Extracts from a report issued by the United States Government Accountability Office (GAO) in March 2011, typically operational and maintenance cost is between 60-80% of the total cost of facility during its lifetime. Besides, the report also revealed that there were weaknesses in assets maintenance activities carried out by the government [19]. Based on these reports, it is clear that the inspection of school building is very important as to evaluate the building condition before it become serious. This task will reduce the future maintenance cost and it must be done by the experts.

III. MATERIALS AND METHODS

Data required for the evaluation of school building condition obtained by building inspection works. A sample of this research focuses on public school in Kuching, Sarawak. Data collection and analysis conducted based on CSP1 Matrix protocol. There are 134 public primary schools in Kuching Division [20], and the sampling criteria used are based on school age, which refer to the first building constructed for the school. School age is range from 1 year to 65 years. This research used two sampling methods which is simple random sampling and stratified sampling. Variable of Selection (VOS) used in the calculation of sample size was the range of school age and the calculation of sample size was using the Simple Random Sampling (SRS) formula. Based on the calculation, 24 schools have been selected as sample. Then, Probability Proportional to Size method was used to determine the probability of strata based on strata size.

The condition of building component is evaluated using a Standard Building Inspection Code published by the Royal Institution of Surveyors Malaysia (RISM) and Condition Survey Protocol (CSP) 1 Matrix. These code and protocol is a guideline to the Building Surveyor to assess any defect of building based on priority and condition. This matrix has its own scoring system [21] to facilitate the examiner to assess the condition of school building carefully and entirety. All defects identified are assessed and recorded on-site with the evidences (photos and plan tag). The score obtained from the scoring system determine the level of defects/component such as good, fair and dilapidated. Besides, the possible cause of the defects also identified. This information recorded in Defect Sheet, and then it was compiled in the Schedule of Building Condition. A summary of finding such as the number of defects, total score and schools rating based on CSP1 Matrix is produced. These results are compared with schools age as to associate the relationship between school age and building condition. Comparisons are presented in the form of bar charts and tables.

IV. RESULT AND DISCUSSION

Assessment of the physical condition of school building at Kuching Division was conducted on 24 schools. In total, 4,275 defects were identified and the total mark is 45,868. The rating for overall condition of the buildings is 9.71, which at a fair level but close to dilapidated. To examine the relationship between the ages of school building with building condition, the age of each school was identified. Two schools are below 10 years, five schools are between 11-20 years and 17 schools were over than 20 years. This indicated that the majority of schools inspected were more than 20 years old.

A. The Number of Defects

A total of 4,275 defects identified in 24 schools involved in the study. Highest number of defects found at SEK11, which is 365 defects while the lowest at SEK01 with 30 defects. Table I shows the number of school according to age range compared to the number of defects.

It is clear that the building older than 20 years have a high number of defects with a majority of 12 schools have between 100-200 defects. However, the highest number of defects recorded by the schools in range between 11-20 years is more than 300. This scenario leads to a questionable quality of construction work that being done within this period of time.

TABLE I
THE NUMBER OF SCHOOL ACCORDING TO AGE RANGE
COMPARED TO THE NUMBER OF DEFECTS

School age (years)	No. of schools	No. of schools according to the number of defects			
		0- 100	100- 200	200- 300	> 300
1-5	1	1	0	0	0
6-10	1	0	0	1	0
11-15	3	0	0	1	2
16-20	2	0	0	1	1
> 20	17	1	12	4	0
Total	24	2	12	7	3

B. Total Mark

A total of 45,868 marks recorded from 4,275 defects identified. The highest score recorded was 3,795 while the lowest score was 189. Meanwhile, only one school recorded score below 1,000 marks and the rest score more than 1000 marks. Table II shows the number of schools according to age range compared to the scores. Majority of 14 schools scored between 1000-2000, while 13 of 14 schools were over 20 years. The next five schools scored between 2001-3000 marks, four schools scored more than 3000 marks and only one school scored below 1000 marks. Three of four schools that scored more than 3000 marks are within 11-20 years. This result demonstrates once again that the schools between 11-20 years have serious building defects.

TABLE II
THE NUMBER OF SCHOOL ACCORDING TO AGE RANGE
COMPARED TO TOTAL MARK

School age (years)	No. of schools	No. of schools based on CSP1 Matrix score			
		0- 1000	1001- 2000	2001- 3000	> 3000
1-5	1	1	0	0	0
6-10	1	0	1	0	0
11-15	3	0	0	1	2
16-20	2	0	0	1	1
> 20	17	0	13	3	1
Total	24	1	14	5	4

C. Total Rating

Total school condition rating for overall study is 9.71, which in fair condition. The lowest rating (6.15-fair) which is the best condition was recorded at SEK08 while the highest rating (13.25-dilapidated) at SEK23. This value indicates that the best schools are in fair condition that requires monitoring and the severe school in a situation that requires serious attention. The associated of ages and building condition show that there are no school in good condition (refer Table III). The majority of 22 schools are in fair condition, while two schools in dilapidated condition. The two schools that in dilapidated condition were over 20 years.

These figures make it clear that although the number of defects is highest in school between 11-20 years, but the defects is at medium condition that requires monitoring and schedule maintenance. Instead, for the schools over 20 years even though have a little number of defects, the defects are serious and require immediate maintenance.

TABLE III
THE NUMBER OF SCHOOL ACCORDING TO AGE RANGE COMPARED TO
TOTAL RATING

School age (years)	No. of schools	No. of schools based on CSP1 Matrix rating		
		1-4 (Good)	5-12 (Fair)	13-20 (Dilapidated)
1-5	1	0	1	0
6-10	1	0	1	0
11-15	3	0	3	0
16-20	2	0	2	0
> 20	17	0	15	2
Total	24	0	22	2

D. Association between Building Age and Condition

To examine the theory of association between building age and its condition, the relationship between three aspects evaluated (number of defects, total score, and building rating) with building age was assessed. Table IV shows the relationship between school building ages with the three aspects. Based on CSP1 Matrix analysis and Table II, it shows the relationship between school age theories to school building assessment aspects. Basically, the higher the school age, the more defects occurred and the critical age for building defects occurs is between 11-20 years.

TABLE IV
RELATIONSHIP BETWEEN BUILDING AGE WITH THE THREE ASPECTS

No	Theory	No. of defects	Total Marks	Building Rating
1	The older the school, the more building defects occurred	Related	Related	Related
2	The critical school buildings age is between 11-20 years	Related	Related	Not related

V. CONCLUSION

This paper presented findings that represent the actual condition of public primary schools in Kuching Division of Sarawak, Malaysia. The result shows that the actual condition of the schools are fair with the overall rating is 9.71. These schools should be given particular attention by carrying out regular monitoring and maintenance. The result also shows that there are close relationship between school's building ages and their condition. The older the age of school, the more severe building condition can be predicted.

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