

The Development of Smart School Condition Assessment Based on Condition Survey Protocol (CSP) 1 Matrix: A Literature Review

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Abstract—Building inspection is one of the key components of building maintenance. The primary purpose of performing a building inspection is to evaluate the building's condition. Without inspection, it is difficult to determine a built asset's current condition, so failure to inspect can contribute to the asset's future failure. Traditionally, a longhand survey description has been widely used for property condition reports. Surveys that employ ratings instead of descriptions are gaining wide acceptance in the industry because they cater to the need for numerical analysis output. These kinds of surveys are also in keeping with the new RICS HomeBuyer Report 2009. In this paper, we propose a new assessment method, derived from the current rating systems, for assessing the specifically smart school building's condition and rating the seriousness of each defect identified. These two assessment criteria are then multiplied to find the building's score, which we called the Condition Survey Protocol (CSP) 1 Matrix. Instead of a longhand description of a building's defects, this matrix requires concise explanations about the defects identified, thus saving on-site time during a smart school building inspection. The full score is used to give the building an overall rating: Good, Fair or Dilapidated.

Keywords—assessment matrix, building condition survey, rating system, smart school and survey protocol.

I. INTRODUCTION

THE purpose of conducting a building inspection is to assess the building's condition. The inspection is a key means of identifying a building's defects. Defects usually display their symptoms before getting worse and causing building failure. It is therefore crucial for building inspections to be performed many times in an asset's life cycle. This is also supported by the philosophy of Dasar Pengurusan Aset Kerajaan (DPAK), the Malaysian Government Asset Management Policy and Total Asset Management (TAM) Manual. These two documents underpin the Malaysian government's asset management plan, depicted in Fig. 1.

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Specifically, the TAM Manual [1] outlines the need to conduct building inspections to fulfil the requirement for continuous evaluation throughout an asset's life cycle.

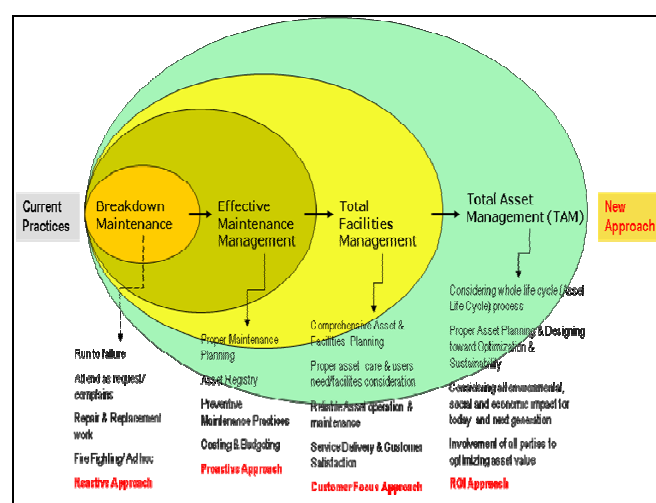


Fig. 1 Maintenance transformation approach towards TAM
Source: Mat-Deris, 2009

Traditionally, building surveyors have primarily relied on descriptive longhand surveys. This means that surveyors recorded every detail by hand when performing on-site building inspections. This is an acceptable practice when applied to building survey work, especially if the property being inspected is considered to be in unreasonable condition; for example, it could be an abandoned, vacant and/or dilapidated property. This approach is highlighted in the Royal Institution of Chartered Surveyors (RICS) HomeBuyer Service 2009 (3rd Edition Practice Notes), which came into effect beginning 1 July 2009. These practice notes mention that the building survey report is usually longer, more detailed and more technical than the RICS HomeBuyer Report [2].

As the HomeBuyer Service points out, there is a need for a quick and practical approach to performing building inspections under reasonable property conditions. According to the RICS (2009), the reporting procedure for a RICS building inspection produces a shorter and less detailed report in a standardised format. In addition to this report, a condition rating is included; this special feature standardises the report and provides a quick overview of the condition of the entire

property. This approach is useful when doing routine building inspections during the normal cycle of maintenance, which includes an annual general building inspection.

Taking this as our point of departure, we developed the Condition Survey Protocol (CSP) 1 Matrix as an assessment method for evaluating building condition. This method was specifically developed for first-line, visual building inspection work. It comprises three protocols: Protocol 1 is defined as visual inspection, Protocol 2 as Non-Destructive Testing (NDT) and Protocol 3 as sample-taking and/or Destructive Testing (DT). The primary features of this matrix are the rating forms. To test whether or not the matrix was practical and effective, the matrix was used to evaluate the building condition of ECSTRACTM, an eco-sustainable toilet.

II. LITERATURE REVIEW

A. The Importance of School Condition Assessment

Generally in Malaysia, smart school condition assessment has not been formally developed. So far, there is no parameter or a system to assess school building condition in detail to obtain reasonable assurance whether the school building is still providing a conducive environment to learning or not.

Therefore, this research made to enhance the quality of school buildings and provide a good level of satisfaction in the learning process for students. Since the school building is a major asset in the learning process, information on the current condition of this building is very important to the school management in planning and executing maintenance process.

School condition assessment helps in prioritising maintenance activities in maintenance planning. According to [3], priority to the school building is based on the following 4 criteria or class:

- a) *First priority* – building used for students programme, school management and visitors,
- b) *Second priority* – under-utilised building and empty used for school management, staff research activities and to provide certain services,
- c) *Third priority* – newly built building designated to meet the standards of Fire and Rescue Department and requires some improvement,
- d) *Fourth priority* – Repaired building or building that have program changes in the future.

Class of prioritisation helps school management in decision making stage in term of costing, urgency, risks and profitability [3-4]. Theoretically, class of prioritisation is

important in strategic planning of school condition assessment provided that current conditions of building are known. Then the sequence of activities and decision making stated by [3] then can be done realistically based on facts and neither by assumption nor gut feeling. Thus it helps school management to make strategic and right decisions.

B. Smart School Condition Assessment in School Maintenance Management Process

Maintenance is compulsory for school building to ensure safety and conduciveness of learning environment process. In Malaysia, maintenance practice is limited to a minimal percentage compared to other Asian countries [3, 5]. As an organization that provides education to the people, schools should have their own roles and policies as solutions to the situation described by above.

It is important to ensure that school buildings and facilities are safe and are in good condition. There are a variety of roles and the maintenance policy practiced in the school. Every organization has a policy role and the maintenance of different, depends on the quantity, system and design quality of the building [3].

In Malaysia, the role and policies of the school building maintenance is sometimes forgotten by the school management [3]. Based on previous research conducted by the University Technology MARA have found that most of the maintenance problems that arise in public schools is due to lack of lighting, broken floor, cracked ceilings, trapped air, peeled paint, exposed wires, no air conditioning, smelly building, malfunction of fans / vents, unavailability of security alarm or fire extinguisher in the classroom or the auditorium, unavailability of emergency plan, an excessive number students per classroom, lack of tables and chairs, damaged sinks or toilets, dirty cafeteria and floor and many other problems [3].

In some cases, individuals who carry out the maintenance works is an individual who has no experience in maintenance. For example, gardeners are assigned by the headmaster to carry out maintenance work. It is a common knowledge that many schools, particularly public schools have lack of special maintenance staff [3].

Standard maintenance policy as been implemented throughout the country is to ensure that adequate budget is allocated for maintenance works. A maintenance plan that have constant maintenance activities, selection of quality materials, sufficient number of maintenance staff and the extensive involvement and commitment by the school management in terms of maintenance are crucial in creating a conducive school environment to the students. The following Table 1 is a list of maintenance and school building condition issues collected from local newspaper.

TABLE I
LOCAL NEWSPAPER REPORT ON MAINTENANCE AND SCHOOL BUILDING CONDITION ISSUES.

No	Local Newspaper	Date	Report Title	Paper Excerpt
1	Bernama	30.08.2010	6% school buildings are critical	A total of six per cent from 9,642 schools in this country to be audited by the Audit Committee of the Ministry of Education School Facilities are categorized in critical physical condition, said Deputy Education Minister Dr Mohd Puad Zarkashi. Among the problems facing are an electrical wiring issues and the lack of teachers quarters facilities.
2	Utusan Malaysia	13.08.2010	Hall Roof of SMK Wakaf Tapai collapsed	The incident is believed to occur when the wood trusses supporting the roof of the building which was completed and used since the end of 2005 was not able to support any longer and cause the entire roof collapsed.
3	Berita Harian	02.04.2010	Ministry of Education goes for school physical condition auditing throughout county	Hulu Selangor: The Ministry of Education will audit the physical condition of schools building throughout the country to enable actions such as upgrading the physically bad condition of school building, especially in rural areas. Deputy Prime Minister, Tan Sri Muhyiddin Yassin, who is also Minister of Education, said the move was necessary because the physical condition of schools, especially classroom is important in creating a conducive learning environment that will affect student performance.
4	Berita Harian	30.03.2010	5 years old school building was cracked	Sekolah Kebangsaan Taman Bersatu, which accommodates about 700 students in Years One to Six had serious cracks in some parts of the wall, other than sedimentation of the ground floor is believed due to the instability of building site. In addition, the school's roof structure is also problematic.
5	Utusan Malaysia	15.12.2009	Danger of sick school building to students	A Tamil School (SJKT) Glenmarie which opened since 24 years back is now confronted with sick building issue that exposes students and teachers to the risk of accidents. Since its opening, the school has not been undergoing any upgrading works or repairs to this day.
6	Bernama	11.09.2009	Education Ministry Needs RM500 Million To Repair 567 Schools, Teachers Quarters and Hostels	Pagoh: Education Ministry on financial need provisions of RM500 million for the repair work of six (6) percent or 567 from 9,462 of the national-type schools (Sekolah Jenis Kebangsaan), teachers' quarters and hostel buildings That had been categorised as "very critical" throughout country.
7	Utusan Malaysia	19.07.2009	School roof collapsed	According to project manager, Abdullah Sani, the roof structure of the school porch was slightly imbalance caused by the hit from one of the machines while the maintenance work done yesterday.
8	Bernama	27.09.2008	Investigate cause of school wall collapsed	Ministry of Education has directed the Kuala Selangor Education Department to investigate the cause of a wall collapsed at the School Datuk Harun, Selangor, two days ago.

9	Berita Harian	29.08.2008	Roof frame collapsed	SHAH ALAM: The roof frame of a new three-storey Sekolah Menengah Kebangsaan (SMK) Section 16 which still under construction, collapsed early yesterday morning due to the weakness of the roof structure.
10	Berita Harian	14.04.2008	School hall closed	Deputy Education Minister, Datuk Razali Ismail, who visited the scene yesterday said the school hall which able to accommodate about 500 students at any one time was believed to fall due to the truss joints to support the roof is not strong.
11	Utusan Malaysia	05.01.2008	Obliged to contribute RM145 to PIBG SK Taman Tun Dr Ismail	Parents who send their children to Sekolah Kebangsaan Taman Tun Dr. Ismail 1 (SK TTDI 1), here was shocked when the Parents and teachers Association (PIBG) fee covers the PIBG fees of RM40, RM15 hall fees, school maintenance fee of RM20 and RM70 computer costs.
12	Berita Harian	15.08.2007	Public education asset need to be monitored	<p>KUALA LUMPUR: The Public Service Department (PSD) has approved the establishment of Asset Procurement and Property Maintenance is the first in the Ministry of Education to address the country's public education asset management in a systematic and effective way.</p> <p>Incidents such as delay in school buildings construction, computer labs collapsed and failure of contractors to meet contract conditions and requirements have drive the Education Minister, Datuk Seri Hishammuddin Hussein to ask for a mechanisms need to be established to prevent similar incidents recurring.</p>

III. CONDITION SURVEY PROTOCOL (CSP)1 MATRIX

The rating criteria for building inspections are still being developed. One of the earliest contributions was made by [6], followed by [2, 7-11]. [6] and [7] proposed rating criteria that could be applied to any type of building. [8-10] provided criteria that were specifically designed to assess the condition of timber houses. [11] developed the Navil Matrix®, which is currently used in building inspections. The most recent criteria were developed by [2], who established the 3-rating system for the inspection of homes classified as having reasonable property conditions.

With the aim of contributing to the development of building inspection rating systems, this research concentrates on providing rating criteria that can be used to assess a building's defects. Our system gathers two sets of data, namely, the condition of the building and the seriousness of a building's defects, which can be analysed to provide a rating of the building's overall condition. As Protocol 1 (visual inspection) forms the basis of this rating system, we named the system the Condition Survey Protocol (CSP) 1 Matrix. The CSP1 Matrix was developed as a rating tool for a reasonable property condition assessment. The matrix is also suitable for all types of buildings because the data input relies on the condition and damage assessments. While the elemental breakdown of each building might vary from building to building, this does not prevent the format of the matrix from being able to accommodate any condition of survey work. The goals behind the CSP1 Matrix are:

- i. To enable the surveyors to collect data within shortest possible time by avoiding descriptive, longhand write-ups during fieldwork;
- ii. To record the existing defects of the building, the main source of data, by assessing the condition and assigning priority to each defect recorded;
- iii. To obtain an overall rating of the building's condition. The proposed remedial work is not the main concern of this matrix. Moreover, the repair work usually cannot be carried out immediately after the survey's completion because of budget constraints. Therefore, the validity of any proposed remedial work would need to be reconfirmed later; and
- iv. To use the numerical rating acquired from the survey work to perform statistical analysis.

The data required for the CSP1 Matrix are the condition and the priority assessments, as shown in Tables 1 and 2. Each numerical score (1 to 5) is accompanied by a scale value and description. This will help surveyors to rate the building's defects and to determine the exact condition implied by the scale values. The scale values and their descriptions depend on the maintenance standard of the building being evaluated. For instance, the scale can be made more stringent than the example provided here. The examples given in Tables 2 and 3 are the most basic scales used in the CSP1 Matrix.

TABLE II
CONDITION ASSESSMENT PROTOCOL 1

Condition	Scale Value	Description
1	Good	Minor Servicing
2	Fair	Minor Repair
3	Poor	Major Repair/Replacement
4	Very Poor	Malfunction
5	Dilapidated	Damage/Replacement of Missing Part

TABLE III
PRIORITY ASSESSMENT

Priorit y	Scale Value	Description
1	Normal	Functional; cosmetic defect only
2	Routine	Minor defect, but could become serious if left unattended
3	Urgent	Serious defect, doesn't function at an acceptable standard
4	Emergency	Element/structure doesn't function at all; OR Presents risks that could lead to fatality and/or injury

Each recorded defect is assigned a condition and priority rating. Each rating is then multiplied to determine the total score for each defect. The total score is then matched with the matrix, as shown in Table 4. The scores range from 1 to 20. A colour (green, yellow or red) is then applied to indicate the score in each of the 3 parameters: Plan Maintenance (1 to 4), Condition Monitoring (5 to 12) and Serious Attention (13 to 20), as shown in Table 5. This method of analysis makes it easy to identify the level of seriousness of each defect recorded during the building inspection.

Ratings for the individual defects must be assigned carefully and according to the preset maintenance standards and/or defect definitions used by the surveyors/clients. This will reduce the risk of misinterpreting the seriousness of the defects identified, especially when dealing with red-coded defects. It is important to keep in mind that the red-coded defects should be dealt with first; this will influence the overall building rating and highlight the individual defects that are posing extreme danger to the building. This will also help the surveyor to identify the risk of individual defects and provide clients with well-informed defect summaries.

TABLE IV
THE MATRIX

Scale		Priority Assessment			
		E 4	U 3	R 2	N 1
Condition Assessment	5	20	15	10	5
	4	16	12	8	4
	3	12	9	6	3
	2	8	6	4	2
	1	4	3	2	1

TABLE V
THE DESCRIPTIVE VALUE ACCORDING TO SCORE

No	Matrix	Score
1	Planned Maintenance	1 to 4
2	Condition Monitoring	5 to 12
3	Serious Attention	13 to 20

After scoring every defect, we calculated the overall building rating, which summarises the building's condition. The score of each defect is added up and divided by the total number of defects to get the overall building rating. The building is then rated Good, Fair or Dilapidated, according to the score (out of 20). Table 6 shows the overall building ratings.

TABLE VI
OVERALL BUILDING RATING

No	Building Rating	Score
1	Good	1 to 4
2	Fair	5 to 12
3	Dilapidated	13 to 20

All of the information gathered for the CSP1 Matrix is recorded in the Schedule of Building Condition form and for reporting purposes, the CSP1 Matrix comprises a photograph box, a defect plan tag and an executive summary as shown in Appendix 1.

IV. CONCLUSION

Building inspection requires skill in identifying defects and familiarity with reporting procedures. It primarily involves on-site work and preparation of a report. This paper focuses on the latter. Traditionally, longhand descriptions have been employed for reporting building inspection work. These are time consuming, particularly during site inspections. The CSP1 Matrix has been developed to shorten this process, thus shortening on-site inspection time. As the case study has shown, the CSP1 Matrix achieved its objective and proved to be a reliable and practical assessment method for building inspections performed under reasonable property conditions. However, the CSP1 Matrix needs further use before it will be clear whether it is suitable for inspections of medium and large properties. It is likely that the CSP1 Matrix is not suitable for unreasonable property conditions, where more detailed descriptions of the defects are required, particularly for the preparation of a Building Survey Report.

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APPENDIX

Appendix 1: Sample of Finalised Executive Summary

**BUILDING CONDITION SURVEY FOR ECSTRAC™,
PULAU LANGKAWI, KEDAH DARUL AMAN**

CONDITION SURVEY PROTOCOL (CSP) 1

EXECUTIVE SUMMARY

1.0 Property Information

Building Address : ECSTRAC™ Pulau Langkawi, Kedah Darul Aman
Owner Name : Ministry of Science, Technology and Innovation (MOSTI)
Date of inspection : 26.06.2009
Weather : Clear and Fair

2.0 Condition Survey Protocol (CSP) 1 Matrix

No.	Matrix	Score	Color Code	Finding(s)
1.	Planned Maintenance	1 to 4		25
2.	Condition Monitoring	5 to 12		4
3.	Serious Attention	13 to 20		0
Total Defects				29

3.0 Overall Building Rating

No.	Building Rating	Score
1.	Good	1 to 4
2.	Fair	5 to 12
3.	Dilapidated	13 to 20

Total marks - 127
Number of defects - 29
Total score - 4.33
Overall building rating - Good

4.0 Recommendation

This building is in Good condition.

However, the total score is close to 5, indicating that, if the defects identified in this inspection, especially the ones coded yellow, are left unattended, the building's condition will fall to Fair.

Therefore, it is recommended that periodical inspections be carried out on this building and that any actions recommended by this report are carried out to prevent further dilapidation to the building.

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