

## THE PRACTICE OF BUILDING INSPECTION IN MALAYSIAN TOTAL ASSET MANAGEMENT

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### Abstract

The implementation of Total Asset Management (TAM) is important for sustainable development. Safety and security are aspects that need to be assured of in sustainable development. To ensure that the aspects are assured, the construction industry professionals who are involved in designing, creating, maintaining and disposing the assets should have knowledge in asset management. Therefore, this paper reveals the awareness, knowledge, and familiarity of construction industry professionals about asset management, particularly in terms of building inspection. The data was obtained by using a questionnaire-survey, in which questionnaires were distributed among 205 Malaysian Professionals from various fields. The data was analysed by using the Statistical Package for Social Science (SPSS) software. The result shows that the majority of respondents are aware of the need for building inspection and the importance of it. However, they lack knowledge on how to perform a proper building inspection. This is because they are not familiar with the standards or protocols which are often used as a guide such as QLASSIC, RICS Building Survey Report, ASTM E-2018, CPBS101 and others. This is somehow related to many reports of building disasters which occur in Malaysia. To achieve sustainable development, all professionals involved in asset management should have sound knowledge of the principles of TAM, in order to implement it comprehensively.

*Keywords:* Asset management, building inspection, safety and security, facilities

### Abstrak

Pelaksanaan Pengurusan Aset Menyeluruh (PAM) adalah penting untuk pembangunan lestari. Keselamatan merupakan salah satu aspek yang perlu dijamin bagi menjayakan pembangunan lestari. Bagi memastikan aspek keselamatan terjamin, pihak profesional industri pembinaan yang terlibat dalam mereka bentuk, mewujudkan, menyelenggara dan melupuskan aset perlu mempunyai pengetahuan dalam pengurusan aset. Justeru, kertas ini mendedahkan kesedaran, pengetahuan dan kebiasaan para profesional mengenai pengurusan aset, terutamanya dari sudut pemeriksaan bangunan. Data penyelidikan diperolehi melalui soal selidik yang diedarkan dalam kalangan 205 orang profesional dari pelbagai bidang. Data yang dikumpulkan dianalisa menggunakan perisian the Statistical Package for Social Science (SPSS). Keputusan menunjukkan majoriti responden menyedari keperluan pemeriksaan bangunan dan kepentingannya. Walaupun begitu, mereka kurang pengetahuan mengenai tatacara pelaksanaan pemeriksaan bangunan yang betul. Ini kerana rata-rata responden tidak biasa dengan piawaian atau protokol pemeriksaan bangunan seperti QLASSIC, RICS Building Survey Report, ASTM E-2018, CPBS101 dan lain-lain. Situasi ini boleh dikaitkan dengan kewujudan banyak laporan tentang kejadian bencana melibatkan struktur binaan di Malaysia. Bagi mencapai pembangunan lestari, semua pihak profesional yang terlibat dalam pengurusan aset perlu mempunyai pengetahuan mengenai prinsip-prinsip PAM supaya pelaksanaannya adalah komprehensif.

*Kata kunci:* Pengurusan aset, pemeriksaan bangunan, keselamatan, fasiliti

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## 1.0 INTRODUCTION

Over Safety and security is an important aspect in the provision of assets. The provision of assets is necessary to meet the characteristics of safety and security because it involves human life. Furthermore, safety and security is also one of the principles of sustainable development. It is the social demand of the community for safety and security in daily life. Hence, proper asset management practices will be able to ensure the safety and security of users of the assets. Besides, appropriate asset management practices would be able to provide a variety of benefits, particularly in terms of financial, operational smoothness, the environment and can help an organization create a complete positive visibility of the assets.

In a pro-active move, the former Prime Minister of Malaysia, Tun Abdullah Ahmad Badawi, launched the Government Asset Management Policy (GAMP) in March 2009. He was confident that the GAMP can stimulate long-term economic growth and able to make the country as a leader in the field of asset management in the region. Under the GAMP, the government has introduced Total Asset Management (TAM) in the management of government assets. The TAM establishment aims to realize the goal of GAMP to protect the interests of citizens in terms of providing quality services to the people through the provision of proper assets.

Currently, practices in Malaysia give the responsibility to manage and maintain government assets to each agency. Previously, government agencies typically adopted a reactive maintenance of government assets that are carried out ad hoc without a systematic plan and schedule. The reactive maintenance is part of the maintenance method as described by Lavy [1]. There are many drawbacks in a reactive maintenance practice which did not care for management planned assets, lower asset life, slow process of repairing, non-economical long-term cost, inhibits the activity in the agency, reducing the quality of service, and others. Besides, damage and defects in the building were also influenced by the work of inefficient monitoring and nonchalant attitude about the construction stage [2]. Besides, a workshop with Kajang Municipal Council reveals that there are no periodic building inspection works performed to assess building condition. This is due to the limited budget and workforce to conduct such works. This situation may happen to almost government agencies when the allocation for maintenance-related works not given serious attention.

Total asset management, with a comprehensive approach, including preventive maintenance and minimizing breakdown maintenance, should be practiced. This practice is consistent with the concept of sustainable development because it can prolong the life of the asset and maintain the performance of the asset, since sustainability of buildings is one of the main aims in the construction industry [3]. In addition, asset management based on sustainable

development is necessary to achieve the level of quality, safety, health, environment and comfort among the people. TAM is the best approach in managing assets and facilities because of the other importance of this approach, which is the return on investment. This is because the provision of assets and facilities is a great investment to the government. Therefore, the results or returns obtained should be taken into account. This is to ensure that the product or return for each investment made is worth the value invested.

The TAM model consists of four main phases that include the planning phase, creation phase, consumption phase and disposal phase. The planning and creation phases can be classified as project management, where it is the process of preparing an asset which involves activities such as planning, design, procurement, construction and commissioning. At this stage, asset planning should be done carefully, taking into account various aspects. Good planning will give better effect to the various parties, especially the users of the asset. Asset planning should consider the impact of an asset in short, medium and long term. In addition, the planned asset should be evaluated based upon previous performances. The success or failure the previous asset planning should be a clue to the provision of assets in order to meet the requirements.

It is therefore important to planners, architects, engineers, surveyors and other professionals to know and be proficient on TAM. These construction industry professionals are involved in the TAM phases from planning until the disposal of the assets. The longest phase in building lifecycle is occupancy phase. In this phase, building condition should be maintain to ensure it functionality and maintain the value. The effective maintenance works depend on accurate data and information about current building condition [4]. The maintenance data and information obtained by performing building inspection. Therefore, it is important to the professionals to have knowledge about building inspection works to ensure that the maintenance data and information is accurate.

However, current buildings condition in Malaysia, especially government assets such as school buildings were not in good condition [5]. School is one of government biggest asset and should be maintained to ensure its functionality and value. Besides, even newly completed houses have the defective issue that put in doubt the competency of construction team [6]. This situation rise the question on the practice of building inspection and maintenance among Malaysian professional. Therefore, this paper reveals the understanding of building inspection in asset management among a sample of Malaysian Professionals.

## 2.0 LITERATURE REVIEW

In general, the structure of government's asset management documentation consists of four stages,

namely policy, manuals, management procedures and supporting documents. This section discusses the policy and the manual. The policy outlines the government's asset management strategy that should be standard practice for all government agencies, while the manual clarifies the concepts, practices and responsibilities of TAM as contained in the GAMP.

In total, there are four objectives of GAMP such as follows:

- To create assets to meet the requirements of government facilities;
- To ensure that asset management is implemented systematically, holistically and in a sustainable manner, to achieve the optimal benefits of the asset;
- To establish a systematic asset information system, integrity and easily accessible, and
- To ensure the TAM can be implemented and monitored effectively.

In addition, there are three rationales for the establishment of GAMP, specifically to ensure a comprehensive asset management, to ensure that assets are always in good condition and to keep the value of government investment. However, the most important aspect is that it involves human lives. It is necessary to ensure that the assets are in good condition to ensure the safety and security of building users. Besides, assets in good condition can be used properly, have economical usage and longer life expectancy. It meets the requirements of sustainable development, encompassing environmental, economic and social aspects.

The TAM Manual is a document that explains the concepts, principles and strategic framework in practice. Asset management has a broad scope in which it combines different disciplines and processes in the maintenance of the asset. The processes in asset management include Demand Management, Risk Management, Value Management, Life Cycle Cost, and Economic Evaluation. The following are the characteristics of an effective asset management-based TAM Manual [7]:

- Optimize the service potential of the assets to ensure that assets are used and maintained properly;
- Reduce the demand for new assets and financial savings through demand management techniques;
- Achieve the best returns through the economic evaluation of the life cycle cost, value management and risk management;
- Reduce the creation of unnecessary assets that will impact the high operating costs of assets; and
- Focus on decisions, clarify responsibility and accountability, and provide performance reports.

Asset life cycle needs to be emphasized in the asset selection process because the asset needs resources to owning and operating during its lifetime. The TAM Manual outlines eight key asset management

activities to be performed by each agency. Figure 1 shows the eight main activities in TAM Manual.

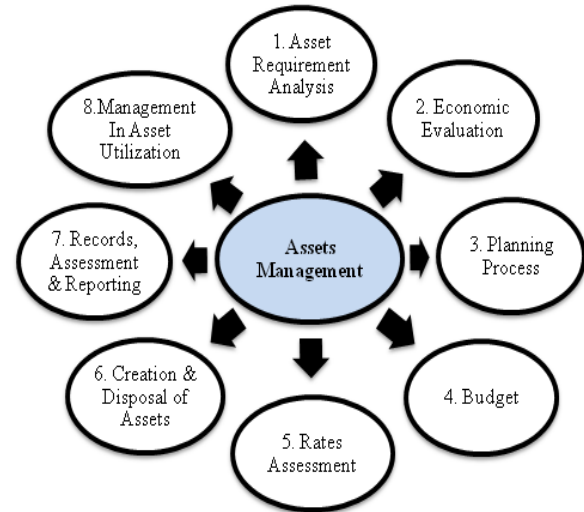


Figure 1 The main activities in TAM manual

Based on Figure 1, there are eight activities in the TAM Manual, which are asset requirement analysis; economic evaluation; planning process; budget; rates assessment; creation and disposal of assets; records, assessment and reporting; and management in asset utilization. The implementation of these activities involves a variety of expertise to ensure that the best asset management is achieved.

The main purpose of TAM practice is to achieve the optimal asset benefits so that the quality of service delivery can be improved. To achieve optimal asset benefit, the TAM general model is divided into two levels, namely Process Management and Support Management. Process Management consists of planning, creation, use and disposal of assets, while Support Management consists of demand management, human resources, finance, value & risk, and performance data. Even so, both types of management are carried out based on community demand.

Wisdom in TAM allows the parties involved during the planning process to plan the provision of assets more effectively and meet the goals of the organization. Therefore, all the professionals involved in this works especially Planners should have the knowledge and mastery the TAM scope. This advantage can help to improve the quality of provision of assets as to make Malaysia a leader in this field in South-East Asia.

Asset management is closely related to safety and security. Asset management processes which start from planning stage to disposal stage are to ensure the quality and performance of the assets. Asset performance is closely linked to the quality of life [8-9]. Thus, the proper maintenance should be implemented to ensure that good health and safety of building users

is assured [10-11]. Ho *et al.* stated that properly maintained asset could ensure the safety of owners, occupants and the public [12]. In addition, proper asset management can provide better health and economic aspects [13-17]. Hence, the preference for asset maintenance should be evaluated based upon the level of risk assumed and the effects arising from a process [18-19].

You explains that when the building was designed and built in good condition, the performance will decrease if not properly maintained [20]. Thus, building management is aimed to provide a comfortable living environment to the residents in the long term [8]. You supported that building quality maintenance is in line with sustainability principles [20]. This reflects to the aspect of environmental and economical sustainability. Therefore, long-term building management has become an important issue [21-22].

In addition, improper maintenance work may cause accidents and harm the users [23]. For example, building structural failure could result in loss of life and damage to property. Parida & Chattopadhyay mentioned without a formal performance measurement, it is difficult to plan, execute, control and upgrade the maintenance process [24]. Therefore, Rohayah pointed out that building management activities such as building condition assessment can assist in determining priorities for maintenance planning [25]. Building inspection is actually a key activity in tracking building performance.

Education and training in the management of asset quality are important [26]. Chan *et al.* stated that many researchers had shown that project management is a key to achieving quality in construction [27]. A clear and comprehensive project's specification is an important determinant of the quality of construction [28]. Therefore, it is understandable that all the professionals involved in the provision of assets should be well informed in the field of asset management. Total asset management will lead towards sustainable development.

### 3.0 RESEARCH METHOD

Data collected via questionnaire survey for the professionals involved in the field of asset management. The finding is then referred to the cases that due to improper asset management implementation. The cases are sourced from media reports.

A set of questionnaire each was distributed among construction professionals to get feedback on one of the key components of asset management, which is building condition inspection. This survey was conducted from January to June 2014. The questionnaires were distributed among these professionals when they attended Building Surveying (BS) Continuous Professional Development (CPD) Talk Series that consists of a series of four talks. The respondents were required to answer questions posed

in the questionnaire at the end of the event. The topic of the talk centred on the asset management principles.

In total, there are four main sections in the questionnaire. Part A is on questions about respondents' background consisting of academic background, nature of business and employment sector. Part B asked respondents' opinion about the need for inspection of the asset at certain point of times. Next, Part C asked the opinion about the preferred methods for performing building inspection work. Finally, the respondents were asked the extent of their familiarity with the protocol or standards of building inspection that has been developed locally and internationally. A total of 205 respondents participated in this survey. The data is analyzed using Statistical Package for Social Science (SPSS) software. Then, the results from the analysis are presented in statistical tables.

## 4.0 RESULTS AND DISCUSSION

This section discusses the results from the questionnaires and also highlights of the media reports on cases of building disasters in Malaysia.

### 4.1 Respondents' Background

A total of 205 participants who attended the BS CPD Talk Series had participated as respondents in this survey. The respondents were among Malaysian Professionals from diverse backgrounds in terms of academics, nature of business and sectors. Table 1 shows the frequency and percentage of respondents based on academic backgrounds.

**Table 1** Respondents' academic background

Academic Background	Frequency	Percentage (%)
Architecture	11	5.37
Civil Engineering	14	6.83
Mechanical Engineering	10	4.88
Electrical Engineering	8	3.90
Quantity Surveying	13	6.34
Building Surveying	65	31.71
Prop. Mgmt. & Valuation Surveying	19	9.26
Others	65	31.71
Total	205	100

Based on Table 1, the majority of respondents were from the background of Building Surveying with 31.71% of the total, followed by the percentage of respondents from academic backgrounds of Property Management & Valuation Surveying with the percentage of 9.26%. In addition, there are also respondents from academic backgrounds such as Architecture, Civil Engineering, Mechanical Engineering, Electrical Engineering, and Quantity

Surveying. There were 31.71% of the respondents from other academic backgrounds.

Next, the backgrounds of the respondents were analysed, based on respondents' nature of business. Table 2 shows the frequency and percentage of respondents based on their nature of business. Based on Table 2, the majority of respondents were from the building management field with 22.93%, followed by construction (20.49%), academics (15.61%), insurance (0.98%) and law (0.49%). However, there are 39.51% of the respondents who belong to other groups.

**Table 2** Respondents' nature of business

Nature of Business	Frequency	Percentage (%)
Academic	32	15.61
Construction	42	20.49
Building management	47	22.93
Insurance	2	0.98
Law	1	0.49
Others	81	39.51
Total	205	100

The respondents were also employees from various sectors of employment. Table 3 shows the frequency and percentage of respondents by employment sectors. Based on Table 3, the majority of respondents were from the government sector, with a share of 48.78%. Nevertheless, the percentage of respondents who worked in the private sector was also high as a percentage of 45.37%. Meanwhile, 5.85% of the respondents were from other employment sectors.

**Table 3** Respondents' employment sectors

Sector	Frequency	Percentage (%)
Government	100	48.78
Private	93	45.37
Others	12	5.85
Total	205	100

This background shows diversity of respondents that come from government and private sectors. The diversity of respondents can contribute to meaningful findings. Construction and building management nature of business shows that the findings were derived based from these two environments. It reflects the TAM cycle that are mostly dominated by these two classifications i.e. people who are involved in construction are the ones who construct the building on the ground, and people who are involved in building management are the ones who manage the built assets. Since the respondents are captured from BS CPD talk series, most of the respondents were from the Building Surveying academic background, despite the others with academic background who share the same percentage with Building Surveying.

#### 4.2 The Need for Building Condition Inspection

This section describes the views of professionals on the needs of the building condition inspection at particular points of times. In general, the responses obtained showed that professionals are aware of the requirement for building condition inspection, in particular, within specific points of time. The result of the questionnaire for the needs of building inspection condition is shown in Table 4.

**Table 4** Respondents' agreement on the need for building condition inspection

How far do you agree the situation below need inspection?	Percentage of Agreement (%)				
	Not agree at all	Not agree	Quite agree	Agree	Agree at all
Before purchasing the property	3.41	0.96	6.83	22.44	66.34
Before completion of building	3.41	5.36	8.29	30.73	52.20
After (just completed) completion of building	3.90	1.95	11.22	30.73	32.20
Before the issuance of certificate of practical completion	1.46	1.95	7.32	26.83	62.44
Done periodically (once a year)	7.32	11.22	20.97	28.78	31.71
Done Periodically (once in 2 years)	3.90	12.68	22.93	34.63	25.85

For the need to perform building inspections before buying the property, the majority of 66.34% of the respondents were in the 'strongly agree' group, followed by 22.44% who 'agree'. Percentage of respondents who 'agree' and 'strongly agree' on the inspection requirements were very high compared to respondents who 'disagreed and 'strongly disagreed', respectively by 0.96% and 3.41%; while 6.83% of the respondents 'quite agreed' to conduct inspections before buying property. This shows that professionals are aware that property inspection is essential to be carried out before buying the properties involved. This

is to ensure that the property purchased is desirable and not detrimental to the buyer.

Building condition inspections should be carried out after the completion of the construction work. This is supported by the results from the survey that showed a majority of 32.20% of the respondents 'strongly agreed' with the implementation of building inspection after completion of building construction. In addition, 30.73% of respondents agreed with this scenario. Meanwhile, 3.90% of the respondents are 'strongly disagreed', and 1.95% 'disagreed'. Furthermore, there are 11.22% respondents are 'quite agreed' with the situation. Building inspection after the completion of

construction is critical to ensure the quality of the constructed building is good. The possibility of building will be delivered to customers with defects will be higher if the inspection was not performed. This will cause dissatisfaction of owners and give a bad image to the contractor. Thus, with the examination after the completion of construction, the contractor can carry out repairs to any defects before the building was handed over to the owner.

The questionnaires also gathered the professional opinions on the building inspection requirements before the issuance of Certificate of Practical Completion (CPC). Responses obtained showed that the majority of respondents 'strongly agree' with 62.44% while 26.83% 'were agreed' that the building condition inspections should be conducted prior to the issuance of certificates of completion. The remaining 7.32% of the respondents 'quite agreed'; 1.95% 'disagreed' and another 1.46% 'strongly disagreed'. These results indicate that the majority of professionals realize the importance of building condition inspection before the certificate is issued. This is to ensure that buildings that are constructed completely meet the required standards and works properly.

Building condition inspections should be carried out periodically. However, the duration of each inspection is not fixed and varies based on the type of building or

facility. The questionnaire also sought the response of the professionals for regular checks of the building. For a period of one year, the majority of 31.71% of the respondents agreed to conduct periodic inspections once a year followed by 28.78% 'agreed', 20.97% 'quite agreed', 11.22% 'disagreed', and 7.32% 'strongly disagreed'. For the inspection once in two years, the majority of 34.63% of the respondents 'agreed', followed by 25.85% 'strongly agreed', 22.93% 'quite agreed', 12.68% 'disagreed', and 3.90% 'strongly disagreed'. Comparison between the two periods of these inspections shows that the percentage of respondents who 'strongly agree' is higher for inspection once in a year. This may be because many respondents are aware that building damage can occur at any time due to many causes. Therefore, more frequent inspection is better to avoid more serious damages from getting worse.

### 4.3 Preference of Performing Building Inspection

This part presents the results of the questionnaires on the preference of performing building inspection. The results of this questionnaire generally portray the knowledge of the respondents about the proper and effective technique and method of building inspection. Table 5 shows the results of the questionnaires.

**Table 5** Respondents' preference of performing building inspection

Preference of performing building inspection	Percentage of preference (%)				
	Not prefer at all	Not prefer	Quite prefer	Prefer	Prefer at all
The presence of owner/occupier during inspection	5.85	8.29	21.46	32.68	31.71
Preliminary inspection once arrived at site	6.34	3.41	17.07	41.95	31.22
External to internal	5.37	5.37	18.05	38.53	32.68
Internal to external	5.85	4.88	20.00	35.12	34.15
Start at top and working down (top down)	8.29	10.24	21.95	35.12	24.39
Start at bottom and working up (bottom up)	6.34	12.20	20.96	32.20	28.30
Start at roof space	9.27	11.22	31.22	27.32	20.98
Defect recording by long-hand (free flow writing)	3.90	12.20	27.32	41.46	15.12
Defect recording by tape-recorder	6.83	13.66	29.76	34.14	15.61
Defect recording by site-prepared sketches	4.88	3.41	21.46	41.46	28.78
Defect recording by pre-printed form/checklist	3.41	0.98	14.15	40.00	41.46
Defect recording by on-site computer	6.34	5.85	26.34	40.49	20.98
Defect recording by hand-held device (PDA, Smart phone, Tablet, etc)	5.37	5.37	17.07	38.54	33.66

Majority 32.68% of respondents prefer the presence of owner/occupier during the inspection of building while 31.73% of them 'prefer at all' with the situation. However, 8.29% of respondents who do not prefer the presence of owner/occupier and 5.85% 'not prefer at all'. The rest of 21.46% respondents 'quite prefer' about the presence of owner/occupier. In general, the presence of the owner/occupier of the building can help inspectors in performing building inspection work, particularly to identify causes of building defects. It can facilitate and accelerate the work carried out as well as get the additional information.

For the preference of performing preliminary inspection once arrived at site, majority 41.95% of respondents prefer on the action and 31.22% of respondents 'prefer at all'. Meanwhile, 17.07% of respondents are 'quite prefer' followed by 6.34% 'not prefer' at all and 3.41% of them 'not prefer'. This indicates that the respondents were aware of the importance of preliminary inspection to get early depictions of the building to be inspected. These early depictions of the building are able to facilitate the planning works of the actual inspection which is more detail and comprehensive.

For the approach of building inspection, majorities 38.53% of respondents 'are prefer' and 32.68% are 'prefer at all' to perform the inspection from external to internal. This percentage is followed by 18.05% of respondents who 'quite prefer', 5.37% 'not prefer' and 5.37% 'not prefer at all'. The results for performing inspection from internal to external are quite similar to the majority 35.12% of respondents 'are prefer', 34.15% 'prefer at all', 20.00% 'quite prefer', 5.85% 'not prefer at all' and 4.88% 'not prefer'. The results of the preference of building inspection based on building level also showed similar results for both the opposite way which is top-down and bottom up (refer Table 5). Meanwhile, for the performing of building inspection start at roof space, majority 31.22% of respondents are 'quite prefer' followed by 27.32% 'prefer', 28.30% 'prefer at all', 11.22% 'not prefer' and 9.27% 'not prefer at all'. The better way to perform building inspection is to start at top and working down (top down). Actually, this method should start at the top-most space, which is at roof space.

There are several ways to record defects in the building such as by long-hand (free flow writing), tape-recorder, site-prepared sketches, pre-printed form/checklist, on-site computer and hand-held device (PDA, smart phone, Tablet, etc.). For free flow writing, majority 41.46% of respondents 'are prefer' on this method followed by 27.32% 'quite prefer', 15.12% 'prefer at all', 12.20% 'not prefer' and 3.90% 'not prefer at all'. The similar result was obtained for defects recording by a tape-recorder where the majority of 34.14% 'prefer', followed by 27.32% 'quite prefer', 15.61% 'prefer at all', 13.66% 'not prefer' and 6.83% 'not prefer at all'. For defect recording by site-prepared sketches, majority 41.46% of respondents are 'prefer', followed by 28.78% 'prefer at all', 21.46% 'quite prefer', 4.88% 'not prefer at all' and 3.41% 'not prefer'. The results for defect recording by pre-printed form/checklist show that majority 41.46% of

respondents 'prefer at all', followed by 40.00% 'prefer' and 14.15% 'quite prefer'. Meanwhile, 3.41% do 'not prefer at all' and 0.98% is 'not prefer'. Besides, 40.49% of respondents prefer defect recording by on-site computer, followed by 20.98% 'prefer at all', 26.34% 'quite prefer', 6.34% 'not prefer' at all and 5.85% 'not prefer'. The last method questioned in this survey are recording by a hand-held device, in which the majority of respondents 'are prefer' with 38.54%, followed by 26.34% 'quite prefer', 20.98% 'prefer at all', 6.34% 'not prefer at all' and 5.85% 'not prefer'.

From these results, we can conclude that the majority of respondents prefer recording with pre-printed form and site-prepared sketches. However, there are some methods that are less compatible and not systematic. Some of these methods could be used as an additional method for collecting supportive information during the inspection process. From all these methods, the best way to record building defects are by using pre-printed form/checklist. Meanwhile, another method that can be used as an additional way to collect evidence, is by photo's recording.

#### 4.4 Familiarity with Building Inspection Standard/Protocol

This section shows the result of the questionnaire about construction professional's familiarity with building inspection standards/protocols that are often used. There are seven standards usually used as guidance in building inspection works such as RICS Building Survey Report (2005), BRE Design Quality Manual (2007), ASTM E-2018 (2008), RICS Home Buyer Report (2009), Condition Survey Protocol (CSP) 1 Matrix (2010), RICS Condition Report (2010), and RISM Code of Practice for Building Inspection (CPBS101) (2011). Table 6 shows the result of respondents' familiarity with the standards.

**Table 6** Respondents' familiarity with building inspection standards/protocols

How far are you familiar with this building inspection standard/protocol?	Percentage of Familiarity (%)				
	Not familiar at all	Not familiar	Quite familiar	Familiar	Familiar at all
RICS Building Survey Report (2005)	25.85	26.34	26.83	15.61	5.37
BRE Design Quality Manual (2007)	30.24	33.66	21.46	11.71	2.93
ASTM E-2018 (2008)	33.17	34.63	21.46	8.78	1.95
RICS Home Buyer Report (2009)	29.27	31.71	23.90	11.22	3.90
Condition Survey Protocol (CSP) 1 Matrix (2010)	29.27	32.20	18.54	13.66	6.34
RICS Condition Report (2010)	27.32	28.78	22.44	15.12	6.34
RISM Code of Practice for Building Inspection (CPBS101) (2011)	26.34	23.41	17.07	22.44	10.73

Overall, responses obtained are disappointing when majorities of the respondents are 'not familiar' or 'not familiar at all' with these standards/protocols. For RICS Building Survey Report (2005), majority 26.83% of respondents are 'quite familiar' with the standard followed by 26.34% 'not familiar' and 25.85% 'not familiar at all'. Meanwhile, only 15.61% of the

respondents are 'familiar' and 5.37% are 'familiar at all' with the standard. Results for BRE Design Quality Manual (2007) shows that only 2.93% of the respondents are 'familiar at all' and 11.71% are 'familiar' with the standard compared to 30.24% 'not familiar at all' and 33.66% 'not familiar'. The rests of 21.46% are 'quite familiar'. The similar situation

recorded by ASTM E-2018 (2008) with almost the same percentages (refer Table 6). Furthermore, 31.71% of respondents are 'not familiar' with RICS Home Buyer Report (2009) followed by 29.27% who are 'not familiar at all'. Only 11.22% are 'familiar' and 3.90% are 'familiar at all' while the rest of 23.90% are 'quite familiar'.

Moreover, result for CSP1 Matrix (2010) shows that majority of 32.20% respondents are 'not familiar' followed 29.27% are 'not familiar at all' with the standard. Besides, 18.54% are 'quite familiar', 13.66% are 'familiar' and only 6.34% are 'familiar at all'. In addition, majority 28.78% of respondents are 'not familiar' with RICS Condition Report (2010) followed by 27.32% 'not familiar at all', 22.44% 'quite familiar', 15.12% 'familiar and only 6.34% are 'familiar at all'. For RISM Code of Practice for Building Inspection (CPBS101) (2011), the highest percentage recorded by the respondents who are 'not familiar at all' (26.34%); 23.41% of respondents are 'not familiar', 22.44% 'familiar', 17.07% 'quite familiar', and 10.73% are 'familiar at all'.

From the overall results, the best results were recorded by CPBS101 (2011) with a total positive response of 33.17% compared to ASTM E-2018 (2008),

which recorded the lowest positive response with the percentage of 10.73%. The overall result of this section shows that the professionals in this study are unfamiliar with the standards/protocols. Responses obtained to answer questions about the respondents' understanding of the inspection method as in the previous section demonstrates that the respondents quite understand the inspection methodology. This is somehow contradicting with the inspection reporting. The answers seem to indicate that the respondents have lack of knowledge of effective and systematic methods in reporting the building inspections. It also indicates that international standard is not well known among the respondents, namely ASTM, RICS and BRE.

Further analysis carried out to test the difference between, academic background, nature of business and sector on their familiarity with building inspection standards or protocols. The test conducted using univariate ANOVA and found that there are significant difference for the standards/protocols on academic background, but not for both nature of business and sectors. The univariate ANOVA result for academic background on their familiarity with this building inspection standard/protocol is presented in Table 7.

**Table 7** Summary of result of univariate ANOVA for academic background

How far do you familiar with this building inspection standard/protocol	F	p-value	Significant
RICS Building Survey Report (2005)	5.337	<0.05	Yes
QLASSIC: Quality Assessment System for Building Construction Work (2006)	2.316	<0.05	Yes
BRE Design Quality Manual (2007)	2.459	<0.05	Yes
ASTM E-2018: Standard Guide for Property Condition Assessments: Baseline Property Condition Assessment Process (2008)	2.458	<0.05	Yes
RICS Home Buyer Report (2009)	5.599	<0.05	Yes
Condition Survey Protocol (CSP) 1 Matrix (2010)	6.349	<0.05	Yes
RISM Code of Practice for Building Inspection (CPBS101) (2011)	7.047	<0.05	Yes

Since there is a significant difference on all the standards, Duncan post-hoc is been carried out. Based on *RICS Building Survey Report (2005)*, it shows that Building Surveying is more preferring this standards compared to Mechanical Engineering, Quantity Surveying, Others and Electrical Engineering. For *QLASSIC: Quality Assessment System for Building Construction Work (2006)*, both Building Surveying and Civil Engineering are more preferring this standard compared to Mechanical Engineering. Then, both Building Surveying and Others more prefer *BRE Design Quality Manual (2007)* compared to Quantity Surveying. Furthermore, Building Surveying is more preferring *ASTM E-2018: Standard Guide for Property Condition Assessments: Baseline Property Condition Assessment Process (2008)* compared to Quantity Surveying and Mechanical Engineering. Besides, Building Surveying is more preferring *RICS Home Buyer Report (2009)* compared to Mechanical Engineering, Quantity Surveying, Property Management & Valuation Surveying, Civil Engineering and Architecture.

For local's standards, Building Surveying is more preferring *Condition Survey Protocol (CSP) 1 Matrix (2010)* compared to Property Management & Valuation Surveying, Mechanical Engineering, Quantity Surveying, Electrical Engineering, Civil Engineering and Architecture. Then, Building Surveying is also more preferring *RISM Code of Practice for Building Inspection (CPBS101) (2011)* compared to Mechanical Engineering.

This result indicate that the respondents from Building Surveying background has the most familiarity with all these standards/protocols. Since the univariate ANOVA result for nature of business and sectors shows that there are no significant difference, Duncan post-hoc analysis is not being carried out.

#### 4.5 Discussion

Based on the questionnaire survey, it shows that the respondents are aware of the need for performing building inspection. Their preferences are varied and mostly agreed that building inspection has to be



conducted once a year. The lacking part here is the knowledge about building inspection standard, where most respondents are not familiar with building inspection standards. Performing building inspection and reporting building inspection are two different matters but closely related. The reporting plays a vital role, especially when it involves dispute-resolution cases. The report needs to stand in court, not just the only on-site building inspection.

There is a lack of building inspection reporting associated with building disasters in Malaysia. One cannot predict a building defects pattern when relying only on building inspection activity. Only the report will tell and analyse the building defects patterns, which enable us to predict the likelihood or tendency of any building disasters that have the possibility to occur. This lacking perhaps can be related to numerous building disasters that take place in Malaysia, to name a few as depicted in Table 8. These cases were identified through media reports. Table 8 shows the information about the cases that occurred from January, 2013 to August 2014.

Table 8 shows the list of cases that occur due to the weakness of building management, particularly in term of building inspection. In 20 months period, there are 13 cases reported by media. This statistic shows that the safety aspect in building or its parts is not convincing and disaster can occur without any warning. More alarming, most reported disasters occur in public buildings or spaces. This indicates that the implementation of building inspection in Malaysia is

poor and aggressive action should be taken to address this situation.

Failure to conduct a proper building inspection caused defects that occur undetected. This can lead to structural failure of the building and pose a danger to building users. Human life is the most precious thing and cannot be interchanged. Thus, building inspection should be done to detect any defects that may lead to any building disaster; and this should come with proper reporting of building inspection. This is to ensure that building users' safety is assured, and they can live in a comfortable environment. Based on the survey findings, the importance of building inspection is acknowledged, but the practicality is not in place. Section 85A in Act 133 (Street, Drainage and Building Act 1974) clearly mentions this but the status of implementation remains unclear.

In general, there are building inspection works carried out in Malaysia. However, the work may be performed without following the proper protocol or standard. In addition, this inspection work may also be done by unauthorized parties. The worst case is, the work of building inspection is not performed at all. This may be the reason why many building disaster cases occur either at the existing or newly completed buildings. This is because the inspection should not only be carried out on the buildings that are occupied, but should also be performed on the building that is still under construction to ensure a good quality of construction product.

**Table 8** The cases of building/structure disasters in Malaysia from January, 2013 to August, 2014 [29-41]

No	Title	Case	Report Date	Source
1	Tujuh kereta rosak dihempap bumbung runtuh	Seven cars parked in front of an old cinema building in Jalan Anston, damaged after the roof crushed pavement collapse premises today.	20 August 2014	Sinar Harian
2	Bumbung pejalan kaki runtuh.	Structures may be down due to not be able to withstand water catchment on the roof of the weight and not maintained for a long time	20 July 2014	Sinar Harian
3	Bumbung SMK Seri Nilam runtuh	Three-story building's roof collapsed may due to the decayed truss.	13 May 2014	Sinar Harian
4	Dua tentera cedera, siling runtuh ketika demonstrasi letupan bom di PWTC	Two soldiers were injured, a ceiling collapsed during a bomb blast demonstration at PWTC.	17 April 2014	Berita Harian Online
5	Siling lobi hotel dalam pengubahsuaian runtuh	Part of the lobby ceiling is a leading hotel in the renovation collapsed.	13 March 2014	Sinar Harian
6	Siling hospital kerap runtuh: Di mana silapnya?	Ceiling in Neonatal Intensive Care Unit Hospital, Serdang Hospital collapses.	3 December 2013	Sinar Harian
7	Pekerja binaan maut bangunan kedai runtuh di Sandakan.	A construction worker was killed when a two-storey shop building that was under construction collapsed.	7 November 2013	Berita Harian Online
8	Pasar raya C-Mart runtuh.	The walls and roof of the building collapsed. Inspection found the building owner to obtain approval of plans to build a warehouse but reliable abusing approval to erect a commercial building	9 October 2013	Utusan Online
9	Bumbung Masjid Kampung Tebauk di Terengganu runtuh.	Part of the roof and ceiling of the mosque collapsed, possibly due to leakage problems.	29 September 2013	Sinar Harian

No	Title	Case	Report Date	Source
10	4 fatal tragedies in the collapse of Second Penang Bridge	The structure of the bridge under construction collapsed and crashed onto a car.	6 June 2013	Berita Harian Online
11	12 pilgrims went through anxious moments in the collapse of mosque roof	Twelve nearly killed after a front roof of the mosque in Binjai Kertas village, in Hulu Terengganu collapsed.	21 May 2013	Malaysiakini
12	Lima cedera kerangka lama bumbung Stadium Gong Badak runtuh	Five construction workers were injured with three of them seriously, when a long frame roof of the Sultan Mizan Zainal Abidin Stadium in the process of restoration, collapsed.	20 February 2013	Sinar Harian
13	Sengkuap bumbung astaka runtuh.	Awnings installed on the roof of the original structure of the stage collapsed due to structural decay and weight due to heavy rain in the area earlier	1 January 2013	Sinar Harian

## 5.0 CONCLUSION

TAM is an important tool in ensuring safety and security aspects that can guarantee sustainable development, if one were to follow it precisely. TAM can maximise asset performance and extend the life cycle of an asset. In addition, TAM also has a big role in creating complete visibility of an organization's assets. Complete visibility is very important in planning the creation, development, and performance of assets.

Based on the survey findings, construction professionals recognize the importance of asset management, particularly in term of building condition inspection. The respondents are also aware that building inspection should be done more often to avoid any defects from getting worse. Furthermore, the respondents prefer to use pre-printed form and site-prepared sketches during performing building inspection. On the other hand, they are also not familiar with the standard or protocol developed as a guide for building inspections process, namely ASTM, RICS and BRE. Therefore, the building inspection which is the key activity in preventing building disasters may be carried out not in the right way or with truly professional competence. Au-Yong *et al.* recommend the maintenance management to encourage the existing maintenance staff for participating the relevant training, workshop, or seminar to gain knowledge and skills [42].

For sustainable development, TAM should be implemented holistically. TAM covers all stages of the asset life-cycle in which all the construction-industry professionals are involved. In terms of safety and security, an important part in asset management is building inspection, which should take place during construction and during the occupancy of the building. Therefore, building inspection practices should be enhanced by conducting courses, workshops and seminars. It requires all professionals in the construction industry to embrace this practice.

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