

Asset Management for Educational Buildings in Egypt

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Abstract—In Egypt, the concept of Asset Management (AM) is new; however, the need for applying it has become crucial because deteriorating or losing an asset is unaffordable in a developing country like Egypt. Therefore the current study focuses on educational buildings as one of the most important assets regarding planning, building, operating and maintenance expenditures. The main objective of this study is to develop a SAMF for educational buildings in Egypt. The General Authority for Educational Buildings (GAEB) was chosen as a case study of the current research as it represents the biggest governmental organization responsible for planning, operating and maintaining schools in Egypt. To achieve the research objective, structured interviews were conducted with senior managers of GAEB using a pre designed questionnaire to explore the current practice of AM. Gab analysis technique was applied against best practices compounded from a vast literature review to identify gaps between current practices and the desired one. The previous steps mainly revealed; limited knowledge about strategic asset management, no clear goals, no training, no real risk plan and lack of data, technical and financial resources. Based on the findings, a SAMF for GAEB was introduced and Framework implementation steps and assessment techniques were explained in detail.

Keywords—Strategic Asset Management, Educational Building, Framework, Gab Analysis, Developing Country.

I. INTRODUCTION

DURING the past few years, the concept of AM has gained support on a global scale. AM in organizations today has become the focal point to improve and optimize the contribution of a physical asset to the overall success and prosperity of such organizations. The application of total AM process has taken agencies from simply acquiring and maintaining assets to more strategic planning approach.

A. Importance of Asset Management

Asset management (AM) aims at providing a customer focus for business to systematically invest, maintain, upgrade, and operate infrastructure assets [1]. The primary goal of AM is to meet a required level of service, in the most cost effective manner, through the management of assets for present and future customers [2]. The importance of AM can be seen with the growing number of reports and guidelines published by various organizations managing infrastructure assets (eg.

FHWA (1999) [1]; IPWEA (2006) [2]; AASHTO (2002) [3]; AUSTRROADS (1997) [4]; Australian National Audit Office (1996) [5]; NPWC (1996) [6]; Queensland Government (1996) [7]; APCC (2001) [8]; Government of South Australia (1999) [9]).

Barret [10] emphasized that the importance of AM principles and behaviors that underpin better practice in AM as the following:

- AM decisions are integrated with strategic planning,
- Asset planning decisions are based on an evaluation of alternatives which consider the life cycle costs, benefits and risk of ownership,
- Accountability is established for asset condition, use and performance, and
- An effective control structure is established for AM.

B. AM Objectives

National AM Working Group (NAMWG) [11] stated that the main objective of AM is: *Sustainability of communities* – building environmental, financial and social resilience and adaptability to face a changing world. While [12] and [13] detailed the AM objectives as follows:

- 1- Specific and measurable outcome or achievement required of asset system in order to implement the AM policy and AM strategy;
- 2- Detailed and measurable level of performance or condition required of the assets;
- 3- Specific and measurable outcome or achievement required of the AM system.

C. Educational Buildings Challenge

According to Ahluwalia S. S. [14], Educational buildings cover a wide range, from kindergarten schools to large universities. Within this range, elementary and high schools are the most difficult to manage and maintain due to their large number and scattered locations. Schools should provide a physical setting that is appropriate and adequate for learning. Students learn better in an environment that is pleasant, safe, and free of health hazards [15], [16]. Hinum [17] further emphasizes that poor maintenance increases running costs, such as for energy and cleaning. Other consequences of poor maintenance include the deterioration of parts of the building, an unsafe and unhealthy environment, a lower quality of teaching and learning. Thus, it can be concluded that the condition of schools is an important concern.

According to statistics of 2009/2010, number of schools in Egypt is 44631, 39376 public and 5255 private. The total education expenditures of year 2010/2011 is 36.3 milliards

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Egyptian pounds while in year 2005/2006 was 18.6 milliards L.E. with an increase 94.8%. [18], [19]. With the huge shortage in expenditures particularly in developing countries , maintaining the operation and conditions of educational facilities becomes a challenge that requires various efforts related to facility condition assessment, resource planning and rehabilitation techniques. This urges the search for innovative developments that can achieve substantial benefits to the assets and country.

II. DEFINITIONS

A. Strategic Asset Management (SAM)

Office of Facilities Management, Griffith University [20], defines SAM as the planned alignment of physical assets with service demand and achieved by the systematic management of all decision-making processes taken throughout the life of the asset. A holistic view of AM as an integrated business process designed to optimize the use of a utility's assets while balancing the varying needs of key stakeholders is supported. [21], [22].

B. Strategic Asset Management Framework (SAMF)

According to the definition of [23]; it is a valuable tool which provides departments with a systematic and consistent approach to managing their buildings to meet service delivery requirements. It guides decision-making processes over the life cycle of an asset: planning, investment/procurement, management-in-use and disposal phases, to enhance the management capability of Government departments for the building assets under their control.

C. Asset Management Plan (AMP)

The Institute of AM [12], [13], defines AMP as: document specifying activities and resources, responsibilities and timescales for implementing the AM strategy and delivering the AM objectives.

III. RESEARCH OBJECTIVES

In Egypt, the concept of AM is new, however the need for applying it has become crucial because deteriorating or losing essential assets such as schools is unaffordable in a developing country like Egypt .The main objective of this research is introducing a comprehensive framework for AM that guarantee sustaining the schools` maintenance and operation process and improving its conditions. This objective is aimed to be achieved through developing a SAMF. The General Authority for Educational Buildings (GAEB) has been chosen to be the case study of the current research as it represents the biggest governmental organization that is responsible for planning, operating and maintaining schools` buildings in Egypt.

IV. RESEARCH METHODOLOGY

Research is adopting the "investigation, assessment and resolving" approach and it is aimed to be applied through the following 3 stages:

Stage1. Measuring the current practice of AM implementation at GAEB

- Identification of AM components/ activities.
- Development of a questionnaire for the purpose of personal interviews with senior managers of the GAEB to identify the current practice of AM implementation.
- Assessment of current AM practice at GAEB.

Stage2. Conducting a gap analysis between the current practices and the desired ones.

- Assessment of the Current AM practice against AM best practice criteria and elements.
- Analyzing the gap between current AM practices and desired ones.
- Identification of areas for improvement.

Stage3. Developing a SAMF to be implemented at GAEB.

- Development of a comprehensive SAMF to improve the current practice.
- Setting and explaining the framework implementation steps and assessment technique in details.

V. QUESTIONNAIRE DESIGN AND FINDINGS

In order to explore the current practice of AM implementation at GAEB, a questionnaire has been developed as the basis for data collection. It was applied through personal interviews with top and middle level managers to maximize quality and credibility of the questionnaires' results. The questionnaire is divided into the following parts: 1) Career information of the respondent, 2) Concepts, knowledge and implementation of AM, 3) Elements of the applied strategic planning, 4) Asset assessment , maintenance practices and information system, 5) Areas for improvement and Implementation barriers . For the second and third parts all the questions are closed and some questions have choices for answers with a three point increasing scale with 1 indicating the lowest level and 3 indicating the highest one. In the fourth and fifth parts some questions are open to explore the current practice and the respondents `opinion about what really needs improvement.

Questionnaire findings are represented in Table II and showing the following:

1. Concepts, Knowledge and Implementation of AM

Questioning the meaning of AM and SAM as they understood at GAEB, the answers are being limited to "life cycle" and "Efficient use of resources" consequently. Responses show that the main current goal of managing organization assets is "Cost efficiency", but in general the goals are not clear enough. The responses also revealed the following: there is no a comprehensive framework for AM but just some functions of AM are applied, GAEB has an asset register for each asset that includes some aspects such that: age, location, capacity, and maintenance records but it is not updated in a regular basis, Assessment of assets` conditions is only done when problem occurs and there is no regular tracking for all costs spent on assets. The findings show limited knowledge and partial implementation of AM.

2. Elements of Strategic Planning

Questions in this part aimed at investigating to what extent strategic concept is realized and strategic planning is practiced in GAEB. Responses revealed a good understanding of what sustainability mean as it should include human, financial, social, and environmental aspects. Responses show that GAEB realizes the need for SAMF that includes people, process and technology. The main findings regarding the current implementation of strategic planning elements are: lack of top management and governmental support, AM team is not identified, no separate AM department but practicing some functions of AM, no training related to AM is provided, no regular tracking of legislative developments. Responses also revealed that the AM plan is not comprehensive and it should include: improvement, financial, risk, operation and maintenance plans and the current plan is not understood by all stakeholders as it should be. Responses assure that GAEB has some sort of maintenance plan but don't have a risk plan. Questioning whether they have performance measures to address levels and standards of service and how regular they assess the ability of the assets to meet the demand for services, revealed that the assessment doesn't include every element and not in a regular basis.

3. Asset Assessment , Maintenance and Information System

Answers of the questions in this part revealed that the assessment includes different areas as: technical, financial, environmental, social, and extent of non compliance and they have a maintenance plan. However , responses show that updating of AM information and records is done only when the asset is maintained, and they monitor asset performance system only when change occurs which reflect the absence of both asset register updating process and monitoring plan. On the other hand they do little preventive maintenance. They have their special IT system to manage asset information, they do follow up for AM decisions through reports and regular meetings and the annual maintenance budget is decided by the top management and based on scheduled plan.

4. Areas for Improvement and Implementation Barriers

A direct question of what really needs improvement, received answers that emphasize on the following aspects: organizational approach, culture, tools & techniques, and knowledge. Another question is asked to know what the obstacles facing the correct and full implementation of AM and the answers showed that there are three major barriers: lack of data, lack of financial resources and lack of technical aspects.

To cover the topic of the fourth part, respondents were asked to give their opinion of what is needed for GAEB to develop SAMF, the following have been stated:

- Independence of organizational decision making to enable top management of efficient and effective planning and implementation ,
- Providing AM training programs,
- Increase cooperation with other governmental organizations,

- Increase utilization of resources.

VI. GAP ANALYSIS

The goal of gap analysis is to determine how well/far an organization is performing against best practices and identify gaps where practices can be improved, and accordingly improving the AM plans. Based on the questionnaire findings, a comprehensive SAM gap analysis process has been conducted. The gap analysis process has been carried out generally in accordance with the International Infrastructure Management Manual [2], as it is the most widely known guideline in the field of AM. The research is following the outline of the Manual scoring system represented in Table I. The results of current practice as corresponding to AM categories and its components have been displayed in Table II. Results then presented in the form of gap analysis assessment chart in Fig. 1 which illustrates the current AM practice in relation to the scoring system levels. Recording and plotting the current practice of AM categories shows that 13 out of 19 subcategories have assessment scores below 25. As a first stage for improving GAEB, a target improvement by 50% sounds reasonable considering the current level of knowledge, available resources and budget planning timeframe. Therefore the gap analysis has been conducted targeting the *Systematic Approach* level and aiming to achieve a score between 51 and 70, which represents 50% improvement in GAEB practices.

TABLE I
SCORING SYSTEM

SCORE	SYSTEM
Unaware: Score 0 - 10	A rating that shows that the organization and its staff are not aware of a particular process or a process element
Aware: Score 11 - 30	A rating that shows that the organization and its staff have a reasonable awareness of the process, but do not practice (apply) it widely.
Application: Score 31 - 50	A rating that shows that awareness of the process exists and is being applied in some cases
Systematic Approach: Score 51 - 70	A rating that shows that the organizations awareness of the process is very high and it is being applied consistently in almost all the cases.
Competence: Score 71 - 85	A rating that shows that the organization is well aware of the process, applies it systematically throughout the organization (high compliance) and its process is matured to an extent that it can be classified as one of the best processes (when benchmarked against other similar organizations).
Excellence: Score 86 - 100	A rating that shows that the process is applied systematically within the organization and the process that is followed can be rated as the best in the industry

VII. DISCUSSION

The gap analysis shown in Fig. 1 illustrates the levels of current and targeted AM practices for each management category and component. From a SAM perspective, gap analysis chart in Fig. 1 illustrates that the GAEB practices of asset knowledge, systems, processes, Information and strategies are generally reaching the level of "Awareness" and /or "Application". The aim is to advance application of AM to reach "Systematic Approach" level as a first stage in the improvement process. In order to identify the relative AM

improvement priorities, a weighting score ranges between 1 and 5 has been applied to the gap between current and target practice scores.

The weighting represents the importance placed upon the respective component; with 5 indicates the most important and 1 indicates the least. The weight for each component has been

determined by reviewing the literature and observing the repetitiveness (importance) of the elements in different frameworks. The weighted gap score is calculated as follows:

Weighted gap score = (target score – current score) * weight. The resultant weighted gap scores provide a useful mechanism for identification of AM improvement priorities.

TABLE II
CURRENT AM STRATEGY AND PRACTICES

Item	Sub Item	Current Practice
Data and Information systems	<ul style="list-style-type: none"> - Data collection - Condition assessment - Concepts - Asset register - Plans and records - Maintenance/financial systems - Special information systems - Systems integration 	<ul style="list-style-type: none"> - Limited knowledge of what AM and SAM mean - Limited condition assessment and performance data. - Have asset register that include age, location, capacity and maintenance records - Records are not updated in a regular basis but when maintained only. - Have own IT program for asset information management
Strategic Asset Planning	<ul style="list-style-type: none"> - Level of service - Risk management - Lifecycle planning - Financial planning 	<ul style="list-style-type: none"> - Recognizing the need for SAMF that should include people, process and technology but Don't have a comprehensive one - Understand what sustainability means. - Recognizing that AM plan should provide: Improvement, Financial, Risk and O&M plan - Have maintenance plan - Don't have a risk plan - Limited assessment to the ability of the asset to meet the demand for services - No regular tracking of cost of each asset. - Convinced that to implement AM plan, asset life cycle activities should be recognized according to previously prepared plans but their AM plan is not comprehensive - Although they convinced that technical, financial and environmental aspects of maintenance & operation have a strategic impact on the performance of asset, they just focus on technical aspects of maintenance. - Convinced that developing a SAMF, needs: independence of organizational decision making, AM training, more cooperation with other organizations, and utilization of resources.
Processes and practices	<ul style="list-style-type: none"> - Operations/maintenance strategy - Condition monitoring - Assessment 	<ul style="list-style-type: none"> - Assess the condition of the assets when Problem occurs only. - Have limited performance measures that address level of service - Basic assessment of different performance areas as Technical, Financial, Environmental, Social, and Extent of non compliance. - Assess the technical aspect by performing regular tests. - Do limited preventive maintenance - The annual maintenance budget is based on Scheduled plan.
People and organization	<ul style="list-style-type: none"> - Organizational strategy, policy, plans, objectives. - Roles and responsibilities - Training - Improvement 	<ul style="list-style-type: none"> - Goals of managing assets are not clear enough. - Don't have asset mgmt department but they do some functions of AM - The current plan is not understood by all stakeholders - Asset mgmt team is not identified - No training related to AM is provided - Annual maintenance budget is decided by top management only - Lack of top management and governmental support - Do follow up for AM decisions through reports and regular meetings - Realize the need for improvement in Organizational approach, Culture, Tools& techniques, Knowledge. - Have some major barriers for AM implementation as lack of: data, technical and financial aspects.

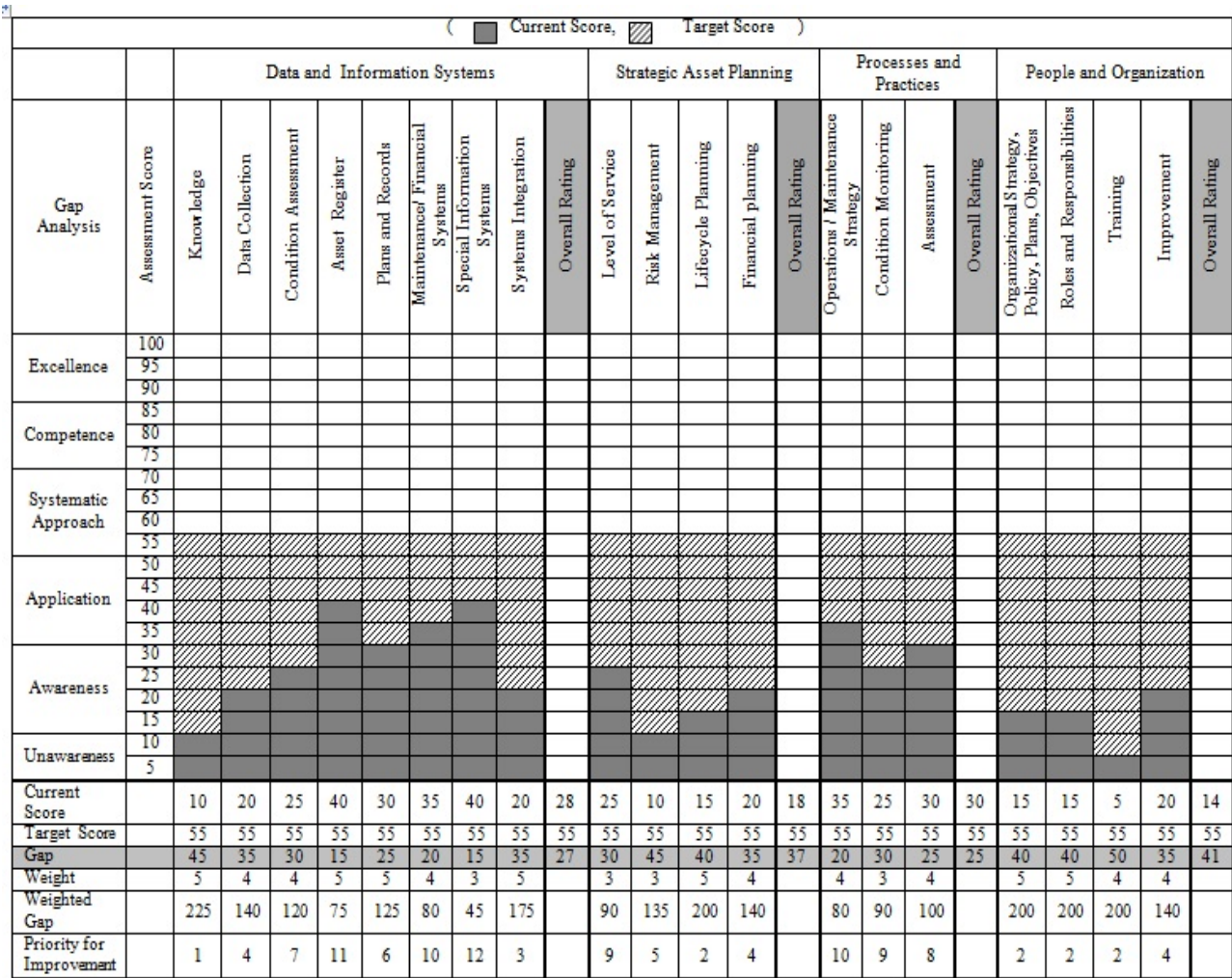


Fig. 1 Asset Management Gap Analysis Chart

A. Key Areas for Improvement

Table III shows the components of AM according to their priority for improvement as resulted from ranking the weighted gap scores in Fig. 1. The ranking in Table III indicates that: AM knowledge, training, organizational strategy, lifecycle planning and system integration represent the most needed areas for improvement. It worth noticing that the areas related to “people and organization” category which represent more than 20% of SAM elements are on the top of areas that need improvement.

TABLE III
THE NEED FOR IMPROVEMENT PRIORITY

Priority	Item
1	Knowledge
	Training
2	Organizational strategy, policy, plans, objectives
	Roles and responsibilities
3	Lifecycle planning
	Systems integration
	Financial planning
4	Improvement
	Data collection
5	Risk management
6	Plans and records
7	Condition Assessment
8	Assessment
9	Level of service
	Condition monitoring
10	Operations/maintenance strategy
	Maintenance/financial systems
11	Asset register
12	Spatial information systems

VIII. PROPOSED FRAMEWORK

The improvement action for the outlined components requires the integration of strategies, plans and practices in the different level of management through the asset life cycle, which urges the need for a comprehensive multi dimensional approach. Therefore the research aims at developing a SAMF to attain the following requirements:

- Assists managers to develop a formal corporate approach to identify their agency's AM requirements.
- Provides a systematic approach to existing management activities and practices through asset lifecycle.
- The establishment of clear linkages between the various AM functions.

By reviewing the literature and studying different models, strategies and frameworks, each of the three dimensions SAMFs introduced by South Australians Framework [24], and Queensland Government buildings guidelines, Australia [23], were found to be the most appropriate approach for achieving the previous requirements. Therefore a modified three dimensions SAMF has been developed to be implemented in GAEB.

A. Three Dimensions Framework

The developed Framework is illustrated in Fig. 2 and represents the following three dimensions:

1. Management Levels

There are three main levels of AM. Each level has its own management responsibilities and activities. Information flow system should be developed to ensure that all processes are clear to all levels.

- Government strategies, which set whole-of-government policies establish priorities and monitor outcomes.
- Agency (GAEB) strategies, which meet the service delivery responsibilities by ensuring the effectiveness of the investment, management processes and control over strategic functions.
- Facilities management, which is the practical day to day management of the asset(s) to minimize whole of life costs and physically manage the asset.

2. Life-Cycle Functions

Different tasks to be performed at different stages of the asset's life, so the life cycle of assets should include these functions:

- Planning: examine all options to achieve service delivery objectives and develop management strategies to provide the best utilization of assets in line with strategic plans, operational plans and service delivery strategies.
- Acquisition/Procurement: evaluate decisions at the earliest stages of a proposal, define capital investment projects, prepare budget documentation and formulate acquisition plans.
- Operation and Maintenance: minimize the cost and risk with effective maintenance strategies and procedures, and operational costs;

- Disposal: regularly evaluate the agency's investment in assets to identify functional or physical obsolescence, financial viability and unacceptable risk.

3. SAM Requirements

Are the Management's needs that ensure all organizational requirements that consider the structures, staff, resources and information will best support the AM process. It includes:

- People and Organization: Consider the extent to which the asset management responsibilities and functions nominated within the framework should be centralized or devolved. Policies, guidelines and procedures related are also considered. Consider the needed AM skills and knowledge
- Strategic Planning: Allocate the necessary finance, people and systems for AM and the delivery of asset services. When establishing roles and responsibilities in a SAM context, departments need to address relevant requirements at the strategic and operational level.
- Data and information systems: Ensure the availability and quality of information which supports decisions and assessment of outcomes. GAEB needs to establish effective processes to manage asset information over the entire life-cycle of the building.
- Processes and Practices: Performance practices should provide assurance that a department has established processes to determine if its delivery of services is efficient and effective.

The developed SAMF provides departments in GAEB with a systematic and consistent approach to manage their buildings to meet service delivery requirements. It guides decision-making processes over the life cycle of an asset to enhance the management capability of departments for the building assets under their control.

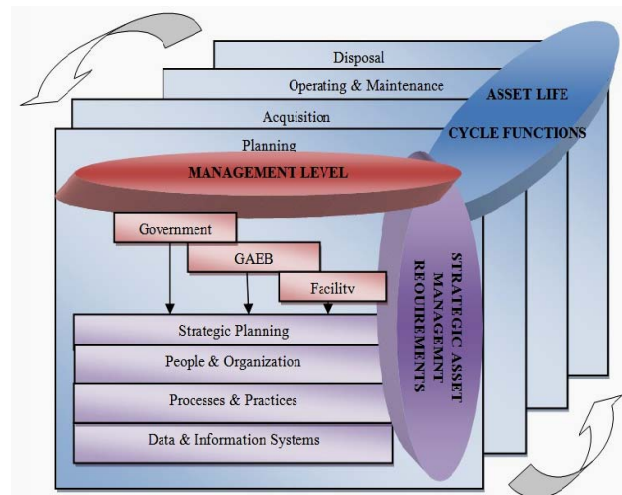


Fig. 2 Three Dimensions SAMF

IX. FRAMEWORK IMPLEMENTATION AND ASSESSMENT

The framework implementation process emphasizes on the dimension of SAM requirements where the requirements

comprise plans and processes that should be in place in order to apply the SAMF effectively and enhance the areas that need improvement. The study developed a checklist to be applied as a multifunctional tool for framework implementation and self assessment of AM maturity in GAEB. Checklist in Table IV contains the framework requirements, their main steps and detailed tasks required to identify, plan and implement the SAMF. Implementing the framework is aimed at raising the level of AM practice to reach at least the “*Systematic Approach*” level. The developed checklist can also be used as an assessment tool where the corresponding strategic outcomes for each requirement are displayed in the checklist to measure the level of AM maturity against it and a scaled score ranges from 1 to 5 is applied for each task. The scale represents the level of AM maturity as follows: 1 for aware (< 30%), 2 for Application (31–50), 3 for Systematic Approach (51–70), 4 for Competence (71–85) and 5 for Excellence (86–100). Fig. 3 illustrates the mechanism of the assessment process; it is as simple as the following steps:

- For each task, choose the measuring score that most closely describes GAEB practice.
- For each step (S), get the average score from the corresponding tasks.
- For each requirement (R), get the average score from the corresponding steps.
- The gained average score for each requirement reflects the amount of the achieved strategic outcome (O).
- Assign the gained score against the different levels of maturity in the overall maturity matrix to indicate the level of SAM practice in GAEB.

The developed checklist tool and its mechanism do not only assess the overall AM maturity but also allows assessing the detailed step by step level of implementation of the framework. Therefore, the developed framework, its implementation and assessment procedure introduce a simple mechanism to be adopted and applied by the different level of management; facility, organization and government and through the asset life cycle.

TABLE IV
SAMF IMPLEMENTATION AND ASSESSMENT CHECKLIST

Framework Requirements	Steps	Tasks	Strategic Outcome	Measuring score				
				1	2	3	4	5
People & Organization (R1)	Develop AM Policy (S1)	- Establish key objectives of General Authority for Educational Buildings in accordance with the government objectives. - Establish plans for monitoring and improvement of AM outcomes.	(O1) - Asset management accountabilities are defined, understood and accepted - clear direction for asset management improvement is identified					
	(S1) Score							
	Develop AM Strategy (S2)	- Develop AM plans.						
		- Define level of service.						
		- Identify data and system requirements.						
		- Link to the Long Term Financial Plan						
		- Define need for improvements of skills & process						
		- Identify management arrangements						
	(S2) Score							
	Develop Management Arrangement (S3)	- Identify key positions to participate in sustainable AM (representatives of top management, service managers, service providers, IT, finance, risk management).						
		- Identify Resources, roles and responsibilities for development and delivery of AM plans allocated.						
		- Identify staff resources, funding and training needs for AM plans.						
		- Identify audit plan for AM improvement.						
		- Identify mechanisms for reporting AM plan progress against elements of the plan for future.						
	(S3) Score							
	Improvement Plan (Develop Skills and Processes) (S4)	- Identify areas for improvement and training needs						
		- Provide all relevant information						
		- Evaluate improvement in AM performance						
		- Evaluate AM practices and report to government.						
		- Revise the continuous improvement plan and that the determined ongoing and future requirement, financial impacts, tasks and responsibilities, resources required and timeline are documented in the AM plan.						
	(S4) Score							
			(O1) Score					
Strategic Planning (R2)	Develop AM Plan (S1)	- Confirm the strategic objectives established in AM policy and strategy	(O2) - Assets are managed from a 'whole of asset life' perspective.					
		- Reference documentation, asset summary, stakeholders & their role in service delivery						
		- Document Vision, mission, goals & objectives, how goals are met						

Framework k Requirem ents	Steps	Tasks	Strategic Outcome	Measuring score				
				1	2	3	4	5
		- Inform Plan with relevant information from: community engagement activities, legislation, changes in technology, service deficiencies, other governmental policies or strategies.						
		- Link to asset register						
		- Define level of service						
		- Establish renewal standards and priorities						
		- Establish communication process and Information flow processes						
		- Develop risk management plan						
		- Predict future demand						
		- Develop plan for renewal						
		- Develop maintenance plan						
		- Develop Life cycle cost management and financial forecast						
		- Develop Improvement plan						
		- Link to long term financial plan						
		- Identify Standards & guidelines						
		- Establish clear links to other strategic documents						
	(S1) Score							
	Define Level of service (S2)	- Establish and document levels of service for each asset						
		- Identify asset-related needs						
		- Communicate with government on: organizational issues impacting on service delivery; service delivery requirements						
		- Incorporate relevant information from relevant legislation; local area/place plans, planning schemes/strategies, changes in technology; known service deficiencies.						
		- Ensure service delivery levels are within asset capacity.						
		- Determine quality and cost standards for service delivery.						
	(S2) Score							
Strategic Planning	Predict Future Demand and Renewal Plans (S3)	- Identify long term population growth, distribution, density and demographic projections.						
		- Determine future requirements associated with corporate plans or operational plans						
		- Determine areas for expansion (Potential acquisition dates, Cost estimates, Impact on service levels, asset lifecycle and financial considerations)						
	(S3) Score							
	Develop Long Term Financial Plan (S4)	- Incorporate financial information such as depreciation, expenditure projections, operation, maintenance, and upgrade and planned disposals.						
		- Explore Revenue						
		- Develop a Funding Plan						
	(S4) Score							
	Develop Funding Plan (S5)	- Identify any shortfall in capital renewal funding						
		- Review renewal program and useful lives						
		- Document changes to useful lives						
		- Identify surplus or low use assets for disposal						
		- Review capital program to increase renewal funding and revise expenditure projections						
	(S5) Score							
	Manage Life Cycle Cost and Financial Considerations (S6)	- Estimate useful / remaining useful life for each asset and annual depreciation expense per asset.						
		- Determine valuation of each asset (Date of valuation and valuation methodology employed)						
		- Identify maintenance activities (Description and timing of program, maintenance expense per asset)						
		- Develop Renewal/ Replacement Plan (Renewals capital expenditure)						
		- Acquisition (Upgrade capital expenditure)						
		- Disposal (Proposed timing of asset retirement or disposal, Estimated residual values at disposal)						
	(S6) Score							
	Develop Risk	- Risk Management (Identification of risks and risk mitigation strategies)						

Framework Requirements	Steps	Tasks	Strategic Outcome	Measuring score				
				1	2	3	4	5
	Management Plan (S7)	- Establish risk management team						
		- Identify Organizational risk context						
		- Determine risk evaluation criteria						
		- Identify, analyze, and evaluate risks						
		- Develop risk treatment action plans						
	(S7) Score							
				(O2) Score				
Processes & Practices (R3)	Develop Performance Management Plan (S1)	- Define key performance indicators	(O3) - A service level approach is taken to ensure long term structure and financial sustainability					
		- Define standards, tools and indicators for monitoring and assessment.						
		- Develop a schedule for asset assessment						
	(S1) Score							
	Develop Maintenance Plan (S2)	- Define the maintenance requirements						
		- Correlate and quantify the maintenance requirements with service strategy, asset performance standards and risk management.						
		- Develop a schedule for maintenance according to priorities and document timing for each maintenance						
- Define Maintenance expense per asset								
Score (S2)								
			(O3) Score					
Data & Information Systems (R4)	Establish Data and Information Systems	- Establish Asset Register	(O4) -Quality asset information informs asset management decision making and supports improved asset management.					
		- Identify the data required to implement and improve AM processes for each asset						
		- Establish an implementation plan for data collection						
		- Identify an AM Information System						
		- Ensure integration between different framework requirements						
			(O4) Score					

AM Requirements		R1	R2	R3	R4
Rating level	Strategic Outcomes	O1	O2	O3	O4
Aware :					
Application:					
Systematic Approach :				42	
Competence:					
Excellence:					

R1	
S1	53
S2	31
O3	$(53+31)/2 = 42$

Develop Performance Management Plan (S1)					1	2	3	4	5
- Define key performance indicators								65	
- Define standards, tools and indicators for monitoring and assessment.							40		
- Develop a schedule for asset assessment							45		
(S1) score					$(65+40+45)/3 = 53$				

Fig. 3 SAM Maturity Assessment Matrix

X. CONCLUSIONS AND RECOMMENDATIONS

- From a SAM perspective, gap analysis shows that the GAEB practices of asset knowledge, systems, processes, Information and strategies are generally reaching the level of "Awareness" and/or "Application"
- Advancing the application of AM to reach "Systematic Approach" level as a first stage in the improvement

process urged the focus on areas for improvement especially "people and organization"

- The developed framework and assessment tool are intended to be used by any management level, of any size, and at any stage of implementing an asset management program.
- The developed simple and easy to apply checklist facilitates the implementation of the model.

5. It helps frame the discussion on prioritizing gaps and developing implementation plans, however it does not provide prepackaged solutions where every local government identifies its needs and the corresponding potentials and available resources.
6. An extended implementation of the framework is required to identify the possible barriers of the implementation and/or assessment process.

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