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Critical Success Factors for Successful Energy Management Implementation towards Sustainability in Malaysian Universities

A. Abdullah Saleh, A. H. Mohammed, M. N. Abdullah

***Abstract*—**Recently, universities are increasingly consuming energy to support various activities. A large population of staff and students in Malaysian universities has led to excessive energy consumption which directly gives an impact to the environment. The key question then ascended "How well is an energy management (EM) been practiced in universities without taking the Critical Success Factors (CSFs) into consideration to ensure the management of university achieves the goals in reducing energy consumption. Review on past literature is carried out to establish CSFs for EM best practices. Thus, this paper highlighted the CSFs which have to be focused on by management of university to successfully measure the EM implementation and its performance. At the end of this paper, a theoretical framework is developed for EM success factors towards sustainable university.

***Keywords*—**Critical success factors, energy management, sustainability, Malaysian universities.

I. Introduction

UNIVERSITY buildings are high consumers of energy in the category of commercial buildings [1]. According to [2], almost no country in the world can hope to achieve carbon dioxide reduction targets without including building sector. The building industry is one of the big resource users of energy consumption [3]. As shown in Fig. 1, industry sector was the highest user of electricity with its share of 43.6% of the total consumption and followed by commercial sector with its share 34.1% in 2012.

In Malaysia, the Ministry of Higher Education (MOHE) spends more than ten million ringgit annually on the expensive electricity bills [4]. As supported in Table I, it shows a new tariff rate effective from January 1, 2014 comparing to previous tariff rate in 2011. Indeed, the increases of electricity tariff in peninsular of Malaysia effect on operational costs for university to support all the activities as it has a large areas and communities.

MOHE has urged all education centers to save energy for expensive monthly electricity bill which had become the concerns for many parties [5]. A survey done has shown the energy consumption in Universiti Teknologi Malaysia and International Islamic University Malaysia has led to more than ten million ringgit annually due to increment of students' population almost every year [5].

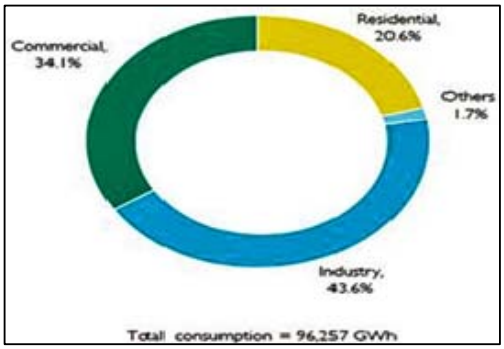

Fig. 1 Sectoral percentage contribution of energy usage for year 2012

TABLE I
Medium Voltage Peak/Off-Peak Commercial Tariff

Medium Voltage Peak/Off-Peak Commercial Tariff	Previous Rates (1 June 2011)	New Rates (1 January 2014)
For each kilowatt of maximum demand per month during the peak period	38.6 RM/kw	45.1 RM/kW
For all kWh during the peak period	31.2 sen/kWh	36.5 sen/kWh
For all kWh during the off-peak period	19.2 sen/kWh	22.4 sen/kWh

TABLE II
Number of Students and Academic Staff in Higher Education Institute for 2010

Energy users in higher education institute for year 2010	IPTA	IPTS	Polytechnics	Community Colleges
Student	437,420	509,556	86,471	17,279
Academic Staff	28,571	33,613	6,741	2,259
Total	465,991	517,369	93,212	19,538
Grand Total of student and academic staff	1,096,110			

Note: IPTA - Institut Pengajian Tinggi Awam; IPTS - Institut Pengajian Tinggi Swasta

The statistic of MOHE shows the total people are more than one million people at any given time in higher education institutes, which include the public and private universities, colleges and polytechnics in Malaysia. Table II shows a total of students and academic staff in Higher Education Institute for year 2010 [6]. If non-academic staffs and others are included, the consumption on energy may assumed almost comparable to small commercial cities due to their size, population, and the various activities taking place in

A. Abdullah Saleh is a PhD candidate sponsored by Ministry of Higher Education and Universiti Teknologi Mara (+6012-398 6857; e-mail: alia796absaleh@gmail.com).

A.H Mohammed, Professor, and M.N. Abdullah , senior lecturer, are with the Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, Johor Malaysia (e-mail: abdhakim@utm.my, matnaim@utm.my).

campuses, which have impacts on the environment either directly or indirectly [7]. Thus, in order to reduce the consumption of energy, effective EM shall be practiced. In fact, an energy cost savings of 5-15 percent is usually obtained [8].

Fig. 2 Integration of environmental, social and economic

EM is the best approach to a solution to provide a roadmap to achieve energy policies and objectives during financially challenging times [5]. 20 percent of the energy bill can be saved with simple improvements [9]. The study of EM becomes crucial in developing countries. It can be proven by many studies have been done previously. For example of the previous studies relate to EM are energy conservation program in government building [10], study on the current status of energy consumption and various energy conservation in Malaysian environment [11], energy efficient design of office buildings in Malaysia [12], conceptual framework of energy awareness development process [13], energy efficiency award system in Malaysia for sustainable energy [14], implementation of EM key practices for Malaysia universities [5], sustainable EM and its effect on energy efficiency index in university buildings [1]. Therefore, to be a university that is sustainable in terms of energy, it is important to implement EM based on the concept of sustainability which integrates environmental, economic and social that will be the catalyst to the success of the university's mission in particular and the country in general.

The concept of sustainability has been widely recognized, promoted, integrated and considered in many sectors, including education sector [15]-[17]. Building does not have to be new to be efficient where it can be applied by converting existing buildings into models of sustainability [18]. The University Leaders for a Sustainable Future (ULSF) describes sustainability by stating: *"Sustainability implies that the critical activities of a higher education institution are (at a minimum) ecologically sound, socially just and economically viable, and that they will continue to be so for future generation. A truly sustainable college or university would emphasize these concepts in its curriculum and research, preparing students to contribute as working citizens to an environmentally sound and socially just society. The institution would function as a sustainable community, embodying responsible consumption of energy, treating its diverse members with respect, and supporting these values in the surrounding community"*. From this perspective, the main challenge towards sustainable university is through simultaneous environmental, social, and economic improvement. It is also known as "Triple Bottom Line" (TBL) which is often used in any organizations to achieve sustainability [19].

In supporting sustainable development in response to Chapter 36 of Agenda 21, the four international organizations with a strong commitment have formed a "Global Higher Education for Sustainability Partnership" (GHESP). In order to organize universities towards sustainability, there are four founding partners of the initiative which are the International Association of Universities (IAU), the Association of University Leaders for a Sustainable Future (ULSF), the COPERNICUS Program of the Association of European Universities (CRE) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) [20].

Taking notes on the importance of EM towards sustainability, however its implementation is very slow due to barriers facing by many organizations [21]. Most current patterns of energy use are unsustainable [22]. The progress toward sustainability in universities is not only unsatisfactory, but it is also frustrating [23]-[28]. Yet, there are still many of university leaders and academicians are unaware of sustainability principles and resulted to unsustainable university [29]-[30]. The movement towards campus sustainability has not been outlined properly, where most efforts are lack of strategy, and when strategy is present, it follows more from barriers than from a long-term goal [31]. Current efforts mostly focus on environmental sustainability only [32]. It is also supported by [33] where the efforts by the Malaysian Government have produced a limited success to improve EM.

Therefore the idea of CSFs for EM towards sustainable university is vital to improve the management of energy in university in the sense that it will indicate the progress in particular areas [34]. More research is needed to sort out the success of implementing the sustainable building and identify how its performance could be improved especially in existing buildings [35]. The key question asked is "How well is an EM been practiced in universities by taking the CSFs into consideration and how their relationships with identified KPIs to ensure the university achieve the sustainability". Therefore, what is really crucial is that the existing attitude of universities and their attention to sustainability principles should be reinforced with support from all the organizational members. In other words, the sustainability practices need to be understood and practiced by all members of the organization at various levels to ensure the mission can be mobilized successfully. This can be done by identifying CSFs which can be a reference to assist people involved to know exactly what factors are most important towards the success of EM and these CSFs can be measured through a reliable Key Performance Indicators (KPIs) as a direction to the university to practice EM strategically at once to achieve the goals of practicing EM towards sustainability.

II. CSFS TO IMPLEMENT EM TOWARDS SUSTAINABILITY

CSFs have been used significantly to present or identify a few key factors that universities should focus on to be successful. As a definition, CSFs refer to *"the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department, organization"* [36]. With the example of research exists on the CSFs, it is clear that CSFs are important and adopted by many areas. For instance, the understandings of CSFs in project management within an organizational context have been presented [37]-[40]. In addition, there are also researches conducted within the context quality management system [41]-[43], stakeholder management [44], building maintenance projects [45]-[47], knowledge management [48], [49], environmental management system [50]-[52], enterprise resource planning system [53], waste management [54], supply chain management [55] and sustainability [56], [57]. To date, CSFs for implementing EM towards sustainable university in Malaysia context has not been explored. Although context-driven research may differ on the nature of focus, there are some common factors can be used for EM.

However, the literature is still dominated by "laundry list" of CSFs rather than systematic and comprehensive by grouping the CSFs into cluster. For this research, the CSFs are the few key areas or activities that 'must go right' for EM to flourish and successful [58]. The three pillars which are "The Path", "The Members" and "The Process" are the foundation to the success of EM implementation [59]. The paths to be pursued in a logical manner, the members are to practice and support the EM, and the process to be followed to achieve the target. Previous studies have shown that CSFs variables are overlapped and some of the variables carry the same meaning [58]. Therefore, in this research, all variables of the CSFs are categorized according to cluster. Amongst the CSFs to implement EM towards sustainability are:-

A. Top Management Support

1. Develop Energy Policy and Guidelines

Energy management is first and foremost a management and organizational effort. Without proper attention, the program will have only marginal success or fail altogether. Developing a clear and achievable energy policy and guidelines is important [5], [29], [57], [59]-[63] to ensure the success of EM implementation. It integrates SMART concept which are Specific, Measurable, Attainable, Realistic and Timely. The energy policy and guidelines should be periodically updated and performance against the established policy and guidelines should be assessed on an ongoing basis.

2. Leadership to Implement and Manage Committee of EM

References [5], [57], [60], [61], [64] identified leadership and management as success factors on projects though this competence is seldom identified as CSFs. According to Chancellor of Birgeneau in Campus Sustainability Report, a comprehensive approach can help to create a culture of sustainability on campus, which can be as important as the reductions in environmental impacts. Leadership and champions are required at all levels of the University, since a large number of tools are needed to achieve these goals.

3. Create Incentives by Establishing an Award for Positive Contribution

A way to improve EM is by developing incentives that will reward and motivate the university energy teams as well as the faculty, staff and students that contribute significantly to meeting the goals and objectives of the university. Tangible incentives, motivation and recognition are need from top management committee or from government agencies to reward achievement for example through awards, certificates, financial or other means [63], [65]. UTM will be the first Malaysian university to participate in ASEAN Energy Award, where not even one university in Asean has taken up the challenge [66].

4. Allocation of Sufficient Resources

The availability of adequate resources has been identified in the literature as an important factor in achieving successful [5], [57], [63], [64]. Resources are important to survive and function in a long time, and the results of the robustness of process in strategic facilities management. Referring to the Malaysia National Higher Education Strategic Plan (MNHESP) in 2007, resources are one of the CSFs to be given a special attention to ensure smooth operations and activities of the organization. Therefore, resources must include people, technology beside money and sufficient time.

5. Training Provisions

The literature review indicates that training is a key factor during implementation of EM, and that training may change attitude and behaviour among managers and employees [5], [63], [66], [67]. It is also to ensure the employees involve understand the process of EM.

B. Comprehensive Facility or Energy Management Team

1. Conduct Energy Audit

Energy audit is needed to reduce energy costs is a crucial business practice for successful organizations [5], [29], [59], [61]-[64], [66]. Energy audits play a more significant role in managing energy expenses. Energy audits can encompass a variety of surveying techniques but most commonly consist of an analysis of energy usage within a building or facility and its contained equipment. Measuring the progress towards campus sustainability can improve environmental performance [68], [69]. By establishing energy audit, it also can provide relevant information to energy manager or energy coordinator on energy use and energy performance of buildings and processes. EM will always be continuously improved and evaluated by regular audits through adequate documentation and benchmarking.

2. Operation and Maintenance (O&M)

Many studies have shown that gains in energy efficiency and cost savings are easily lost when an organization does not support the continued O&M of improvement. It shows significantly to perform O&M as mentioned by [8]. According

to [62], the impact of poor O&M will affect the organization in terms of business continuity and give impact on organizational performance. It is also supported by [5], [61], [63]-[65] where good maintenance program could provide effective energy saving with NO or minimum cost.

3. Management Review & Verification

After the program is completed, then, reporting of progress and meeting policy objectives to top management team is needed. The progress also must be reported to a number of internal and external stakeholders. All staff should be informed about the organisation's progress and performance. These reports will largely be produced by the Energy Management Team. Understanding energy performance and its effective reporting relies on the availability of good data and sound analysis. This requires reliable information that enables production of suitable reports. It should be developed to meet the university's strategic requirements and, in turn, the information it provides will support the delivery of that strategy. The results shall be assessed and analyzed for any good and bad points [5], [29], [57], [62], [63], [65]. The lesson shall be utilized as a feedback in the subsequent plan or program. Thus the activities are repeated to form a cyclic movement.

4. Continuous Improvement

The Plan-Do-Check,-Act (P-D-C-A) cycle is a useful tool to coordinate continuous improvement efforts. This is a management philosophy that seeks improvements as a never ending process of achieving improvements [70]. Under the continuous improvement philosophy, progress is most often incremental, thus delivering improvements over prolonged periods is vital [5], [62], [64], [66], [67]. However, the cycle is not stopped at this step. It is always necessary to go through the cycle again for solving new challenges and problems. The implementation of the model must not be a static process for generating a particular initiative.

C. Stakeholders Involvement

1. Understanding of Project Vision and Goal

A shared vision is an important element towards a success of any projects [29], [61]-[65]. The vision has implications for how universities are organized and the roles that are assumed by administrators, lecturers, parents and students. Once developed, a vision is not static but is part of a regular cycle of reflection, planning and evaluation. The vision informs and is informed by the goals and objectives that follow.

2. Good Communication among the Stakeholders

Good communication throughout the stakeholders is essential for ensuring that they work together to implement any project [5], [29], [61], [63], [64], [66] and specifically to EM. It is vital to communicate the energy management plan to the stakeholders at every stage, as effective energy management relies on everyone being involved and playing their part. Communication within an organization can help to reduce much inefficiency. There is often a wealth of information within an organization which can be used to reduce energy consumption. These include operating instructions and recommendations for machinery, the flexibility of an organization to change certain practices and behaviours in order to become more energy efficient among others. The stakeholders need to be informed of the benefits of saving energy in the university building. Effective communication to provide information by communicating either by "personal touch" (i.e. small face to face meetings, dedicated presentations, internal training, informal gathering, door-to-door canvassing, competitions, suggestion box, videos, web casts, and DVDs or by "print material" (i.e. direct letters, newsletters, pamphlets and brochures, books, external publicity, posters, sticker and websites) to avoid inadequate communication.

3. Knowledge & Skill

The social aspects can play a vital role in the successful implementation of EM which aimed at removing barriers to energy efficiency. Therefore, the stakeholders should not only comply with high requirements on the specialist knowledge but should also have social skills. Knowledge has been recognized as a core strategic asset in increasingly dynamic business environments and communities, depends on a more systematic and effective capture, dissemination, transfer and application of knowledge [57], [61], [63]-[65]. By having knowledge, stakeholders are able to implement EM effectively and efficiently. From the skills that the stakeholders have, knowledge sharing through computer-based information systems provides a robust means for best practices, technologies, and operational guidance.

4. Trust among Stakeholders

Trust among all stakeholders is concerned in the project [29], [57], [59], [61], [63], [64]. The trustworthiness of is equally important to determine the success of EM. Trust among stakeholders can enrich the way of any organization project towards success. Moreover, it is not easy to success in implementing any activity without trust relation in an organization, no matter how the activity is well planned [48].

D. Raising Awareness

1. Understanding the Issues

Before trying to make out any future programs or action plans, it is essential for the university management to understand the current situation in a proper and accurate manner [5], [29], [61], [63], [64]. The current data of energy consumption shall be obtained by measurement, calculation or estimation. The data shall be gathered regularly and arranged/summarized daily, weekly, monthly, by seasons or annually. Then the data shall be checked for the past historical trend and interpreted with relation to operational modes and production scales. That shall also be utilized for the forecast of future trends.

2. Increase General Energy Awareness

Most people are unaware of how their everyday actions and activities in university influence the excessive usage of energy. Increasing overall awareness can be an effective way

to gain greater support for energy initiatives [5], [29], [61], [63], [64].

3. Improve Facility Energy Awareness

Individuals working in or even managing a facility may have little understanding of the energy performance of the facility or its impact on the organization and environment. Targeted efforts designed to increase awareness of facility's energy use can help build support for EM [5], [63]. Such awareness raising initiatives was installation of poster raising awareness in a central section of the building for all to see.

4. Education by Research & Development (R&D), Teaching and Learning

Energy education is another way to establish a proper energy education scheme in the field of energy conservation by means of introducing new courses for both conventional and renewable energy sources [5], [29], [59], [63]. Such education schemes may include energy basic principles, consumption loads and the relevant environmental effects. It may also include the development of new experiments for laboratories in universities and technical colleges. It is also important to pursue academic research work and postgraduate studies in conjunction with industry in order to solve problems related directly to energy conservation and management [71]. Reference [72] mentioned that education is essential because energy management is not a destination, but a process. Academic education cannot be completely separated from research since one complements teaching and research which serves the overall goal of professional education and guarantees a high proportion of prevailing and highly relevant topics in teaching and research.

5. Community Engagement and Partnerships

University has a longstanding commitment to community engagement and values partnership with its local communities, business, industry and government at regional, national and global level that can benefit to all [29], [59], [63]. Further, reporting campus greening efforts indicates an institution's commitment to sustainability and thus may stimulate related community partnerships [25], [73]. There are university programs that involve public participation and campus activities, such as visits to learn about the university, community care with resources from donations, giving everyone the opportunity for education and others.

6. Energy Information

An important and relatively neglected issue is the role of information and communications in sustainable development. Sustainable benefits of any development effort could be enhanced through investment in improved and more equitable information flows [74]. Information is a link between a system and its environment. Energy information may include the latest scientific technological progresses published in useful books, periodicals, reports and journals. Maintaining a specialized library and documentation could help to provide such requested information by individuals, organizations and institutions. Information packages on energy should be provided to decision makers, planners, research scholars and the public [29], [59], [63].

E. Risks Management

The university should employ a robust risk management system to address the external and internal factors that could be detrimental to the strategic plan and the transition towards excellence where the management able to eliminate or reduce the risks involves [57], [61], [62], [65]. By having a robust risk management system in place, it allows the flexibility and agility to deal effectively with both existing and emergent risks. Amongst the risks towards sustainability in university is human resource risk, sustainable funding risk, students' risk, regional nature of the university and, market share risk. The processes of risks management involve:-

1. Identify the Risk

This step is brainstorming where all the potential risks are identified. Risks are then categorized and prioritized by using an assessment instrument. The process of prioritization helps top management and the stakeholders to manage those risks that have both a high impact and high probability of occurrence.

2. Assess the Risk

Traditional problem solving often moves from problem identification to problem solution. However, before trying to determine how best to manage the risks, the root causes of the identified risks must be identified by the project team.

3. Develop Responses to the Risk

The process of assessing possible remedies to manage risk or possibly, prevent the risk from occurring is ready.

4. Develop a Contingency Plan or Preventive Measures for the Risk

At this stage, the project team will convert into tasks in order to reduce or eliminate risk likelihood. The tasks identified to manage risk are developed into short contingency plan that can be put aside. When the risk occurs, this plan can be quickly put into action to manage the risk by crisis.

III. KPIs towards Sustainable University

"To measure is to know. If you cannot measure it, you cannot improve it." [75] It is equally true to say that what is not measured is not managed. KPIs are tool used for measurement that reflect the performance of any organization in the context of achieving its wider goals and objectives [76]. KPIs assist in implementing strategies by linking various levels of an organisation where the Government all over the world expects to use KPIs to adequately capture the link between environmental, social and economic. This is because the impact of environmental matters on organization performance is increasing. Failure to plan for a future may risk the long-term value and future of any organization [77]. KPIs are useful for monitoring progress towards specific goals rather than focusing solely on the goal [78].

KPIs have to be critically considered on the context of

organizational performance measurement. The choice of the right KPIs will initiate a discovery of where and how the organization is moving [79]-[80]. Implementing KPIs successfully highly depends on their development [80], as well as require a systematic approach. This will require insider knowledge of all the people involved that participated in the KPI development. The 1992 Earth Summit recognized the important role of KPIs that can play in helping countries in decisions making concerning sustainable development. This recognition is articulated in Chapter 40 of Agenda 21, which calls on countries at the national level, as well as international, governmental and non-governmental organizations to develop KPIs of sustainable development [81]. A set of KPIs could be used by countries, especially in developing countries to measure progress on sustainable development at the national level. The question of how various universities are framing the central task of becoming sustainable universities is not easy to answer. The approach towards sustainability differ from campus to campus, country to country, policy to policy, and declaration to declaration [82]. Yet there are common principles among the majority of institutional policies, national, and international declarations towards sustainable university as shown in Table III. The common principles consist of sustainable physical operations, sustainable academic research, environmental literacy, ethical and moral responsibility, cooperation amongst universities and countries, the development of inter-disciplinary curriculum, partnerships with government, non-governmental organizations and industry, and public outreach.

TABLE III
COMMON PRINCIPLES OF SUSTAINABILITY IN POLICIES AND DECLARATIONS

Policy / Declaration	SPO	SR	EL	EMR	CUC	DI-DC	PGNI	PO
Stockholm Declaration			X	X				X
The Talloires Declaration	X	X	X	X	X	X	X	X
The Halifax Declaration			X	X	X		X	X
The Kyoto Declaration	X	X	X	X	X		X	X
CRE Copernicus Charter		X	X	X			X	X
Macalester College Implementation Plan	X	X	X	X	X	X	X	X
University of British Columbia Policy	X	X	X	X	X	X	X	X

*Notes: SPO-Sustainable Physical Operations; SR-Sustainable Research; EL-Environmental Literacy; EMR-Ethical and Moral Responsibility; CUC-Cooperation amongst Universities and Countries; DI-DC-Developing Inter-Disciplinary Curriculum; PGNI-Partnerships with Government, NGOs and Industry; PO-Public Outreach

IV. RESEARCH THEORETICAL FRAMEWORK

A theoretical framework is developed to provide understanding of implementation of EM towards sustainable university. A theoretical framework refers to how the researcher not only questions, but develops theories on what the possible answers could be, then this theories are grouped together into cluster that frame the subject [83]. It is based on written documents such as literature, discussion, and logic reasoning.

This framework contains two parts which are managerial area and result area. Key result areas (KRA) of EM implementation towards sustainable universities are identified based on the literature review. After that, a series of structured interviews are conducted. Potential CSFs of EM and KPIs towards sustainability for universities building are selected based from interview. Theoretical framework is a structure that is used for supporting a theory and refers to a collection of interrelated concepts. It can simply be a theory, but it can also be more general or a basic approach to understanding something [84]. Typically, a theoretical framework defines the kinds of variables to look at. The development of theoretical framework will help researcher to develop a hypothesis and perform tests on a relationship that was hypothesized. By testing this hypothesis, it could prove a theory is true or not in the context of the study [83]. The EFQM Excellence Model is one of the most widely used organizational frameworks in Europe and is the basis for the majority of national and regional quality awards. EFQM is formerly known as the European Foundation for Quality Management. This model is designed for helping organizations towards being more competitive by measuring where they are on the path to excellence; helping them understand the gaps; and then stimulating solutions [85]. This Model is regularly reviewed and refined and the last update was published in 2013 [85].

The EFQM Excellence Model consists of two parts, namely ‘enabler’ and ‘results’ (see Fig. 3). The 'enabler' criteria cover what an organization does and how it does it. The 'results' criteria cover what an organization achieves. 'Results' are caused by 'enablers' and 'enablers' are improved using feedback from 'results'. Key result areas (KRAs) and critical success factors (CSFs) provide clues that help to answer the question of whether the organization is able to effectively mobilize its resources where there are conflicting sub goals, environmental uncertainty, and internal politics and constraints [86].

The arrows emphasize the dynamic nature of the model, helping to improve enablers that in turn lead to improved results. The EFQM Model, which recognizes there are many approaches to achieving sustainable excellence in all aspects of performance, is based on the premise that excellent results with respect to performance, customers, people and society are achieved through leadership driving policy and strategy, which are themselves delivered through people partnerships and resources, and processes. The EFQM model is used to measure and improve the overall quality of an organization.

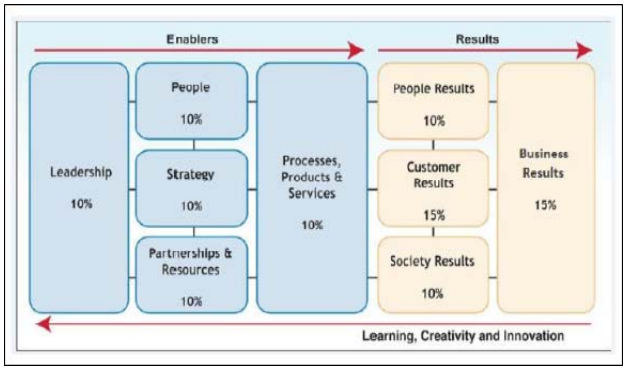

Fig. 3 The EFQM model

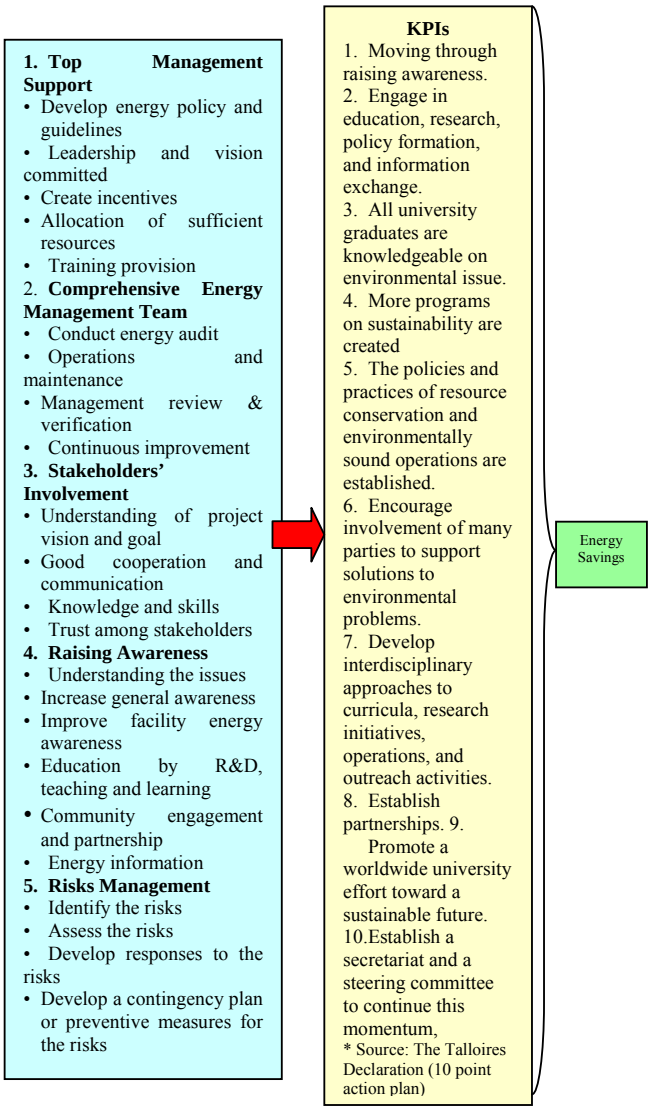

Fig. 4 A theoretical framework of EM towards sustainability

Therefore for this research, the theoretical framework is developed as in Fig. 4, where the CSFs are identified as 'enabler' to implement EM, whilst KPIs are commonly referred to determine the 'Key Result Areas' (KRAs) which integrates environment, economic and social to achieve sustainable university.

V. Research Significance

Five clusters consisting of 23 CSFs are identified namely, i) top management support, ii) comprehensive energy management team, iii) stakeholders' involvement, iv) awareness, v) risks management. This 10-point action plan of Talloires Declaration is selected as KPIs towards sustainable university. It can be hypothesized that there is a significant and positive relationship between CSFs with KPIs for EM towards sustainable university.

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