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The development of Sustainability Graduate Community (SGC) as a learning pathway for sustainability education – a framework for engineering programmes in Malaysia Technical Universities Network (MTUN)

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Abstract. 'Environmental and sustainability' is one of the Program Outcome (PO) designated by the Board of Engineers Malaysia (BEM) as one of the accreditation program requirement. However, to-date the implementation of sustainability elements in engineering programme in the technical universities in Malaysia is within individual faculty's curriculum plan and lack of university-level structured learning pathway, which enable all students to have access to an education in sustainability across all disciplines. Sustainability Graduate Community (SGC) is a framework designed to provide a learning pathway in the curriculum of engineering programs to inculcate sustainability education among engineering graduates. This paper aims to study the required attributes in Sustainability Graduate Community (SGC) framework to produce graduates who are not just engineers but also skilful in sustainability competencies using Global Project Management (GPM) P5 Standard for Sustainability. The development of the conceptual framework is to provide a constructive teaching and learning plan for educators and policy makers to work on together in developing the Sustainability Graduates (SG), the new kind of graduates from Malaysia Technical Universities Network (MTUN) in Malaysia who are literate in sustainability practices. The framework also support the call for developing holistic students based on Malaysian Education Blueprint (Higher Education) and address the gap between the statuses of engineering qualification to the expected competencies from industries in Malaysia in particular by achieving the SG attributes outlined in the framework

1. Introduction

We now live in the era of Sustainable Development (SD) of which operating in Triple Bottom Line (TBL) framework is considered the norm [1]. The way activities are operated on earth must change, thus the professionals who directly are the resources of the industrial system must have a balanced mindset which is able to work and function within the TBL framework to enable them to perform in a broader perspective to create greater business value [2]. This new thinking in understanding the world as a complex interaction of economic, social, environmental and political systems should be made knowledgeable and with high awareness among the university graduates. This is in agreement of the World Economic Forum report mentioning that institutions to be thought of the 'decision-making framework of the city' [3]. Graduates who can think and act as leaders in the 21st century must have a clear, far-sighted view of where cities

should grow and a sustainability practitioner will to ensure the country will get there. These kind of professionals must have technical knowledge and undergo sustainability-oriented courses to have sufficient skills and knowledge to serve the job scope plus being literate in sustainability practices.

Table 1. Operational definition of Triple Bottom Line (TBL) principles (based on "The Future We Want" , United Nations, 2012)

Pillars	Operational definition
Economy	Green economy Poverty eradication Promotion of productive and decent employment Sustainable consumption and production Sustainable tourism
Society	Food security and nutrition Health and population Social protection Education Gender equality and empowerment of women
Environment	Sustainable cities and human settlements and sanitation Disaster risk reduction Desertification, land degradation and drought Sustainable agriculture Chemicals and waste

In Malaysia, professionals like engineers are likely to be the output of higher education institutions (HEI). Specifically for engineering graduates, all engineering programmes in Malaysia must be accredited by the Engineering Accreditation Council (EAC) of which the programme need to fulfill the Programme Outcomes of which 'Environmental and Sustainability' is one of the required outcome [4]. Furthermore, United Nations Educational, Scientific and Cultural Organisation (UNESCO) has been designated by the United Nations General Assembly to lead and guide global education programmes to emphasize the critical role of education in pursuing sustainable development [5]. The commitment to continue the Education for Sustainable Development (ESD) has also been reinforced in post-2015 Sustainable Development Goals (SDGs) in the outcome document "Transforming our world: the 2030 Agenda for Sustainable Development" [6]. It is justified for universities to apply this future scenario and make approaches to its learning structure in the specific context of sustainable development to answer the call of the United Nations Decade of Education for Sustainable Development (DESD) 2005-2014 [7]. Research also shows that promotion of sustainability in the context of higher education can be reached by teaching and research [8]

The students are exposed to sustainability knowledge and the TBL elements based on the courses that have elements of sustainability embedded in them. There is still lack of 'formality' in the form that the subjects are structured thus making the assessment and the flow of knowledge in sustainability practices seems under emphasized and less focused. Sustainability knowledge is added as part of the chapters of a faculty course hence the objective of making sustainability practice as part of the working culture or the norm of in student's life is far less than being achieved. This further supports the observation that experiential learning, which is the suggested approach in learning sustainability education effectively, may not be widely implemented due to the lack of structure in conducting such courses [9]. Due to the absence of the learning pathway in sustainability education students may not be aware of the importance in looking into problems holistically since there is no continuality between one subjects to the other to inculcate the awareness in sustainability practices among the graduates.

This study focus on students of Malaysian Technical University Network (MTUN). MTUN brings together four technology based university in Malaysia i.e Universiti Tun Hussein Onn Malaysia (UTHM), Universiti Malaysia Perlis (UniMAP), Universiti Teknikal Malaysia Melaka (UTeM) and Universiti Malaysia Pahang (UMP). In the context of Malaysia Technical University Network (MTUN), the graduating engineering students are expected to be good both in academics and the soft skills in particular

of being ready to work as engineers [10]. This is in line with the National Graduate Employability Blueprint 2012-2017 published by the Ministry of Higher Education Malaysia. Based on literature sustainability integration across the university curriculum is more evident in the USA or European countries [11]. In the context of MTUN, this study aims to answer the following questions:

- Is it timely to inculcate sustainability awareness in university years to create competitive professionals with sustainability practice mind-set?
- How can sustainable education be formalized in engineering programmes to nurture the SD-oriented thinking in the undergraduates
- Do employers need graduates with SD competency to be the new leaders of the 21st century?

The objective of this study is to propose a framework that address the questions, which involves three parties: Society, Education and Industry (see Figure 1). The Global Competitiveness Report 2014-2015 define competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country [12]. University being the first pillar of the 12 pillars of competitiveness defined in the report, must be able to educate students who in future grow to be the young professionals to be competitive and act as the change agent for the transformation of the country towards realizing Malaysia's Vision 2020 [13]. Having the pathway in sustainability education provide a learning platform for students to view the world in a balanced mindset according to the TBL principles and thus being able to make judgment calls productively in specific when they become engineers in industries and as responsible citizen of Malaysia.

A sustainable corporation should create profits for its shareholders while protecting the environment and improving the lives of those with whom it interacts; it should operate so that its business interests and the interests of the environment and society intersect. This is because businesses can provide transformative solutions co-existence with the ability to have profound impacts on areas including energy and climate, water, agriculture and food, corruption and gender equality. For business to prosper in this new global context in achieving the 17 Sustainable Development Goals (SDGs), current and future leaders will need to demonstrate new skills and competencies, including sustainability competencies [14]. One of the sustainability competencies is sustainability literacy, which is a complementary to the conventional leadership competency models to position the firm for future success [15]. The new young professional i.e. engineer who are 'born' as Sustainability Graduate (SG) in this suggested framework is to acquire this skillset i.e. sustainability practice as part of the employability skills in order to create and protect future value for the company and society, thus embedding it in performing their operations [16]. A recognition of sustainability competency in engineering graduates under this framework is required to stimulate the development growth of the new professionals who then be the change agent during their employment in Malaysian industries.

Table 2 Sustainability Graduate (SG) attributes as young new professionals

Engineer's attribute	Current professional	New professional
Knowledge	Technical Green technology	Technical Triple Bottom Line (TBL) principles
Application	Green processes	sustainability practice and design
System	ability to solve complex engineering problems	ability to contextualize complex system and interaction across ecological, social and environmental dimensions
Quantify	ability to use modern tools to measure process or quality performance	ability to use tools to measure sustainability performance of products, processes and design
Optimise	Engineering design strongly driven by profit and customer requirement	engineering designs to trade off across the three principles of sustainability (Profit, Planet & People)

2. Methodology

The development framework of proposed approach is as depicted in Figure 1.

Sustainability Graduate Community (SGC)	Year 1	First year courses with sustainability embedded	Assessment on knowledge in Sustainable Development
	Year 1/ 2	Introductory course on Green Project Management (GPM)	Undergraduate level of GPM certification
	Year 3 / 4	Industrial attachment vetted with sustainability attributes	Sustainability report based on GRI standard
	Year 4	Final Year Project	Graduate Green Project Management certification

Figure 1. General framework of proposed approach

2.1. First year course with sustainability embedded

In the first year, the objective is to introduce students to sustainability concept and TBL principles in sustainability embedded courses e.g. project management. Some of the lesson outcome should have problem solving approach across the three dimensions of sustainability i.e. Profit, People and Planet. The goal to embed sustainability in all undergraduate teaching programs support the holistic concept on sustainability practice that sustainability is a societal imperative and normative concept about the kind of world we want to live in , and is fundamentally applicable to all students and all disciplines. It also helps to educate the students that there is a paradigm shift in defining occupations from 'green jobs' to 'sustainability-oriented occupations' (see Figure 2). This shift in the definition will eventually drive the society to perceive sustainability as the norm for all businesses and operations [17]. Sustainability-oriented jobs mean all occupations shall have sustainability element and that sustainability knowledge is thus potentially useful to all graduates to prepare them for the new economy [18]

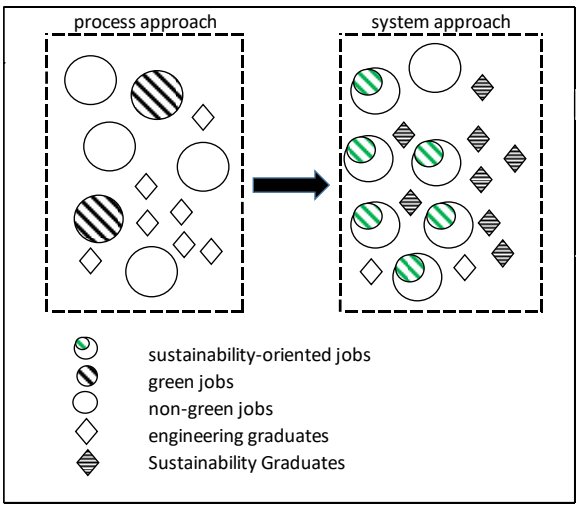

Figure 2. Paradigm shift of occupation view as 'green jobs' to 'sustainability-oriented jobs'

2.2. Introductory course

The introductory course is the first formal education of sustainability in the framework. The course shall adapt the Green Project Management (GPM) P5 Standard tool, which supports the alignment of Portfolios, Programs and Projects with organizational strategy for Sustainability and focuses on the Impacts of Project Processes and Deliverables on the Environment, Society, the corporate bottom line and the local economy [19]. This course would be complementary to the current conventional project management course offered in many engineering programs which emphasis greatly only on project management methodology with lack of emphasis on sustainability elements. The P5 concept integration matrix is described in the following paragraph [19]:

a) Product impacts – objectives and efforts, lifespan and servicing
b) Process impacts – maturity and efficiency
c) Society (People) – labor practices and decent work, society and customers, human rights, ethical behavior
d) Environment (Planet) – transport, energy, water, waste
e) Financial (Profit) – return on investment, business agility, economic simulation

2.3. Industrial attachment vetted with sustainability attributes

This phase is the real world experience where students apply the knowledge on sustainability in GPM course. In Year 3, most of the students in engineering programmes will go for industrial placement in industries to complete their industrial training requirement. The framework suggest that both the faculty and industry supervisors vet the industrial attachment evaluation form with elements of sustainability practices thus promoting the students to contribute to the industry as change agents during their attachment. Experiential learning is the approach recommended for this phase therefore experienced sustainability practitioners or researches are preferred to conduct this training.

2.4. Final Year Project / Green Project Management (GPM) certification

In Year 4, students may choose topic for the Final Year Project (FYP) with problem solving integrated with any of the 17 Sustainability Development Goals (SDGs). This will give opportunity for students to execute projects based on the GPM P5 Methodology with engineering solutions. In addition, students may choose to enrol for GPM certification and obtain a credential or competency as a junior sustainability practitioner. Students who complete this phase may be regarded as Sustainability Graduates (SG) who then be recognised from future employers as graduates who undergo a structured sustainability education in their university years based on the SGC framework.

3. Conclusion

As a conclusion, the SGC framework provide a learning pathway for students to learn about sustainability practices in a structured teaching and learning approach. In the framework, the SG is known as a graduate who has knowledge in SD and show high competency in sustainability practices demonstrated by obtaining GPM certification from professional bodies of Green Project Management Global associations. By having the sustainability elements vetted in the industrial training program structure, the industrial training will provide a real life experience for students to solve complex engineering problems in the industry with solutions than is applicable across the three dimensions of sustainability i.e. Planet, Profit and People

Educating engineering students with sustainability competencies to prepare them to be the change agent in sustainable development (SD) will face many challenges [20]. The implementation of the framework require great commitment from educators, industry players and the communities that embrace sustainability development as the new normative of looking into solutions. The framework is made to be generic to engineering programs in Malaysia as it fits the objective of MTUN graduates to excel both in academics and the soft skills in particular of being ready to work as engineers [21]. The Sustainability Graduate (SG) attributes in Table 2 also answer the call of the nation to produce ‘holistic graduates’ as

documented in the Shift 1 of Malaysian Education Development Plan (Higher Education) 2015-2025 [21] launched in April 2015.

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