Model of University Development in Thailand 4.0 Era toward “Green Campus Concept”

Krittaphas Mongkoldhumrongkul1,∗ and Phatcharapron Sukkanta1
1 Faculty of Science, Energy and Environment, King Mongkut’s University of Technology North Bangkok, Rayong, 21120, Thailand

*krittaphas.m@sciee.kmutnb.ac.th

Abstract. Beneath the green university concept, actions for university sustainability are the approaches to mitigate environmental impacts. For effective operation, understanding of patterns and key factors contributed to a green university in order to plan and improve the performance for maximum efficiency. The research aim was to develop a university development model in Thailand 4.0 era toward “green campus concept”. The participants of this study were students at King Mongkut’s University of Technology North Bangkok, Rayong campus in the 2019 academic year. The sample size was 364 respondents derived from simple random sampling. The collecting data acquired from the questionnaire which verified the model by Structural Equation Modelling. The results revealed that the model was in accordance with the empirical data and passed the evaluation criteria. All factors: Satisfaction, Attitude, Participation, and Perception had influence on Green University Model. Attitude and Perception have a significant impact on Participation of Green University Model development. Furthermore, Satisfaction affected Participation indirectly and significantly (P=0.01). Its Chi-square probability level, relative Chi-square, goodness of fit index, and root mean square error of approximation were 0.246, 0.132, 0.93, and 0.042 respectively. The statistical significance of this study was set at 0.05. Based on the findings, the implementation for green campus should stress on Perception factor and Satisfaction factor because they have direct and indirect effects on Green University Model. Understanding the causal model would endorse the chief executive to plan and decide on successful green university projects.

1. Introduction
The expansion of cities and the development of science and technology cause a great deal of the adoption of natural resources to serve urban development, economic expansion, population growth, population change, and human needs. Similarly, the daily use of life such as consumption, travel, and electricity use radically have contributed to natural degradation along with the increasing amount of greenhouse gas (GHG) emissions into the atmosphere. These have a considerable impact on the environment [1-2]. As this upsurge amount of GHG has been a fundamental cause of global climate change, various countries realize and compel a continuous reduction of global warming problem in accordance with the United Nations Framework Convention on Climate Change (UNFCCC). It consistently has recognized that the cause of an issue is human beings. Everyone should take responsibility and resolve such problem seriously to make this situation arise positively [3].

Sustainable development concept mitigated and crumbled a crisis because it was competent to fulfil human welfare without affecting nature. This concept balanced the three dimensions of social development, economic development, and environmental development [4]. For serve the community
and society, the university as an educational institution introduced the sustainable development plan into the vision, mission, including the university act [5]. These were to solve academic problems, research, and academic services also transfer and develop technology to acquire new knowledge in maintaining a continuous quality environment [5-6]. In particular, green campus was a crucial concept endorsing sustainable development by focusing on good management, efficient utilization of resources and renewable energy promotion. Good management achieved under the idea of participation and quality of life development stressing on the benefit of most people and long-term continuation. Efficient utilization of resources and renewable energy promotion took into account the environmental impact by integrating energy conservation and the environment with teaching, research, and all activities of the university [7].

There were several studies about green university using structural equation modelling, such as students’ perceptions and expectations on green campus concept in Turkey [8] and a university model for sustainable development in Vietnam [9]. Similar activities have also taken place around the world. For instance, Yong Geng et al. [10] handled all campus operations on a long-term basis in China. A case study approach is used to examine the feasibility of the idea. Shenyang University's achievements have provided a solid model for other Chinese colleges to follow, allowing them to begin their efforts while taking into account their specific reality. M.Z. Abd-Razaka et al. [11] investigated students' perceptions of physical development planning at four Malaysian public research universities. The results reveal that, when compared to other campuses, the most compact campus has the fewest concerns with physical growth planning that affects student life. According to Keoy Kay Hooi et al. [12], they developed a customised Green University Framework based on a localisation approach in order to investigate the readiness of Malaysian higher education institutions to engage in and assess the importance of implementing Green University initiatives at their respective institutions. Furthermore, Policy, regulation, staff participation, key performance indicators, project evaluation, environmental implementation, and environmental management potential were all factors in taking the green campus concept into action. They were clear and comprehensive on all environmental issues as well as there had continuously enhanced procedure [13].

King Mongkut's University of Technology North Bangkok (KMUTNB) recognized and took action towards a green university, which was integrated energy and environmental conservation through both teaching and learning management and activities of the university. Besides enhancing a great image, it as well endorsed a sustainable university. The main research objectives were to develop a green university model caused policymaking for valuable improvement.

2. Methodology
The research method was conducted by using a questionnaire as a tool for data collection from 364 respondents in 3 faculties of KMUTNB, Rayong campus in the 2019 academic year. Latent variables observed were Attitude, Satisfaction, Participation, and Perception.

Additionally, the index of Item Objective Congruence (IOC) was determined both structural validity and content reliability, assured by 5 experts in their respective fields with an evaluation index consistent with the content and the purpose of the research.

Descriptive statistical analysis was carried out through examination of frequencies and percentages of the data. Furthermore, the statistical significance level of this study was set at 0.05. The Structural Equation Model (SEM), was employed for statistical analysis purposes.

3. Results and discussion

3.1. Characteristic of sample
The data contained of 364 respondents, 142 respondents (39%) were male, whereas 222 respondents (61%) were female.

The respondents’ age ranged from 17 to 24 years and the mean age was 20.32 (SD. 1.824). The university faculties in the sample included: Science, Energy and Environment (56, 15.4%), Engineering and Technology (82, 22.5%) and Business Administration (226, 62.1%). Within the
sample 21.7% were freshman, 25.5% were sophomore, 28.3% were junior and 24.5% were senior students.

In addition to transportation within university, 29.4% travelled by personal car, travelled by motorcycle, 1.4% travelled by electric car, 6.9% travelled by bicycle, and 7.4% travelled on foot. The characteristic data as shown in table 1.

| Table 1. Assessing the respondents’ transportation within university status. |
|---------------------------------------------------|
| Frequency | Percent | Valid Percent | Cumulative Percent |
| By Personal Car | 107 | 29.4 | 29.4 | 29.4 |
| By Motorcycle | 200 | 54.9 | 54.9 | 84.3 |
| By Electric Car | 5 | 1.4 | 1.4 | 85.7 |
| By Bicycle | 25 | 6.9 | 6.9 | 92.6 |
| On foot | 27 | 7.4 | 7.4 | 100.0 |
| Total | 364 | 100.0 | 100.0 |

3.2. Research hypotheses
The five research hypotheses were enunciated as follows:

Hypothesis 1. Perception has a positive and significant effect on attitude of Green University Model development.

Hypothesis 2. Perception has a positive and significant effect on satisfaction of Green University Model development.

Hypothesis 3. Perception has a positive and significant effect on participation of Green University Model development.

Hypothesis 4. Satisfaction has a positive and significant effect on attitude of Green University Model development.

Hypothesis 5. Attitude has a positive and significant effect on participation of Green University Model development.

3.3. Structural model
It was found that the level of a factor of affected to green university in all 4 aspects such as attitude, participation, satisfaction, and perception, respectively. which are presented in detail below:

Perception directly affected attitude, satisfaction, and participation significantly (P=0.01), the effects of which being 0.29, 0.83 and 0.99, respectively. Moreover, satisfaction directly affected attitude significantly (P=0.01), the effects of which being 0.24. In addition, attitude directly affected participation significantly (P=0.01), the effects of which being 0.37. The model shown as figure 1.

Figure 1. Green university model.
Therefore, the hypothetical model of research was congruent with the empirical data. Moreover, the Goodness of Fit Index (GFI) was 0.93 (GFI> 0.90), whereas RMSEA was 0.042 (RMSEA and RMR<0.05), with a critical number of 256.11, which was more than 200.

Considering as critical factors affecting green campus concept, all critical factors are same as factors from the previous model due to component and condition in assessment are not fluctuated. However, the critical factors in this model represent all factors through convergent validity by confirmatory factor analysis, and fulfill the previous model in the sustainable aspects to diminish the error decision for green campus concept. The finding model defined tendency of affecting factors by decision weighted for each factors.

Investors have a precise decision by giving important each factors following organization policy. The green campus concept can be developed in six ways; 1. Setting and infrastructure - the university should provide more space for greenery and promotes tree-planting activities in the vicinity of the building. 2. Energy and climate change - all building on the campus is an energy-saving building. However, the authoritarian should encourage energy conservative behavior and build up more the renewable energy usage. 3. Waste treatment - management team should support enough bins throughout the campus. 4. Water treatment - the institution should reduce its water consumption while also expanding its water treatment system before discharging it to the outside of the building. 5. Transportation – a policy restricting the number of motor vehicles on campus, as well as encouraging the use of the campus bus and bicycle, will promote a healthier atmosphere. 6. Education and research - environmental subjects that are appropriate for the course have already been taught at the institution. However, environmental awareness should be added as an elective course.

4. Conclusion
Based on the empirical data, perception, Satisfaction, Attitude directly affected participation of Green University Model development significantly (P<0.01).

The implementation for green campus should stress on Perception factor and Satisfaction factor because they have direct and indirect effects on Green University Model. The findings of the study can be used to help King Mongkut’s University of Technology North Bangkok improve its long-term sustainability and performance in higher education. Understanding the causal model will help the chief executive plan and decide on a successful green institution that can be replicated across Thailand and the entire world. However, the primary hurdles to the development of the green campus concept were determined to be a lack of suitable administrative experience in implementing green university initiatives and a lack of funding.

5. References
[1] W. Somboonpong, "Knowledge, Attitudes to Global Warming and Behaviors Causing Global Warming of People in Subdistrict, Sampran District, Nakhon Pathom Province," in The 9th National Conference Kasetsart University, Kamphaengsan Campus, Nakhon Pathom, Thailand, 2012.
[2] S. Apmaya, "A Study of Awareness of Impacts on Global Warming Relevant to Home Economics Knowledge Base of Home Economics Students, Suan Dusit Rajabhat University," RMUTP Research Journal, vol. 9, no. 2, pp. 85-98, 2015.
[3] N. Kulthon, "Students' Participation in Global Warming Mitigation at Prince of Songkla University, Had Yai Campus," Academic Services Journal, vol. 23, no. 1, pp. 176-200, 2012.
[4] S. Anukanon, Environmental Economics, Bangkok, Thailand: TPN Press Limited Partnership, 2004.
[5] S. Wattanatham and V. Rijiravanich, "Guideline for Green University Development," in The 6th Conference on Industrial Operations Development 2015 (CIOD 2015), Bangkok, Thailand, 2015.
[6] P. Atthanak, W. Areerat and T. Areerat, "A Study of Staff’s Attitudes towards a Framework of ‘Green University’ Development Case Study: The Faculty of Information Technology, Rajabhat Maha Sarakham University," in The 1st National Conference on Technology and Innovation Management (NCTIM 2015), Mahasarakham, Thailand, 2015.
[7] T. Buakhao and M. Bejrananda, "Policy and Strategy Formation towards "Green University": A Case Study of Thaksin University, Phatthalung Campus", Journal of the Faculty of Architecture King Mongkut's Institute of Technology Ladkrabang, vol. 14, pp. 40-55, 2012.

[8] E. Tezel, M. Ugural and H. Giritli, "Towards Green Campuses: Students’ Perceptions and Expectations," in The 5th International Project and Construction Management Conference (IPCMC 2018), North Cyprus, 2018.

[9] M. N. Le and A. T. Tu, “A University-City Complex, a Model for Sustainable Development: a Case Study in Vietnam”, Elsevier Procedia, vol. 142, pp. 92-99, 2016.

[10] Y. Geng, K. Liu, B. Xue and T. Fujita, “Creating a green university in China: a case of Shenyang University”, Journal of Cleaner Production, vol. 61, pp. 13-19, 2013.

[11] M. Z Abd-Razak, N. K. F. Mustafa, A. I. Che-Ani, N. A. G. Abdullah, M. F. I. Mohd-Nor, “Campus Sustainability: Student’s Perception on Campus Physical Development Planning in Malaysia”, Procedia Engineering, vol. 20, pp. 230-237, 2011.

[12] K. K. Hooi, F. Hassan and M. C. Mat, “An Exploratory Study of Readiness and Development of Green University Framework in Malaysia”, Procedia Social and Behavioral Sciences, vol. 50, pp. 525-536, 2012.

[13] I. Rodtassana, "Green University," HCU Journal of Health Science, vol. 18, no. 36, pp. 171-188, 2015.

Acknowledgments
Thanks to Asst. Prof. Dr. Prapita Thanarak for her mentorship throughout our project. This research was funded by King Mongkut’s University of Technology North Bangkok. Contract no. KMUTNB-61-NEW-022.