A STUDY OF THE FACTORS INFLUENCING SUSTAINABLE DEVELOPMENT GOALS PERFORMANCE IN THAI HIGHER EDUCATION INSTITUTIONS

SIRIPONG JUNGTHAWAN

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT
SCHOOL OF ENGINEERING
KING MONGKUT'S INSTITUTE OF TECHNOLOGY LADKRABANG
2023

KMITL-2023-EN-D-027-134

Thesis	A Study of the Factors Influencing Sustainable Development Goals Performance in Thai Higher Education Institutions
Student	Mr.Siripong Jungthawan
Student ID.	59610005
Degree	Doctor of Philosophy
Program	Logistics and Supply Chain Management
Year	2022
Thesis Advisor	Assoc.Prof.Dr.Ronnachai Tiyarattanachai
Thesis Co Advisor	Asst.Prof.Dr.Isara Anantavrasilp

ABSTRACT

This study examined the awareness of stakeholders in Thai Higher Education institutions (THEIs) regarding the Sustainable Development Goals (SDGs) and their relationship to the criteria set in the Times Higher Education Impact Rankings (THEIR). The study employed Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) to analyze data collected from stakeholders in 16 THEIs in Thailand.

The findings revealed significant linkages between SDGs with SDG 1 (No Poverty) exhibiting the most connections to other goals. Strong relationships are identified between SDG 1 and SDG 9 (Industry, Innovation, and Infrastructure) indicating potential synergies in addressing poverty and fostering sustainable development. The study also identified leveraged SDGs, including SDGs 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), and SDG 9, which have significant relationships with other goals.

Based on the results, the study recommended that THEI executives should prioritize leveraged SDGs when formulating SDG-related policies. They can align policies with stakeholders' preferences and focusing on leveraged SDGs to enhance the effectiveness of sustainability initiatives in THEIs. The study further suggested considering demographic

factors in policy development to address the diverse needs and perspectives of stakeholders.

The recommendations include optimizing resource allocation, fostering interdisciplinary collaboration, and continuous monitoring and evaluation of sustainability practices. By implementing these recommendations, THEIs can maximize their impact on sustainable development and contribute to the achievement of the SDGs.

Keywords: Sustainable Development Goals (SDGs), Sustainable Higher Education (SHE), Structural Equation Modeling (SEM), Systems Approach, Times Higher Education Impact Rankings (THEIR)

Acknowledgement

In the process of completing this monumental project, I have been fortunate to have received invaluable support and encouragement from various individuals and institutions. My profound appreciation extends to all those who made this journey possible.

First and foremost, I express my heartfelt gratitude to my thesis advisor, Assoc.Prof.Dr. Ronnachai Tiyarattanachai. His dynamic guidance, stimulating suggestions, and constant encouragement were instrumental in coordinating and shaping this project. His belief in my capabilities has been a constant source of motivation. Equally, I owe a depth of gratitude to my thesis co-advisor, Asst.Prof.Dr. Isara Anantavrasilp. His unique perspective and insightful inspirations were pivotal in the construction of this paper, broadening my views and enriching my research experience.

I extend sincere thanks to Asst.Prof.Dr. Jaruwit Prabnasak, the program chairman, who not only spurred me to the completion of my Ph.D. but also acted as a pillar of support and motivation throughout my academic journey. His dedication towards students' success is truly commendable. Furthermore, I am indebted to Dr. Vithaya Suharitdamrong for the unique opportunity to design and develop the Ph.D. program, and his invitation to pursue my Ph.D. His trust and faith in my abilities have provided an unparalleled learning experience.

I would like to express my deepest gratitude to the following domain experts who have generously contributed their expertise and insights to this research; Adhipat Warangkanand, Dr. Chodchanok Attaphong, Dr. Kankanit Kamolkittiwong, Asst.Prof.Dr. Pornsri Laurujisawat, Dr. Weerawit Lertthaitrakul. Their expertise and validation of the questionnaire using the Index of Item-Objective Congruence (IOC) method have significantly contributed to the content validity of this research. I am truly grateful for their valuable insights and contributions to this study.

I would also like to express my sincere gratitude to Asst.Prof.Dr. Supunyada Suntornnont for her invaluable help and support in designing the study and organizing the first international conference. Her expertise and guidance were instrumental in ensuring the success of these important aspects of my research. I am truly grateful for her contributions and dedication to the advancement of knowledge in our field.

I would also like to extend my heartfelt appreciation to Dr. Thidawan Amjang for her invaluable support in analyzing and designing the Structural Equation Modeling (SEM) experiment. Her expertise and guidance in this area have been instrumental in ensuring the accuracy and validity of the statistical analysis conducted in this research. I am truly grateful for her dedication and commitment to the success of this study.

I would like to extend my heartfelt appreciation to all the individuals who participated as respondents in this research. The sample size of 552 respondents played a crucial role in providing valuable insights for the study. Their willingness to take part in the survey and share their perspectives has greatly contributed to the depth and comprehensiveness of the findings. I am truly grateful for their time, effort, and contribution to this research endeavor.

I extend my warm thanks to the staff of the Logistics and Supply Chain program, School of Engineering, for their immense support. Their willingness to provide the necessary resources, equipment, and facilities was a significant element in the completion of this task.

A special nod of gratitude is due to my lab team, Chitsanu Pakdeewanich, whose unflinching assistance and valuable suggestions were crucial in refining the project. Their team spirit and cooperation significantly eased the task's completion.

I'm also grateful to the various contributors and panelists who provided guidance and constructive critiques, particularly during our project presentations. Their input was integral to honing my presentation skills.

My deepest thanks also go to my family and friends. Their unyielding support, understanding, and encouragement have been my strength throughout this project. Without their unwavering faith and guidance, this journey would not have been as enriching and rewarding.

In essence, this project is a product of collective effort, dedication, and mutual support. Without the help of all these individuals and many more who have contributed in their own ways, this project wouldn't have come to fruition. I stand in gratitude for everyone's contribution and dedicate the fruits of this endeavor to all of them.

Siripong Jungthawan

Table of Contents

Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction

1.1 Background and Statement of the Problem

Sustainable Development (SD) has already been around 40 years. Normally, people think this term as a concept of development that focuses on environment only, but it is not like that. This word was published in the "Our Common Future", was published in 1987 by the United Nations (UN). The working group of the World Commission on Environment and Development (WCED) laid the groundwork for the convening of the 1992 Earth Summit and the adoption of Agenda 21, the Rio Declaration, and to the establishment of the Commission on Sustainable Development.

Sustainability has focused on 3 parts as 1) environment 2) society and 3) economics that defined as Triple Bottom Line. Millennium Development Goals (MDGs) ended in 2015, so UN initiated plan to design the post-2015 development agenda and MDGs was updated to Sustainable Development Goals (SDGs) to be implemented during 2016-2030 in Figure 1.1. The UN announced SDGs in August 2015; it was a blueprint to achieve a better and more sustainable future for all including, but not be limited to governments, businesses, civil society, the general public, and also Higher Education Institution (HEI) (United Nations, 2016).

With only 10 years left to achieve the SDGs, world leaders at the Sustainable Development Goals Summit (SDGs Summit) in September 2019 called for a decade of action and delivery for sustainable development and pledged to mobilize financing, enhance national implementation and strengthen institutions to achieve the goals by the 2030 target, leaving no one behind (UN Sustainable Development Group (UNSDG), 2019; United Nations Development Programme (UNDP), 2018).

Thailand is one of the 193 UN member states, which joined the UN in 1946, and has contributed constructively to peacekeeping, human rights, and sustainable development. Prayut Chan-o-cha, the Prime Minister of Thailand and the Chair of ASEAN, made a statement at the 52 ASEAN foreign ministers' meeting that leave no one behind and looks to the future

as well as the adoption of the ASEAN leaders' vision statement on partnership for sustainability in all members (Minister of Foreign Affairs, 2019).

Moreover, he attended the 74 United Nations General Assembly (UNGA 74) Session, New York. He joined the SDGs Summit, which was the first gathering at the summit level of leaders from countries, that in 2015 adopted the "SDGs Agenda 2030", aiming to assess and expedite implementation of SDGs by 2020. Prayut stated that ASEAN must accelerate the implementation of SDGs by enhancing the partnership network, tackling the problems through education, science and technology, and protecting the environment, especially through the responsible use of natural resources such as soil, water, air, and mineral (Minister of Foreign Affairs, 2018).

Figure 1.1 17 Sustainable Development Goals (United Nations, 2019)

As a result, Thai government agencies in all levels have been trying to drive the SDGs through their policies and executions. Private sectors are also expected to contribute to the effort. For the education sector, Thai Higher Education Institution (THEI) takes many important roles in the SDGs. HEIs are the important units that develop human resources and research necessary for achieving self-sustainability and their communities (Rosati & Faria, 2019). Moreover, Times Higher Education (THE) announced the THE Impact Rankings (THEIR) in October 2019 (Times Higher Education (THE), 2018). One of the objectives of the rankings is to

encourage universities to focus efforts that pose positive impacts on SDGs in the areas related to the university's roles and the systems that will be linked to the 17 SDGs (Times Higher Education, 2019). Cause SDGs and their targets have different priorities and context in different countries, there is a need for a study to examine the perspectives of stakeholders in THEIs. This is especially important since Thai universities may have relatively more limited resources to boost SDGs compared to other universities in more developed countries.

This study concentrates on 16 pioneering Thai universities that were ranked in the 2019 THE World University Rankings, as detailed in Table 1.1. The primary objective of this research is to design and develop a comprehensive assessment tool that enables a deeper understanding of the relationship between awareness of SDGs and SDG policy implementation. This assessment tool will focus particularly on sustainability factors within THEIs. Additionally, this study aims to provide valuable insights that could assist Thai university executives in optimizing resource allocation to enhance their sustainability performance.

Table 1.1 The 16 Pioneer Thai Universities Ranked in the 2019 THE World University Rankings

Rank	Name	Overall	Teaching	Research	Citations	Industry Income	International Outlook
601–800	Mae Fah Luang University	28.3–35.2	14.4	9.0	74.4	34.5	50.6
601–800	Mahidol University	28.3–35.2	31.6	21.0	45.2	73.4	46.1
801–1000	Chulalongkorn University	22.2–28.2	31.5	21.7	22.2	64.8	37.8
1001+	Chiang Mai University	10.7–22.1	20.8	14.2	18.0	48.6	32.8
1001+	Kasetsart University	10.7–22.1	18.6	12.8	10.3	59.8	37.1
1001+	Khon Kaen University	10.7–22.1	21.6	12.0	18.0	55.2	31.1
1001+	King Mongkut's Institute of Technology Ladkrabang	10.7–22.1	17.8	19.5	6.7	82.0	19.6
1001+	King Mongkut's University of Technology North Bangkok	10.7–22.1	15.1	9.9	10.1	41.9	20.9
1001+	King Mongkut's University of Technology Thonburi	10.7–22.1	17.3	16.7	23.6	74.0	29.2
1001+	Mahasarakham University	10.7–22.1	18.5	8.0	11.0	35.5	26.1
1001+	Naresuan University	10.7–22.1	16.7	7.8	12.6	34.9	35.9
1001+	Prince of Songkla University	10.7–22.1	18.1	10.1	17.6	35.4	32.6
1001+	Silpakorn University	10.7–22.1	15.5	8.3	13.6	39.9	27.5
1001+	Srinakharinwirot University	10.7–22.1	19.9	8.4	12.6	40.6	20.9
1001+	Suranaree University of Technology	10.7–22.1	19.7	12.3	27.0	44.5	32.1
1001+	Thammasat University	10.7–22.1	18.6	11.7	11.7	38.9	34.4

Reference. Thai THE World University Rankings 2019 www.timeshighereducation.com

1.2 Objectives of the Study

1. To investigate the awareness levels of SDGs among students and lecturers and identify the factors that influence this awareness.

2. To examine the specific factors that shape the THEI's approach to SDGs and the impact of these factors on the implementation of SDGs.

3. To explain the key factors driving awareness of SDGs and their relationship to SDG policy development and implementation.

4. To formulate strategic recommendations for the executive management concerning investment in SDG-oriented policies in their educational institutions, leveraging the insights gained from the study.

1.3 Assumption of Study

H1: Students are aware of sustainable development initiatives in their higher education institutions.

H2: Students express concern about specific sustainable development criteria.

H3: Sustainable development criteria significantly influence university rankings.

H4: Sustainable development criteria affect the reputation of well-known universities.

H5: Universities should invest in achieving SDGs.

1.4 Theory and Concept of the Study

1.4.1 Supply Chain Management (SCM)

1.4.2 Sustainable Development Goals (SDG)

1.4.3 Systems Thinking

1.4.4 Thai Higher Education Systems

1.4.5 Principles for Responsible Management Education (PRME)

1.4.6 University Ranking Systems (URS)

1.4.7 Statistical Tools and Methodologies

1.5 Scope of the Study

This study focuses on the sustainable development initiatives within the 16 pioneering Thai universities that were included in the 2019 THE World University Rankings (THEWUR), as detailed in Table 1.1. The scope encompasses an examination of their respective policies, and awareness levels pertaining to SDGs, as well as the impact of these factors on their overall rankings. This research analyzed data from the 2019 academic year, with a particular focus on key university stakeholders including students, lecturers, and administration.

1.6 Procedure of Study

The procedure of study described below

Figure 1.2 Procedure of Study

We began by searching the KMITL database along with secondary data sources. Keywords used in the literature search included "SDGs," "HEIs," "THEI," "SHE," and "University Impact Ranking." The aim was to identify gaps in the research on SDGs for THEI in international proceedings, abstracts, international journals, documents, and University Ranking Systems (URS). Particular attention was paid to the Times Higher Education (THE) systems that designed the THE University Impact Rankings 2019.

We designed and developed a questionnaire (the assessment tool) based on the UN SDGs and the THE Impact Rankings 2019 (THEIR) criteria. This questionnaire, detailed in Chapter 3, serves as an assessment tool for understanding SDGs and THEIR criteria.

Data were collected from the populations at the 16 pioneer Thai universities using the questionnaire. Quota sampling was used to achieve 25 samples per university, yielding a total sample size of at least 400, as calculated using Yamane's formula (Yamane, 1973).

The questionnaire responses were analyzed to understand community needs and demands that could guide SDG policy implementation. The insights gained from this research aim to inform the formation and implementation of leveraged SDG policies.

The final steps involved writing the dissertation, summarizing the study results, and presenting these results to the committee. And also, we published this study into educational conference.

Acronyms

AGFI	Adjusted Goodness of Fit Index
CFI	Comparative Fit Index
CUPT	Council of University Presidents of Thailand
GFI	Goodness of Fit Index
HEI	Higher Education Institutions
KMITL	King Mongkut's Institute of Technology Ladkrabang
MDGs	Millennium Development Goals
MHESI	Ministry of Higher Education, Science, Research, and Innovation, Thailand
NFI	Normed Fit Index
RMR	Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
SDGs	Sustainable Development Goals
SHE	Sustainable Higher Education
TCAS	Thai University Central Admission System
THE	Times Higher Education
THEI	Thai Higher Education Institutions
THEIR	Times Higher Education Impact Rankings
THEWUR	THE World University Rankings
UN	United Nations
URS	University Ranking System
χ^2	Chi-Square statistics
χ^2/df	Relative Chi-Square

Chapter 2

Literature Review

In this chapter, it was devoted to an in-depth examination of the scholarly work that has been conducted in the areas relevant to this study. This review was not only crucial for developing a comprehensive understanding of the topic, but it also identified gaps in the current research that this study aims to fill.

The main themes covered in this chapter include SDGs and their role within HEIs, the impact of SDGs on university rankings and reputations, the Principles for Responsible Management Education (PRME), and the specifics of THES. Further, this chapter will delve into the mechanisms of Supply Chain Management (SCM) and University Ranking Systems (URS), and their relationship with sustainable development efforts.

By examining a range of sources, including research articles, books, reports, and case studies, this literature review provided the necessary theoretical underpinning for our investigation. In doing so, it helped contextualize our research within the broader academic discourse on sustainable development in higher education. This overview of the current state of knowledge assisted in framing our research questions, shaping the methodology, and providing a rationale for this study

2.1 Supply Chain Management (SCM)

Supply chain management, which is "a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produces and distributed at the right quantities, to the right locations, and the right time, in order to minimize system wide cost while satisfying service level requirements", is both a management philosophy and a strategy for active operation and integration of the company's market and supply relations (American Production and Inventory Control Society (APICS), 2016; APICS, 2017).

Supply chain generic model was developed and modified from APICS supply chain model and supply chain operation reference (SCOR) model (American Production and Inventory Control Society (APICS), 2016; APICS, 2017; Boonsthonsatit & Jungthawan, 2015) in Figure 2.1. The common supply chain model consists of 3 members as 1) Up-streamer are supplier tier 1, 2, ..., n 2) Mid-streamer are manufacturer or factory, and 3) Down-streamer are channels and customers such distributors, wholesalers, retailers, and the end customer. There is the 4 flows of the information, material, cash, and reverse material.

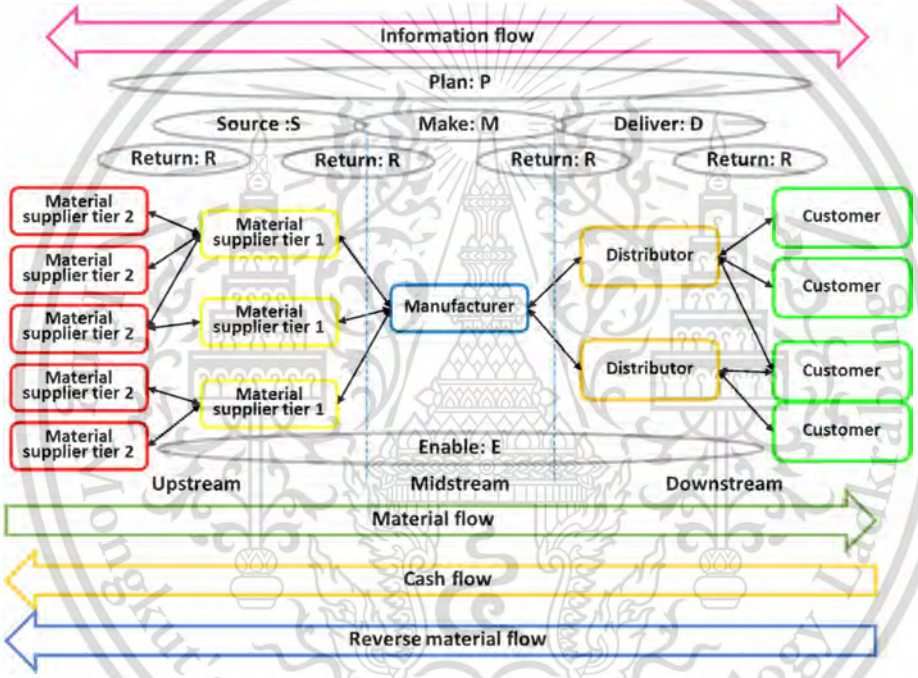

Figure 2.1 Supply Chain Generic Model (Boonsthonsatit & Jungthawan, 2015; Jungthawan et al., 2017)

The supply chain consists with 6 processes (APICS, 2017), 1) Plan (P) describe the activities that link the designing plan to supply chain operation. Planning includes the requirements, data collection, balancing demand and supply, and next action.

2) Source (S) this process discusses about the schedule of order, receipt of good and services. Sourcing enables the ensure of purchase activities; purchase requirement, purchase order the raw material from company to all of suppliers, supplier selection, contract

negotiation. This source processes link to order, deliver, receipt, check, and transfer of raw material, parts, subassemblies, product/service and spare part.

3) Make (M) describe the activities that focus on transform the raw material to finish products. Make represents all type of operation in factory, assembly, process, maintenance, repair, overhaul, recycling, refurbishment, remake, and the other process that produce the product.

4) Deliver (D) explain the activities with support the creation, maintenance the service level, and fulfillment of customer orders. Deliver deal with the receipt, validation and creation of customer orders, schedule the vehicles, pick, pack and shipment all of products to the customer.

5) Return (R) describe the activities that link to the reverse flow of materials. The return process enables and identify the requirement of reverse, the planning of the return, delivery and distribution, the documents of return. reuse, repair, recycling, refurbishment, and reproduce processes.

6) Enable (E) process that describe the associated activities with the support of the supply chain. Enable process connect management of business term, business rules, metrics management, data and information management, resource and facilities management, contract and supply chain network, risk and business continuity management.

2.2 Sustainable Development Goals (SDGs)

SDGs consist of the 17 goals to achieve the 2030 target in figure 2.1 and described below. UN announced SDGs in August 2015; it was a blueprint to achieve a better and more sustainable future for all including, but not be limited to governments, businesses, civil society, the general public, and also HEI (United Nations, 2016).

With only 10 years left to achieve the SDGs, world leaders at the SDGs Summit in September 2019 called for a decade of action and delivery for sustainable development and pledged to mobilize financing, enhance national implementation and strengthen institutions to achieve the goals by the 2030 target, leaving no one behind (UN Sustainable Development Group (UNSDG), 2019; United Nations Development Programme (UNDP), 2018).

Figure 2.2 17 Sustainable Development Goals (United Nations, 2019)

Thailand is one of the 193 UN member states, which joined the UN in 1946, and has contributed constructively in peacekeeping, human rights, and sustainable development. Prayut Chan-o-cha, the Prime Minister of Thailand and the Chair of ASEAN, made a statement at the 52 ASEAN foreign ministers' meeting that leave no one behind and looks to the future as well as the adoption of the ASEAN leaders' vision statement on partnership for sustainability in all members (Minister of Foreign Affairs, 2019).

Moreover, he attended the 74 United Nations General Assembly (UNGA 74) Session, New York. He joined the SDGs Summit, which was the first gathering at the summit level of leaders from countries, that in 2015 adopted the "SDGs Agenda 2030", aiming to assess and expedite implementation of SDGs by 2020. Prayut stated that ASEAN must accelerate the implementation of SDGs by enhancing the partnership network, tackling the problems through education, science and technology, and protecting the environment, especially through the responsible use of natural resources such as soil, water, air, and mineral (Minister of Foreign Affairs, 2018). As a result, Thai government agencies in all levels have been trying to drive the SDGs through their policies and executions. Private sectors are also expected to contribute to the effort. For the education sector, THEIs takes many important roles in the SDGs.

HEIs are the important units that develop human resources and research necessary for achieving self-sustainability and their communities. Moreover, THE announced the THE Impact Rankings (THEIR) in October 2019. One of the objectives of the rankings is to encourage universities to focus efforts that pose positive impacts on SDGs in the areas related to the university's roles and the systems that will be linked to the 17 SDGs (Times Higher Education, 2019).

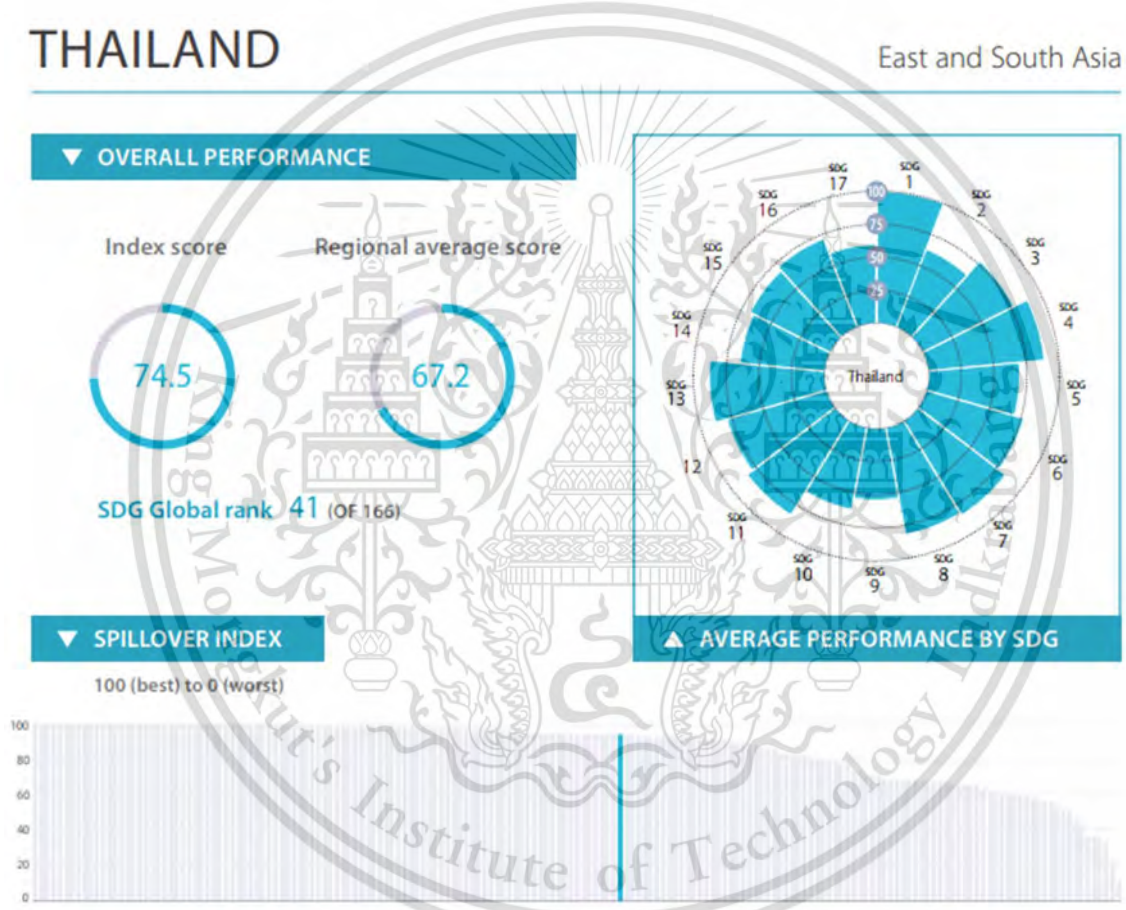

Figure 2.3 SDGs performance of Thailand (Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., 2020)

In 2020, Thailand have been ranked in SDG global ranking at 41 of 166 members around the world (De Geus & Sachs, 2019; Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., 2020) as in Figure 2.3. Thailand government's policy start from poor sustainable development outcomes may have adopted the right mix of policies, including budgets,

regulation, incentive for private investments, and so forth, which puts it on track to achieve the goals by 2030. In the same way the universities should design the SDG policy that have been optimized the resource, budget, manpower, and time to SDG action plan. This leveraged SDG policy that are linked to the systems of Thailand educations.

2.3 Systems Thinking

I use Systems Thinking to expand and discuss THES. Systems Thinking in the new system more correctly, when we explain and discuss about the big picture. Systems thinking consists of three components (Arnold & Wade, 2015)

1) Elements (in this case, characteristics),

2) Interconnections (the way these characteristics relate to and feedback into each other), and

3) A function or purpose (Meadows, 2009).

Systemigrams were observed to be a particular initial phase in understanding causality and structure (J. Boardman & Sauser, 2008; J. T. Boardman, 1994a; Prins et al., 2015; Sivadasan & Sauser, 2009), it is based upon the symbols of Systemigrams. Systemigrams is consist with member and relation in the systems. This is a tool; it will help you mapping the systems. Their structures, behaviors, relations that are the parts, and relationship. They are collecting, and therefore in the nature of the emergent whole (J. Boardman & Sauser, 2008). This tool must come up with some ideas, the new idea concepts, techniques and the emergent in the systems.

The significant parts (noun phrase) and their significant relationships (prepositional or verb phrases) in two elements; node and link. The third element is text over the link in figure 2.4 (Sauser et al., 2011). But their decomposition into parts and relationships were all text; assembling them back in the diagrammatic frame was another, esteem including the method for exhibiting the content. This diagram clearly identified the key elements and the formal structure model.

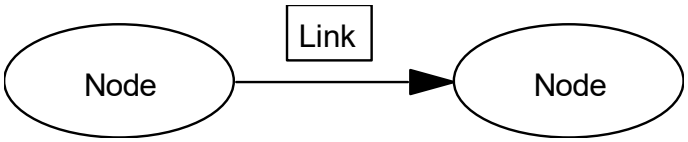

Figure 2.4 Systemigrams by SystemiTool software.

SystemiTool was invented by Boardman and Sauser (J. T. Boardman, 1994b; Sivadasan & Sauser, 2009; Squires et al., 2010); it is software system created to help systems engineers alter and depict a storyboard of scenes of Systemigrams. It is intended to empower the straightforward articulation of complex systems structures (J. Boardman & Sauser, 2008; D. Blair et al., 2007; Sauser et al., 2011; Sivadasan & Sauser, 2009). The tool delivers an interesting way to think about and depict a complex system by focusing the mapper on the relationships between members of the system and the system's interaction with external members of other systems in the same page. The SystemiTool was created to transfer understanding; it included visualization facilities, while the intuitive mode of representation makes diagrams swiftly comprehensible by Systemigrams (J. Boardman & Sauser, 2008; D. Blair et al., 2007; Sauser et al., 2011; Sivadasan & Sauser, 2009).

In table 2.1, we review and summarize the systems approach in several author's view as a systems approach that studies processes, relationships, model-based simulation and standard tests (Basten et al., 2012; Birta & Arbez, 2013; Bjorkman et al., n.d.; J. Boardman & Sauser, 2008; Browning et al., 2006; Canedo & Richter, 2014; Haveman & Bonnema, 2015; M. Law, 2014; National Aeronautics and Space Administration, 2016; Ryan et al., 2013; Topper & Horner, 2013; Wang & Dagli, 2011; Yaroker et al., 2013).

Table 2.1 Definition of Systems Thinking (Adapted from (Arnold & Wade, 2015; J. Boardman & Sauser, 2008; Jungthawan et al., 2019; Squires et al., 2011; Sterman, 2000, 2002))

Who	Definitions
Squires, Wande, Dominick, and Gelosh (Arnold & Wade, 2015; Squires et al., 2011)	Systems Thinking is the ability to think abstractly in order to: - incorporate multiple perspectives; - work within a space where the boundary or scope of problem or system may be "fuzzy"; - understand diverse operational contexts of the system; - identify inter- and intrarelationships and dependencies; - understand complex system behavior; and most important of all, - reliably predict the impact of the change on the system.
Richmond (Arnold & Wade, 2015)	Systems Thinking as the craftsmanship and investigation of making solid deductions about conduct by building up an inexorably profound comprehension of fundamental structure. He underlines that individuals grasping frameworks thinking position themselves with the end goal that they can see both the woodland and the trees; one eye on each.
Kopainsky, Alessi and Davidsen (Arnold & Wade, 2015)	Systems Thinking ought to incorporate thankfulness for long-haul arranging, response loops, non-straight connections among factors, and community-oriented arranging crosswise over territories of an association.
Forrester (Arnold & Wade, 2015)	Some utilization Systems Thinking to mean equivalent to Systems Dynamics. Systems Dynamics is coming to mean minimal more than systems about thinking, discussing systems, and recognizing that systems are critical. As it were, Systems Thinking infers a somewhat broad and shallow familiarity with systems.
Boardman and Sauser (J. Boardman & Sauser, 2008)	They perceived two imminent challenges for systems people. First, the tension established on behalf of a part (of a whole) to essentially belong to a whole, for that is its reason for being, while simultaneously being the part that it is (or the whole that it is), for that is why it was chosen or formed in the first place. The second challenge is related to the first and

Who	Definitions
	has to do with the term System of Systems (SoS). In this setting, the SoS would be considered the whole and the systems its parts.
Sweeney and Sterman (Arnold & Wade, 2015; Sterman, 2000, 2002)	The art of systems thinking includes the capacity to present and diagnosis dynamic complexity (e.g., conduct that emerges from the association of a systems's all the time), both alphabetical and graphically.
Hopper and Stave (Arnold & Wade, 2015)	Fortifying the requirement for a generally acknowledged definition, they state that the term systems thinking is utilized in an assortment of in some cases clashing ways. For instance, some systems engineer consider it to be the establishment of systems elements and additionally various different systems approaches; others see systems thinking as a subset of system dynamics.
Senge (Arnold & Wade, 2015)	Systems thinking as a discipline for seeing wholes and a framework for seeing interrelationships rather than things, for seeing patterns of change dynamically rather than static snapshots.

2.4 Thai Higher Education Systems (THES)

Thai education system is mapped and presented as Figure 2.5. It shows how a young child went to kindergarten for studying and passed to an elementary school ("Prathom" in Thai). After that, they can choose between two paths; a general path toward higher education and a vocational path. For the general path, the students would go to junior high school followed by high school ("Mathayom 1-6" in Thai).

If they choose a junior high school ("Mathayom 1-3"), they will study at a technical college or a senior high school ("Mathayom 4-6"). Council of University Presidents of Thailand (CUPT) officaially developed and launched the new entrance system called Thai University Central Admission System (TCAS) in 2018. TCAS solve the problem of students taking too many university entrance exams, as well as too much emphasis on tutoring schools. Thai students must pass TCAS examination to entrance in a public university or they can apply to

an open university that does not require one. Graduates at bachelor level work in a startup, small or medium enterprises, large corporates, or governmental instrumentalities.

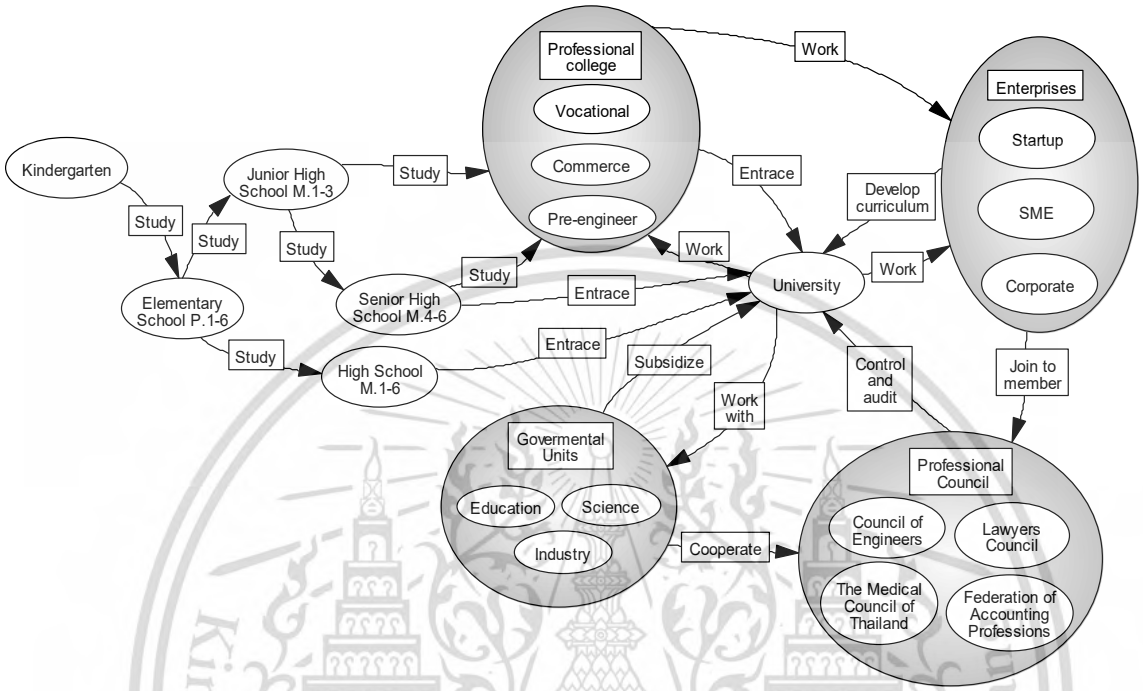

Figure 2.5 The THES (Jungthawan et al., 2019; Jungthawan & Tiyarattanachai, 2020a, 2020b)

2.5 Principles for Responsible Management Education (PRME)

Principles for Responsible Management Education (PRME) is a UN-supported initiative that was founded in 2007. Its aim is to raise the profile of sustainability in business schools around the world, and equip today's business students with the understanding and ability to deliver change for tomorrow.

The initiative is based on six principles that participating institutions commit to, which are:

Purpose: Develop the capabilities of students to be future generators of sustainable value for business and society at large and to work for an inclusive and sustainable global economy.

Values: Incorporate into academic activities and curricula the values of global social responsibility as portrayed in international initiatives such as the UN Global Compact.

Method: Create educational frameworks, materials, processes and environments that enable effective learning experiences for responsible leadership.

Research: Engage in conceptual and empirical research that advances our understanding about the role, dynamics, and impact of corporations in the creation of sustainable social, environmental and economic value.

Partnership: Interact with managers of business corporations to extend knowledge of their challenges in meeting social and environmental responsibilities and to explore jointly effective approaches to meeting these challenges.

Dialogue: Facilitate and support dialog and debate among educators, business, government, consumers, media, civil society organizations and other interested groups and stakeholders on critical issues related to global social responsibility and sustainability.

Business schools that are signatories to PRME are making a commitment to gradually but systematically transform their teaching, research, faculty, students, governance, and partnerships in line with these six principles.

2.6 University Ranking Systems (URS)

Higher education institutions have been ranked by many organizations: some are listed in Table 2.2 (Abramo & D'Angelo, 2015; Davis, 2016; Global University Network for Innovation (GUNI), 2019; Jöns & Hoyler, 2013; Lauder et al., 2015; Millot, 2015; Pavel, 2015; Reddy et al., 2016; Torres-samuel et al., 2019); they include research units, government, private companies and the popular press. These academic program rankings impact the institutions and their communities. There are about 33 university ranking institutions and systems worldwide, and only 9 system that are implemented green and SDGs metrics focus on SHE (Sonetti et al., 2016).

Nowadays, the leading 16 Thai universities use only THE Impact Rankings (THEIR), which apply to all the SDGs to their criteria in October 2019 (Times Higher Education, 2020). THEIR is the only one university ranking to be independently audited by professional services firm PricewaterhouseCoopers, and trusted worldwide by students, professor, governments and industry experts, in 2020's league table provides great insight into the shifting balance of power in global higher education.

There were a total of 1,396 universities ranked, some 11,554 scholars from 135 countries took part of THEWUR in 2019 (Times Higher Education, 2020). In 2020, there were been 16 Thai universities ranked in the THEWUR (Times Higher Education (THE), 2018). This ranking reflects the ability to research, generate results and publish papers that have been cited, as well as evidence of meeting the SDGs for the university.

Table 2.2 University Ranking Organizations (Abramo & D'Angelo, 2015; Davis, 2016; Global University Network for Innovation (GUNI), 2019; Jöns & Hoyler, 2013; Lauder et al., 2015; Millot, 2015; Pavel, 2015; Reddy et al., 2016; Torres-samuel et al., 2019)

URS	Developer	Website	SDGs Metrics
A National Report Card on Environmental Performance and Sustainability in Higher Education (National Wildlife Federation, 2008)	National Wildlife's Federation's State of the Campus Environment (SCE)	n/a	
Academic Ranking of World Universities (ARWU)	Shanghai Ranking Consultancy	shanghairanking.com	
Adaptable Model for Assessing Sustainability in Higher Education (AMAS) (Urquiza, 2013)	Pontificia Universidad Católica de Chile	n/a	
Alternative University Appraisal (AUA) (Dzulkifli Abdul Razak et al., 2013)	Hokkaido University and United Nations University	global.hokudai.ac.jp	/
Assessment of Higher Education Learning Outcomes (AHELO)	The Organisation for Economic Co-operation and Development (OECD)	oecd.org/site/ahelo	
Auditing Instrument for Sustainability in Higher Education (AISHE) (Pipjelink, 2011)	Dutch Foundation for Sustainable Higher Education	niko.roorda.nu	/
Business School Impact System (BSIS) (EFMD Global Network, 2014)	EFMD Global Network	efmdglobal.org/assessments/bsis	
Campus Sustainability Assessment Framework (CSAF) (Cole, 2003; Fadzil et al., 2012; Saadatian et al., 2011)	Linsay Cole, University of Victoria, Canada	n/a	
College Scorecard	Department of Education, U.S.	collegescorecard.ed.gov	
College Sustainability Report Card (CSRC) (Sustainable Endowments Institute, 2012)	Sustainable Endowments Institute	greenreportcard.org	/

URS	Developer	Website	SDGs Metrics
CSA Framework (Nixon, 2002)	Western Michigan University	n/a	
DPSEEA-Sustainability Index Model (D-SiM) (Waheed et al., 2011)	Waheed, Khan, and Veitch (2011)	n/a	
German Centre for Higher Education Development (CHE)	Centrum für Hochschulentwicklung (CHE), German	che.de	
Global Reporting Initiative's Sustainability Report	Global Reporting Initiative (GRI)	globalreporting.org	/
Good Company's Sustainable Pathways Toolkit (SPT) (Company, 2002)	University of Oregon	n/a	
Graphical Assessment of Sustainability in Universities (GASU) (Lozano, 2006)	Rodrigo Lozano, Cardiff University	n/a	
Graz Model of Integrative Development (GMID)	University of Graz, Austria	regional-centre-of-expertise.uni-graz.at/en/research/resources-downloads/graz-model-for-integrative-development	
IREG Observatory on Academic Ranking and Excellence	International Rankings Expert Group Observatory (IREG)	ireg-observatory.org	
Penn State Indicators Report (PENN) (Pennsylvania State University, 2000)	Pennsylvania State University	n/a	
People and Planet's University League (P&K)	People & Planet Student Activities Limited	peopleandplanet.org	/
QS World University Rankings (QSWUR)	QS Quacquarelli Symonds (QS)	qs.com	
Scimago Institutions Rankings (SIR)	Scimago Lab, SRG S.L.	scimagoir.com	
Sustainability Assessment of Food and Agriculture Systems (SAFA) (Food and Agriculture Organization of the United Nations, 2014)	Food and Agriculture Organization (FAO)	fao.org/nr/sustainability/sustainability-assessments-safa	/
Sustainability Assessment Questionnaire (SAQ) for Colleges and Universities (Association of University Leaders for a Sustainable Future, 2009)	Association of University Leaders for a Sustainable Future (ULSF)	ulsf.org/sustainability-assessment-questionnaire	
Sustainability Self-assessment Concept for Higher Education Institute	German Commission for UNESCO (DUK)	n/a	

URS	Developer	Website	SDGs Metrics
Sustainability Tool for Auditing for University Curricula in Higher Education	Rodrigo Lozano, University of Gävle, Sweden	n/a	
Sustainability Tracking, Assessment and Rating System (STARS) (Cole, 2003; Salvioni et al., 2017)	Association of the Advancement of Sustainability in Higher Education (AASHE)	stars.aashe.org	/
Three-dimensional University Ranking (TUR)	University of Maribor	n/a	
Times Higher Education Impact Rankings (THEIR)	Time Higher Education (THE)	timeshighereducation.com	/
UI Green Metric University Rankings	University of Indonesia, Indonesia	greenmetric.ui.ac.id	/
U-Multirank's approach to university rankings	U-Multirank	umultirank.org	
Unit-based Sustainability Assessment Tool (USAT) (Togo, 2008; Togo, Muchaiteye & Lotz-Sisitka, 2009)	United Nations Environment Programme (UNEP) and Rhodes University, South Africa	auc.org.uk/theplatform/usat_unit-based_sustainability_assessment_tool	
US News and World Report (USNWR)	U.S. News & World Report	usnews.com/rankings	
Webometrics	Cybermetrics Lab, the Consejo Superior de Investigaciones Científicas (CSIC), Spain	webometrics.info	

The data provided a list of different university ranking organizations, their developers, and related websites. In many cases, it also indicates whether or not the SDGs are factored into the rankings. We found that a few potential areas of analysis from Table 2.2 are as follow:

1) Presence of SDGs in Ranking Criteria: From this data, it appears that many ranking organizations do not explicitly include SDGs in their metrics. This could be an interesting point of analysis if it should be interested in how sustainability is being integrated (or not integrated) into assessments of higher education.

2) Diversity of Ranking Organizations: There is a wide range of organizations and institutions involved in developing these rankings, from academic institutions and professional organizations to government bodies and independent groups. This diversity might influence the priorities and methodologies of the different ranking systems.

3) Geographical Distribution: The ranking organizations and systems originate from various parts of the world. This could have implications for how global or region-specific considerations are integrated into the ranking criteria.

4) Diversity of Ranking Approaches: Each system likely has a unique methodology and set of criteria for their rankings. Some might focus more on academic performance and research output, while others may prioritize factors like environmental sustainability or social impact.

5) To conduct a more comprehensive analysis: it should delve into the methodologies and criteria used by each of these ranking systems in greater depth. It would also be interesting to compare their results, looking at how the same universities are ranked across different systems. This might illuminate interesting patterns or discrepancies.

Many ranking systems all over the world were reviewed. Most of them focused on academic performance, only 9 ranking systems out of 33 systems focused on sustainability aspects as presented in Table 1.

Table 2.3 University Ranking with Focus on Sustainability Aspects

University Ranking Systems	Abbreviation	Developer	SDGs
Alternative University Appraisal (Dzulkifli Abdul Razak et al., 2013)	AUA	Hokkaido University and United Nations University	/
Auditing Instrument for Sustainability in Higher Education (Pipjelink, 2011)	AISHE	Dutch Foundation for Sustainable Higher Education	/
College Sustainability Report Card (Sustainable Endowments Institute, 2012)	CSRC	Sustainable Endowments Institute	/
Global Reporting Initiative's Sustainability Report (Alonso-Almeida et al., 2014)	GRISR	Global Reporting Initiative (GRI)	/
People & Planet's University League (UK Green League) (Burmann et al., 2021; Jones, 2012, 2015)	P&P	People & Planet Student Activities Limited	/
Sustainability Assessment of Food and Agriculture Systems (Food and Agriculture Organization of the United Nations, 2014)	SAFA	Food and Agriculture Organization (FAO)	/
Sustainability Tracking, Assessment and Rating System (The Association for the Advancement of Sustainability in Higher Education, 2019)	STARS	Association of the Advancement of Sustainability in Higher Education (AASHE)	/

University Ranking Systems	Abbreviation	Developer	SDGs
*Times Higher Education Impact Rankings * (De la Poza et al., 2021; Lauder et al., 2015; Times Higher Education, 2019; Times Higher Education (THE), 2018)	THEIR	Time Higher Education (THE)	/
UI GreenMetric University Rankings (Tiyarattanachai & Hollmann, 2016; Universitas Indonesia, 2020)	UI GreenMetric	University of Indonesia, Indonesia	/

Alternative University Appraisal (AUA) was developed to evaluate and assess an institution's education for sustainable development by using an assessment tool. An AUA dialogue committee invited the institution to develop a sustainable plan and worked together with the institution's management team (Dzulkifli Abdul Razak et al., 2013).

The European Foundation for Quality Management designed an Auditing Instrument for Sustainability in Higher Education model (AISHE) to measure the level of sustainable development. The European universities have been working on the productive implementation of sustainable education. They had a list of criteria that affected their operation and ranking of sustainability (Pipjelink, 2011).

College Sustainability Report Card (CSRC) was designed for the evaluation of campus and endowment sustainability events at universities in the US and Canada. This report examined universities as the lens of sustainability. It aimed to provide accessible information and case studies for universities to learn from each other's experiences and establish more effective sustainability policies (Sustainable Endowments Institute, 2012).

Global Reporting Initiative's Sustainability Report (GRISR) has been widely used as a global standard for sustainability. GRISR has become a part of the framework for mandatory educational sustainability reporting in many countries. This standard was applied and set to communicate with internal and external stakeholders. The GRISR framework assessed the universities and the source of public information as environmental management and environmentally friendly service practices (Alonso-Almeida et al., 2014).

People & Planet's University League (P&P) was developed by People & Planet. in 2007. The universities are assessed against thirteen dimensions. Fifty percent of the score were input from the Higher Education Statistics Agency. The remaining scores are evaluated based on the evidences found by academia who review the university website and other publicly available information. This ranking system orders the universities in a list from best to worst (Burmann

et al., 2021; Jones, 2012). The results have been published in the popular weekly Times Higher Education Magazine since 2011 (Jones, 2015).

Sustainability Assessment of Food and Agriculture Systems (SAFA) was created by the Food and Agriculture Organization to assess sustainability as SAFA guideline version 3.0. The SAFA Tool guides users for mapping, contextualization, indicators, and reporting. SAFA helps the organization to evaluate itself and its internal communication about sustainability goals and performance (Food and Agriculture Organization of the United Nations, 2014).

Sustainability Tracking, Assessment, and Rating System (STAR) was created by the Association of the Advancement of Sustainability in Higher Education. STAR is a voluntary, self-reporting framework for helping higher education institutes track and measure their sustainability status. STAR was designed to provide a framework for understanding sustainability in all higher education sectors. They can compare across institutions using a common set of criteria and help an institution improve its sustainability (The Association for the Advancement of Sustainability in Higher Education, 2019).

UI GreenMetric University Rankings was initiated by the Universitas Indonesia (UI) in 2010. The UI GreenMetric measured institution sustainability efforts based on the framework of the environment, economy, and equity (Tiyarattanachai & Hollmann, 2016; Universitas Indonesia, 2020).

One of the most widely-recognized university rankings is the THE World University Rankings (THEWUR) (De la Poza et al., 2021; Lauder et al., 2015; Times Higher Education, 2019; Times Higher Education (THE), 2018). A total of 1,396 universities were ranked including 11,554 scholars from 135 countries in the THEWUR in 2019 (Times Higher Education, 2019). In 2020, a total of 768 universities from 85 nations including 16 Thai universities were ranked in the THE Impact Rankings (THEIR) designed to measure universities' impact on the UN SDGs in the context of HEIs (Times Higher Education (THE), 2018).

2.7 Times Higher Education Impact Rankings (THEIR)

THE launched the THE Impact Rankings (THEIR) in October 2018, which rank the performance and contribution of universities towards the SDGs (Times Higher Education (THE), 2018). The 2018 version (the first version) focused on 11 SDGs deemed more relevant to

university operations. The level of relevance of SDGs to universities is presented as Figure 2.6, THEIR except the SDGs have the level of relevance less than 30% as Goal 1: No Poverty, Goal 2: Zero Hunger, Goal 6: Clean Water and Sanitation, Goal 7: Affordable and Clean Energy, Goal 14: Life Below Water, and Goal 15 Life on Land.

In October 2019, THE launched the new version of THEIR, 2.0B 2019-0903, which then covered all 17 SDGs. THEIR encourage the universities to submit data for at least four SDGs, on of that must be SDG 17 – partnerships for the goals. The score calculation formula consists of the mandatory SDG 17, and the scores from the best three SDG scores as in Equation 1 (Times Higher Education (THE), 2018).

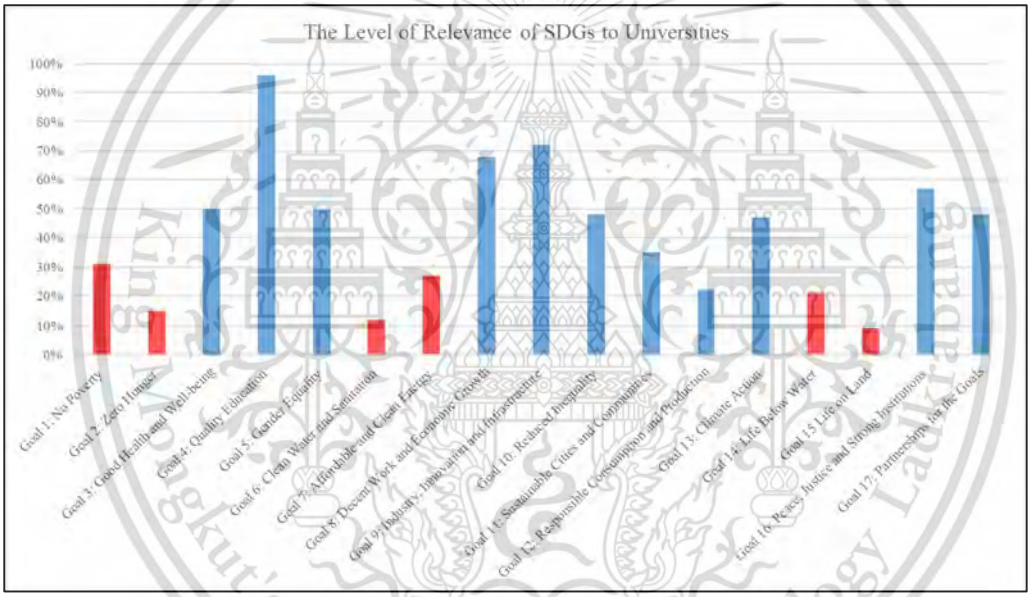

Figure 2.6 The Level of Relevance of SDGs to Universities (Jungthawan & Tiyarattanachai, 2020b, 2020a)

$$SDG\ 17 + SDG\ A + SDG\ B + SDG\ C = 100\% \quad (2.1)$$

And the weight of scores are in Equation 2 (Times Higher Education (THE), 2018).

$$(22\% * SDG\ 17) + 26\% * (SDG\ A + SDG\ B + SDG\ C) = 100\% \quad (2.2)$$

This method was designed to allow the universities to participate as widely as possible. The methodology was made flexible considering that different universities in different region

may have different priorities and statuses on the SDGs, and also different contexts. In Table 2.4, I reviewed the papers in the ScienceDirect's data base to explore the research for knowledge and gap for this research landscape.

Table 2.4 Literature Review of Papers

Author	Year	SD/SDG	HE/HEI/HES Education	Ranking/Rating / QA	Assessment Model	NGO	Systems Approach
Al-Rawahy (Al-Rawahy, 2013)	2013	/	/ Engineering				
Anand et. al. (Kaur Anand et al., 2015)	2015	/	/ Canada				
Annan-Diab and Molinari (Annan-diab & Molinari, 2017)	2017	/	/			/ UN PRME	
Barbier and Burgess (Barbier & Burgess, 2017)	2017	/			/ Quantitative assessment		/
Bastianoni et. al. (Bastianoni et al., 2019)	2018	/			/		/
Beddewela et. al. (Beddewela et al., 2017)	2017	/	/			/ UN PRME	
Benjaoran and Parinyakulset (Benjaoran & Parinyakulset, 2018)	2018	/	/ Suranaree University of Technology	/ UI GreenMetric			
Berzosa et. al. (Berzosa et al., 2017)	2017	/	/		/		
Bina et. al. (Bina et al., 2016)	2016		/ MA and MSc programs			/ UN DESD	
Borges et. al. (Cesar Borges et al., 2017)	2017	/	/ College of management				
Chen et. al. (Chen et al., 2018)	2018	/	/ Taiwan		/ Fuzzy Delphi, AHP		
Chin and Jacobsson (Chin & Jacobsson, 2016)	2016	/	/		/ Application		

Author	Year	SD/SDG	HE/HEI/HES Education	Ranking/Rating / QA	Assessment Model	NGO	Systems Approach
Cicmil et. al. (Cicmil et al., 2017)	2017	/	/			/	
D. Morse et. al. (Morse et al., 2018)	2018	/	/		/ HUBZero Software		
Dagiliute and Liobikiene (Dagiliute & Liobikiene, 2015)	2015	/	/				
Decamps et. al. (Barbat et al., 2017)	2017	/	/			/ UN PRME	
Dlouha and Pospisilova (Dlouhá & Pospíšilová, 2018)	2018	/	/ Czech		/ Online survey		
Duke and Hinzen (Duke & Hinzen, 2014)	2014	/	/	/			
Foo (Foo, 2013)	2013	/	/ Malaysia		/ Green University, EIA	/ NGO	
Freidenfelds et. al. (Freidenfelds et al., 2018)	2018	/	/	/ UI Green Metric			
G. Dyer and M. Dyer (Dyer & Dyer, 2017)	2017	/	/ America		/ 5 level framework		
Geng et. al. (Geng et al., 2013)	2013	/	/ Shenyang University, China		/ Integrated model		
Gorobets (Gorobets, 2008)	2008	/	/ Ukraine				
Haertle et. al. (Haertle et al., 2017)	2017		/			/ UN PRME	
Holm et. al. (Holm et al., 2015)	2015	/	/ China, Nordic countries	/	/ Surveys		
Hooi et. al. (Hooi et al., 2012)	2012	/	/ Malaysia		/ Green University		
Hoveskog et. al. (Hoveskog et al., 2018)	2018	/	/		/ Business		
Janowski (Janowski, 2015, 2016)	2016	/			/ Digital	/ Government	

Author	Year	SD/SDG	HE/HEI/HES Education	Ranking/Rating / QA	Assessment Model	NGO	Systems Approach
Kecetep and Ozkan (Keçetep & Özkan, 2014)	2013		/ European	/	/		
Kolb et. al. (Kolb et al., 2017)	2017	/	/ Business school		/		
Koscielniak (Koscielniak, 2014)	2014	/	/ Poland		/ Sustainable University		
Lauder et. al. (Lauder et al., 2015)	2015	/	/	/ UI Green Metric, GREENSHIP, STARS	/ UI Green Metric, GREENSHIP, STARS		
Nowotny et. al. (Nowotny et al., 2018)	2018		/				
Nuttle and Bouwer (Nuttle & Bouwer, 2009)	2009	/	/		/ Qualitative reasoning models		
Palacin-Silva et. al. (Palacin-Silva et al., 2018)	2017	/	/				
Pavel (Pavel, 2015)	2015		/ Tops 20 universities	/ ARWU, QS, THE	/ Statistical tools		
Perez-Esparrellsa and Orduna-Malea (P. E. Carmen & Enrique, 2018)	2018		/ Technical university	/ THE	/ Statistical tools		
R. Khalili et. al. (Khalili et al., 2015)	2015	/	/ Americas and China		/ Questionnaire		
Ragazzi and Ghidini (Ragazzi & Ghidini, 2017)	2017	/	/	/ UI Green Ranking	/ Questionnaire		
Richter et. al. (Richter et al., 2017)	2017	/	/ Early childhood				
Roos (Roos, 2017)	2017	/	/			/ UN PRME	
Rosati and Faria (Rosati & Faria, 2019)	2019	/	/ 90 countries		/ Country level analysis		

Author	Year	SD/SDG	HE/HEI/HES Education	Ranking/Rating / QA	Assessment Model	NGO	Systems Approach
Salvia et. al. (Amanda Lange, Salvia et al., 2019)	2019	/	/		/ Snowball sampling survey		
Storey et. al. (Storey et al., 2017)	2017	/	/			/ UN PRME	
Stough et. al. (Stough et al., 2018)	2018	/	/ Katholieke Universiteit Leuven		/ ECTS, Sustainability assessment		
Watson et. al. (Watson et al., 2013)	2013	/	/ Georgia Institute of Technology		/ STAUNCH		
*** Jungthawan	2023	/	/ Thailand	/ THE	/ Online survey and Statistical Tools	/	/

The essence of the literature review conducted in this research highlights the extensive variety of URS developed by different institutions and researchers worldwide. This diversity underpins the complexity of assessing universities, considering their various priorities, statuses, and commitments to the SDGs. The flexibility of the methodologies proposed in these URS is a crucial aspect, acknowledging the contrasting contexts and resources of universities globally.

In this study, a comprehensive analysis of the existing literature from ScienceDirect's database was conducted. Various papers were assessed to uncover potential knowledge gaps and opportunities for further research within the study landscape.

One of the key findings was that many ranking systems have been created independently by different institutions and organizations. Notably, these URS often differ in their methodologies and assessment criteria, reflecting the unique perspectives and priorities of their respective developers.

Some ranking systems are focused more on specific areas of sustainability, such as the environment, while others provide a more holistic view of university performance. For example, the UI Green Metric ranks universities based on their commitment to environmental

sustainability, while the QS World University Rankings employ a more comprehensive set of metrics.

Moreover, several papers reviewed in the study incorporated systems approach to assessing HEIs. However, the actual use of the systems approach was somewhat varied. For instance, some papers proposed complex integrated models for sustainability assessment, while others utilized more traditional survey and statistical tools.

In terms of geographical focus, the reviewed papers covered a wide array of countries and regions, reflecting the global interest in sustainability and the role of higher education in promoting the SDGs.

Overall, the literature review reveals an active and evolving research landscape focused on the development and refinement of URS. The significant variation among the methodologies and focuses of different ranking systems suggests there is room for further research and potential convergence on best practices.

Chapter 3

Research Methodology

This chapter outlines the research methodology used to gather data for this study. The survey was conducted across 16 universities in Thailand that are integral to this research. In the following sections, this chapter will detail the specific methods used to collect and analyze the data, including the design of the survey, the sample selection, data collection process, and methods of analysis. This chapter will also address ethical considerations related to the research and strategies used to ensure the validity and reliability of the findings.

3.1 Study Area

The focus of this research is a survey conducted across 16 universities in Thailand. These universities, listed in Table 3.1, were selected based on their ranking in the THEWUR 2019 (Times Higher Education, 2020). The choice of these universities is predicated on their demonstrated focus on sustainability in higher education, along with their reputation for delivering quality education.

Table 3.1 The 16 Pioneer Thai Universities Ranked in the 2019 THE World University Rankings

Rank	Name	Overall	Teaching	Research	Citations	Industry Income	International Outlook
601–800	Mae Fah Luang University	28.3–35.2	14.4	9.0	74.4	34.5	50.6
601–800	Mahidol University	28.3–35.2	31.6	21.0	45.2	73.4	46.1
801–1000	Chulalongkorn University	22.2–28.2	31.5	21.7	22.2	64.8	37.8
1001+	Chiang Mai University	10.7–22.1	20.8	14.2	18.0	48.6	32.8
1001+	Kasetsart University	10.7–22.1	18.6	12.8	10.3	59.8	37.1
1001+	Khon Kaen University	10.7–22.1	21.6	12.0	18.0	55.2	31.1
1001+	King Mongkut's Institute of Technology Ladkrabang	10.7–22.1	17.8	19.5	6.7	82.0	19.6
1001+	King Mongkut's University of Technology North Bangkok	10.7–22.1	15.1	9.9	10.1	41.9	20.9
1001+	King Mongkut's University of Technology Thonburi	10.7–22.1	17.3	16.7	23.6	74.0	29.2
1001+	Mahasarakham University	10.7–22.1	18.5	8.0	11.0	35.5	26.1
1001+	Naresuan University	10.7–22.1	16.7	7.8	12.6	34.9	35.9
1001+	Prince of Songkla University	10.7–22.1	18.1	10.1	17.6	35.4	32.6
1001+	Silpakorn University	10.7–22.1	15.5	8.3	13.6	39.9	27.5
1001+	Srinakharinwirot University	10.7–22.1	19.9	8.4	12.6	40.6	20.9
1001+	Suranaree University of Technology	10.7–22.1	19.7	12.3	27.0	44.5	32.1
1001+	Thammasat University	10.7–22.1	18.6	11.7	11.7	38.9	34.4

Reference. Thai THE World University Rankings, 2019 www.timeshighereducation.com

3.2 Study Population

The population for this study was divided into two primary groups from each university listed in Table 3.1; lecturers and students. The sampling strategy was designed to encapsulate a broad view of the university community and capture diverse perspectives on sustainability. From each university, 3 lecturers and 22 students were selected to participate in the survey, yielding a total of 400 responses. The respondents were chosen to be representative of the various faculties and academic levels at their respective universities, ensuring a wide range of insights.

The sample size was determined based on Taro Yamane's formula (Yamane, 1973), which provides a simplified means to calculate a sample size. Yamane's formula allows for a confidence level of 95%, with a margin of error of ±5%, leading to a suitable sample size for a population of this scale in Table 3.2.

The selection of lecturers and students was carefully done, considering several factors such as their experience, their fields of study, and their involvement with sustainability initiatives at their universities. This targeted approach was designed to provide an in-depth understanding of sustainability efforts and perceptions within Thai higher education institutions.

Furthermore, to ensure the consistency of responses, all participants were provided with the same set of instructions for the survey. The questionnaire included both closed-ended and open-ended questions to collect quantitative data and qualitative insights. In Equation 3.1, it is the Taro Yamane's formula.

$$\text{Formula } n = \frac{N}{1+Ne^2} \quad (3.1)$$

When n = sample size

N = population size from 16 universities

e = error in this research uses 0.05, sample size and error reference from Table 3.2.

Table 3.2 Population, Sample Size and Error Based on Taro Yamane

Population (N)	Sample size by error					
	±1%	±2%	±3%	±4%	±5%	±10%
500					222	83
1,000				385	286	91
2,000			714	476	333	95
3,000		1,364	811	517	353	97
4,000		1,538	870	541	364	98
5,000		1,667	909	556	370	98
6,000		1,765	938	566	375	98
7,000		1,842	959	574	378	99
8,000		1,905	976	580	381	99
9,000		1,957	989	584	383	99
10,000	5,000	2,000	1,000	588	385	99
20,000	6,667	2,222	1,053	606	392	100
50,000		2,381	1,087	617	397	100
100,000		2,439	1,099	621	398	100
∞		2,500	1,111	625	***400**	100

3.3 Questionnaire Design

The questionnaire was meticulously designed to comprehensively address the research objectives. Its structure and content were influenced by several sources, including the UN SDGs (Sachs et al., 2020; United Nations, 2016), the THEIR (Times Higher Education (THE), 2019; Times Higher Education, 2020), and relevant literature, research, and theories pertaining to sustainability in HEIs. Given the demographic of respondents, the questionnaire was provided in Thai to ensure full comprehension and accurate responses.

The questionnaire comprised of 149 questions, divided into three distinct sections. These sections encompassed both quantitative and qualitative inquiries, promoting a comprehensive exploration of the subjects' perceptions and attitudes. The structure aimed to extract insights on general demographic information, awareness of SDGs (considered as the "X

Factors" or independent variables), and perceptions on policies related to Sustainable Higher Education (SHE) (considered as the "Y Factors" or dependent variables).

Section I: General Information

This introductory section comprised of 10 questions aimed at gathering demographic information about the respondents. Data such as the respondent's name, university affiliation, address, department, faculty, position, professional experience, gender, age, and income were collected. These data provided context to the responses, allowing for a nuanced analysis of different demographic groups' perspectives on SHE.

Section II: Awareness Towards SDGs

The second part of the questionnaire contained 70 questions geared towards understanding respondents' awareness of the SDGs. The SDGs, being global initiatives, play an important role in shaping sustainability measures at THEIs. This section aimed to gauge the respondents' understanding, knowledge, and importance they attribute to these global goals within their academic environment.

Section III: Perceptions on Policy Related to SHE

The final section comprised 69 questions targeting the respondents' perception of, and priorities concerning, different policies related to SHE. This section delved deeper into understanding how the participants perceive current policies, what they consider effective, and where they believe improvements can be made. This section's data can provide a roadmap for policy alterations to better align with the sustainability goals of the higher education community.

Each section and question were designed with the goal of extracting the most useful and actionable data to guide future policy-making in the realm of sustainable higher education. By understanding the current awareness levels and policy perceptions, steps can be taken to improve sustainability initiatives across THEIs.

Figure 3.1 Sections of the SDGs Questionnaire

The questionnaire was designed to establish the relationship between awareness towards SDGs (referred to as SDG-X) and perceptions on policy related SHE (referred to as SDG-Y), using the Structural Equation Modeling (SEM) method. Figure 3.2 illustrates the conceptual model, which examines the underlying factors and relationships derived from the responses.

The arrows depicted in the figure signify the directional relationships between the latent variables (SDG-X and SDG-Y) and the manifest variables (the specific questions in the questionnaire). For instance, SDG-X1 represents an overall measure of awareness towards SDGs, while SDG-X1.1, SDG-X1.2, and SDG-X1.3 denote specific sub-factors within SDG-X. Similarly, SDG-Y1 captures the general perception of policies related to SHE, while SDG-Y1.1, SDG-Y1.2, and SDG-Y1.3 represent distinct aspects of policy perception within SDG-Y.

Using SEM, the measurements of the manifest variables are related to the latent variables through these directional arrows. For example, the responses to questions in the questionnaire related to SDG-X1 (awareness towards SDGs) are considered indicators of the latent variable. Similarly, the responses to questions related to SDG-X1.1, SDG-X1.2, and SDG-X1.3 contribute to the overall assessment of SDG-X.

By employing SEM, this research aims to uncover the underlying factors driving awareness towards SDGs (SDG-X) and perceptions on policy related to SHE (SDG-Y) among the participants. The analysis will allow for a comprehensive examination of the relationships and interdependencies between these factors, shedding light on the complex dynamics within the higher education community regarding sustainable development.

The utilization of SEM in this study ensures a robust statistical approach to analyze the data collected through the questionnaire. It enables the exploration of the latent variables and their influence on the observed responses, providing a more comprehensive understanding of the relationship between awareness of SDGs and perceptions on SHE policies.

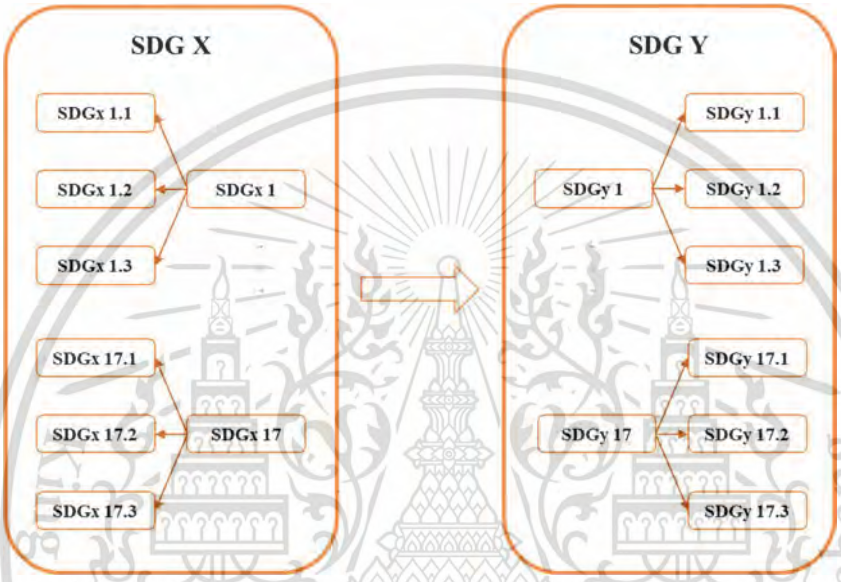

Figure 3.2 Structure and Relation of the SDG-X and SDG-Y Factors (Jungthawan & Tiyarattanachai, 2020b, 2020a)

The drafted questionnaire underwent a thorough process of validity and reliability checks to ensure its robustness and accuracy.

3.3.1 Content Validity

To assess the content validity of the questionnaire, an index of item objective congruence (IOC) was utilized. Five domain experts, whose expertise is listed in Table A2.1, were selected to validate the questionnaire using the IOC method. The IOC method, developed by Rovinelli and Hambleton (1976) (Rovinelli & Hambleton, 1976), is widely used in test development to evaluate content validity during the questionnaire design stage.

In the IOC assessment, a value greater than 0.6 is considered indicative of good content validity. Ideally, the IOC should fall within the range of 0.60 to 1.00, indicating a high level of validity and reliability of the questionnaire (C. Turner & Carlson, 2003).

By involving domain experts in the validation process, the questionnaire underwent rigorous scrutiny, ensuring that the items accurately captured the relevant constructs related to awareness of SDGs (SDG-X) and perceptions on policy related to SHE (SDG-Y). The experts assessed the items for their relevance, clarity, and alignment with the research objectives, contributing to the overall validity of the questionnaire.

3.3.2 Discrimination Power of the Items

The discrimination power of the questionnaire items was also assessed to determine whether the questions effectively distinguished between different levels of respondents' perceptions and awareness. The corrected item-total correlation, a measure of discrimination, was calculated based on a trial sample of 50 respondents, as shown in Tables 3.3 and 3.4.

The corrected item-total correlation values ranged from 0.311 to 0.890. These correlation values indicate the degree to which the individual items in the questionnaire are interrelated and contribute to the overall construct being measured. Higher correlation values suggest stronger discrimination and a better ability of the items to differentiate between respondents' varying perceptions and awareness levels.

The discrimination power assessment confirms that the questionnaire items were constructed to capture the intended constructs effectively. The range of correlation values demonstrates that the items collectively contribute to a comprehensive measurement of awareness of SDGs (SDG-X) and perceptions on policy related to SHE (SDG-Y), enhancing the validity and reliability of the questionnaire.

These validity and reliability checks ensure that the questionnaire used in this research is a valid and reliable tool for measuring the constructs of interest. By employing these rigorous procedures, the questionnaire's soundness has been established, providing confidence in the accuracy and precision of the data collected from the respondents.

Table 3.3 The Corrected Item-Total Correlation of SDG-X factors

SDGs (Cronbach's Alpha = 0.992)	**Corrected Item-Total Correlation (Discrimination)**			
	SDGx	***SDGx.1***	***SDGx.2***	***SDGx.3***
SDG 1: No Poverty	0.458	0.392	0.342	0.418
SDG 2: Zero Hunger	0.462	0.491	0.517	0.391
SDG 3: Good Health and Well-being	0.586	0.523	0.581	0.311
SDG 4: Quality education	0.534	0.564	0.722	0.646
SDG 5: Gender Equality	0.702	0.623	0.750	0.739
SDG 6: Clean Water and Sanitation	0.789	0.783	0.850	0.767
SDG 7: Affordable and Clean Energy	0.761	0.890	0.875	0.816
SDG 8: Decent Work and Economic Growth	0.760	0.842	0.825	0.758
SDG 9: Industry, Innovation, and Infrastructure	0.716	0.840	0.827	0.784
SDG 10: Reduced Inequalities	0.751	0.861	0.772	0.733
SDG 11: Sustainable Cities and Communities	0.784	0.735	0.785	0.826
SDG 12: Responsible Consumption and Production	0.817	0.789	0.782	0.774
SDG 13: Climate Action	0.786	0.726	0.820	0.871
SDG 14: Life Below Water	0.788	0.782	0.791	0.819
SDG 15: Life on Land	0.777	0.763	0.692	0.767
SDG 16: Peace, Justice and Strong Institutions	0.783	0.797	0.613	0.649
SDG 17: Partnerships for the Goals	0.768	0.714	0.733	0.720

Table 3.4 The Corrected Item-Total Correlation of SDG-Y factors

SDGs (Cronbach's Alpha = 0.992)	Corrected Item-Total Correlation (Discrimination)			
	SDGy	*SDGy.1*	*SDGy.2*	*SDGy.3*
SDG 1: No Poverty	0.676	0.811	0.673	0.590
SDG 2: Zero Hunger	0.768	0.719	0.730	0.713
SDG 3: Good Health and Well-being	0.792	0.720	0.684	0.499
SDG 4: Quality education	0.722	0.711	0.600	0.617
SDG 5: Gender Equality	0.695	0.651	0.700	0.720
SDG 6: Clean Water and Sanitation	0.824	0.725	0.557	0.679
SDG 7: Affordable and Clean Energy	0.713	0.628	0.770	0.711
SDG 8: Decent Work and Economic Growth	0.738	0.505	0.599	0.728
SDG 9: Industry, Innovation, and Infrastructure	0.753	0.659	0.619	0.676
SDG 10: Reduced Inequalities	0.743	0.803	0.585	0.687
SDG 11: Sustainable Cities and Communities	0.723	0.662	0.604	0.564
SDG 12: Responsible Consumption and Production	0.775	0.739	0.697	0.631
SDG 13: Climate Action	0.757	0.604	0.577	0.655
SDG 14: Life Below Water	0.749	0.617	0.636	0.727
SDG 15: Life on Land	0.755	0.698	0.595	0.679
SDG 16: Peace, Justice and Strong Institutions	0.732	0.690	0.683	0.485
SDG 17: Partnerships for the Goals	0.705	0.622	0.698	0.549

3.3.3 Reliability Assessment

To ensure the reliability of the questionnaire, Cronbach's alpha was calculated. Cronbach's alpha is a commonly used measure of internal consistency and reliability. It assesses how closely related a set of items is as a composite measure, with values ranging from 0 to 1. A Cronbach's alpha value greater than 0.60 is generally considered acceptable (Cronbach, 1951; Tavakol & Dennick, 2011).

The reliability analysis was performed using the Analyze > Scale > Reliability Analysis function in IBM SPSS Statistics 20. The obtained Cronbach's alpha for the assessment tool was found to be 0.992. This high value indicates a strong internal consistency among the items in

the questionnaire, suggesting that they collectively measure the intended constructs of awareness of SDGs (SDG-X) and perceptions on policy related to SHE (SDG-Y) reliably.

The interconnectedness of the X factors and Y factors in the questionnaire serves to establish a balanced relationship between the demands of the community and the supply of SDGs policies within the THEIs. By exploring the relationships between these factors, this study aims to promote alignment with the 17 SDGs, enabling THEIs to collectively move in the same direction towards sustainability.

The results obtained from the analysis of the questionnaire are expected to provide valuable insights for Thai university executives. The findings can be utilized to optimize resource allocation, ensuring that investments are directed towards achieving better sustainability performance in line with the 17 SDGs. The study's outcomes have the potential to guide decision-making processes and drive THEIs towards a more sustainable future.

Overall, the reliability assessment confirms the robustness and consistency of the questionnaire. With a high Cronbach's alpha value and the interconnectedness of the X and Y factors, this research instrument is well-positioned to capture the perceptions, awareness, and policy-related aspects necessary for studying sustainability in higher education institutions effectively

3.4 Data Collection

The data collection process for this research involved administering the questionnaire through an online platform using Google Forms. The questionnaire was distributed to the participants in a randomized manner, with the quota sampling method employed to ensure representation from each university.

Each university contributed 22 student responses and 3 lecturer responses, resulting in a total sample size calculation as follows:

Total sample size = (22 students x 16 universities) + (3 lecturers x 16 universities)

= 352 + 48

= 400 responses

The use of quota sampling ensured that an adequate number of participants from each university were included in the study, allowing for a representative sample that reflects the diverse perspectives within the THEIs.

By leveraging an online platform for data collection, participants were provided with a convenient and accessible means to complete the questionnaire. The use of technology facilitated the efficient collection of data from a larger number of participants, enhancing the overall reliability and generalizability of the research findings.

The sample size of 400 responses provides a robust dataset for analysis, enabling the exploration of the relationships between awareness towards SDGs (SDG-X) and perceptions on policy related to SHE (SDG-Y) among students and lecturers in the 16 selected Thai universities.

The data collected through the questionnaire will serve as the foundation for conducting statistical analyses and exploring the research objectives and hypotheses. The insights gained from this data will contribute to a comprehensive understanding of the factors influencing sustainability in THEIs and inform recommendations for policy development and implementation.

Overall, the data collection process was designed to ensure a representative sample and a sufficient number of responses, providing a solid basis for analyzing and drawing meaningful conclusions from the study.

3.5 Data Analysis

Once the data collection phase was completed, the collected data was subjected to rigorous statistical analysis to uncover meaningful insights and address the research objectives. Two main types of statistical analysis were conducted:

3.5.1 Descriptive Statistics

Descriptive statistics were utilized to summarize and present the collected data in a clear and concise manner. Various statistical measures such as frequency tables, charts, graphs, histograms, means, minimum and maximum values, standard deviations, skewness, and kurtosis were employed to provide a comprehensive overview of the data. These

descriptive statistics allowed for a better understanding of the distribution, central tendency, and variability of the variables under investigation.

The use of descriptive statistics facilitated the exploration of the characteristics and patterns within the data, providing valuable insights into the awareness of SDGs (SDG-X) and perceptions on policy related to SHE (SDG-Y) among the participants. By presenting the data in an organized and visual format, the descriptive statistics aided in identifying key trends, variations, and potential outliers within the dataset.

3.5.2 Inferential Statistics

Inferential statistics were employed to make inferences and draw conclusions beyond the collected sample to the larger population. These statistical techniques involved the utilization of sample data to estimate population parameters, hypothesis testing, and examining relationships among variables.

A range of inferential statistical methods was applied, including t-tests, z-tests, Chi-square tests, Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA), correlation analysis, factor analysis, and path analysis. These techniques allowed for deeper analysis and investigation of the relationships and associations between the variables of interest.

Through inferential statistics, the study aimed to determine the significance of relationships, identify differences among groups, and explore the underlying factors and pathways related to awareness of SDGs and policy perceptions in THEIs. The findings derived from these analyses would provide a robust understanding of the factors influencing SHE and support the formulation of informed recommendations.

By employing both descriptive and inferential statistics, this research ensured a comprehensive and rigorous analysis of the collected data. These statistical methods provided the necessary tools to examine the research questions, test hypotheses, and gain valuable insights into the awareness and perceptions of students and lecturers regarding SDGs and sustainability policies in THEIs.

3.5.3 Analytical Approaches and Techniques

Confirmatory Factor Analysis (CFA): CFA is employed to test and verify the measurement of the factors' structure and model fitting. It helps determine whether the respondents' data can be effectively represented by SEM. In this study, CFA was conducted

based on the 17 SDGs. The goodness of fit of the model is assessed using criteria such as the chi-square to degrees of freedom ratio ($\chi 2/df < 3$), Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residual (RMR) (< 1), and goodness-of-fit indices (GFI, CFI, NFI) ranging from 0.90 to 1 (Hair Jr. et al., 2010; Hooper et al., 2008; Mueller & Hancook, 2001).

Structural Equation Modeling (SEM): SEM is a statistical technique used to define the factors representing the means, variances, and covariances of the studied data. It helps structure the parameters into a pictorial model and equations. SEM is a powerful tool for testing and evaluating the model and the influences of the factors. It is widely applied in various fields, including behavior, business, and education (Fan et al., 1999; Hooper et al., 2008).

Data Interpretation: The results of the questionnaire are analyzed using descriptive statistics and inferential statistics. Descriptive statistics provide summaries and measures of the data, such as mean, variance, and standard deviation. Inferential statistics include hypothesis testing methods such as t-tests, z-tests, chi-square tests, analysis of variance (ANOVA), analysis of covariance (ANCOVA), correlation analysis, factor analysis, and path analysis. These statistical tools help interpret the data, identify patterns, and understand the relationships between variables.

The findings from these statistical analyses can be used to identify and prioritize stakeholders' demands, explore the interconnections between the SDGs, and inform the design and implementation of policies based on the identified SDG factors (SDG-X) and stakeholder perceptions (SDG-Y).

3.6 Research Framework

The research framework for this study, as depicted in Figure 3.3, guided the step-by-step approach taken to investigate the factors influencing awareness and perceptions of SDGs among students and lecturers in THEIs. The framework involved the following key steps.

Figure 3.3 Research Framework (Jungthawan & Tiyarattanachai, 2020b, 2020a)

Step 1: Determining the Sample Size

The sample size for this study was determined to be at least 400 individuals. This calculation was conducted using Yamane's formula (Yamane, 1973), which took into account the desired level of precision and confidence in the findings. The sample was divided into two groups: 340 students and 60 lecturers.

Step 2: Literature Review and Questionnaire Development

A comprehensive literature review was conducted to identify gaps in the existing research on SDGs in THEIs. Keywords such as HEIs, SDGs, SHE, THEI, and THEIR were used to search for relevant literature. This literature review served as the foundation for questionnaire development.

The questionnaire was carefully designed as an assessment tool to capture information related to SDGs and THEIR criteria. It incorporated insights from the literature review and the specific objectives of the study outlined in Chapter 1. The questionnaire, as discussed in Section 3.3, consisted of three sections: General Information, Awareness towards SDGs (SDG-X), and Perceptions on Policy related to SHE (SDG-Y).

Step 3: Questionnaire Analysis

The collected responses from the questionnaire were subjected to thorough analysis. The aim was to examine and understand the community needs and demands in relation to SDG policy implementation. Statistical tools and techniques, including both descriptive and inferential statistics, were employed to extract valuable insights from the data.

Through this analysis, the study sought to identify patterns, trends, and associations in the responses, shedding light on the levels of awareness and perceptions regarding SDGs among the participants. The findings from this analysis served as a basis for formulating SDG policies that would effectively address the identified needs and demands of the community.

Step 4: Leveraged SDG Policies

To further refine and prioritize the leveraged SDG policies for THEIs, a focus group was established. This group consisted of members from the academic management team and other staff members of THEIs. The focus group served as a platform for in-depth discussions, allowing for the exchange of ideas, perspectives, and insights.

The focus group discussions aimed to achieve consensus and alignment among the participants regarding the leveraged SDG policies that should be formulated and implemented within THEIs. The input and recommendations derived from these discussions played a vital role in shaping the final leveraged SDG policies, ensuring their relevance, practicality, and effectiveness.

By following this research framework, the study aimed to comprehensively explore and address the factors influencing SDG awareness and policy perceptions in THEIs. The framework provided a systematic and structured approach that integrated literature review, questionnaire analysis, and focus group discussions to inform the development of evidence-based leveraged SDG policies for THEIs.

Overall, this research framework ensured a robust and rigorous methodology, guiding the research process towards generating valuable insights and contributing to the sustainable development agenda in THEIs.

Chapter 4

Results and Discussion

This chapter aims to present a detailed analysis of the collected data, discuss the implications of the findings, and offer insights into the research topic of sustainability in THEIs. I delved into the key findings derived from the statistical analysis conducted on the collected data. These findings shed light on various aspects related to the stakeholders' awareness towards the SDGs (SDG-X) and their perceptions on SDG policy factors related to sustainability in THEIs (SDG-Y). The results provide valuable insights into the level of awareness, the relationships between SDG-X and SDG-Y factors, and the factors that significantly influence stakeholders' perceptions and priorities.

Furthermore, the discussion portion will go beyond presenting the findings by offering a comprehensive analysis and interpretation of the results. We would explore the implications of the findings within the context of the research topic, drawing connections to existing literature and theoretical frameworks. The discussions would also address any discrepancies, unexpected outcomes, or limitations of the study, providing a nuanced understanding of the research findings.

By thoroughly examining and discussing the results, this section aims to contribute to the broader understanding of sustainability in THEIs. It provides valuable insights for executive management, university administrators, and other stakeholders who seek to enhance sustainability practices and policies within higher education settings.

4.1 Institutions of the Respondents

The institutions from which the respondents were selected play a crucial role in understanding the representation and diversity of the sample. Table 4.1 provides a comprehensive summary of the samples collected in this study, presenting the distribution of respondents across the targeted THEIs.

In total, the study gathered data from 16 universities, encompassing a wide range of educational institutions in Thailand. These universities were selected based on their relevance

to the research topic and their commitment to sustainability in higher education. The sample consisted of 552 respondents, including 59 staff members and 493 students.

The inclusion of both staff and student respondents allows for a comprehensive exploration of perspectives and insights from different stakeholders within the higher education system. The staff members, with their expertise and experience, bring valuable insights into the implementation of sustainability policies and practices within the institutions. On the other hand, the students, as the primary beneficiaries of higher education, provide valuable perspectives on their awareness, perceptions, and expectations regarding sustainable development goals and policies.

By collecting data from a diverse range of institutions, this study aimed to capture a broad spectrum of perspectives and experiences within the higher education landscape. This approach ensures that the findings and conclusions drawn from the analysis are representative and reflective of the overall higher education context in Thailand. The inclusion of multiple institutions strengthens the generalizability and validity of the research outcomes, enabling broader implications and recommendations for sustainability initiatives in higher education institutions.

Table 4.1 Summary of Study Population and Sampling Population

THEI	Abbreviation	Population	Sample Size		
			Lecturer	Student	Total
Chiang Mai University	CMU	38,101	3	24	27
Chulalongkorn University	CU	44,896	2	26	28
Kasetsart University	KU	68,215	5	24	29
Khon Kaen University	KKU	34,740	3	24	27
King Mongkut's Institute of Technology Ladkrabang	KMITL	24,640	4	68	72
King Mongkut's University of Technology Thonburi	KMUTT	16,129	4	28	32
King Mongkut's University of Technology North Bangkok	KMUTNB	28,005	4	82	86
Mae Fah Luang University	MFU	14,636	6	26	32
Mahasarakham University	MSU	44,296	3	23	26
Mahidol University	MU	30,996	4	23	27
Naresuan University	NU	23,030	5	25	30
Prince of Songkla University	PSU	40,103	5	25	30
Silpakorn University	SU	27,044	3	23	26
Srinakharinwirot University	SWU	24,679	3	23	26
Suranaree University of Technology	SUT	18,167	2	25	27
Thammasat University	TU	43,673	3	24	27
Total		**430,105**	**59**	**493**	***552**

*Confidence level set in this study was at 95% and P = 0.05 (Yamane, 1973).

4.2 Demography of the Respondents

Table 4.2 provides the demographic characteristics of the respondents in terms of gender and position. It presents the frequency and percentage distribution of the respondents within each category.

The first column of the table, "Gender," categorizes the respondents based on their gender identity. The table shows that out of the total sample size of 552 respondents, 215 (38.9%) identified as male, 278 (50.4%) identified as female, 37 (6.7%) identified as LGBTQ, and 22 (4.0%) did not provide a response regarding their gender identity.

The second column, "Position," categorizes the respondents based on their educational status or professional role. The table indicates that among the respondents, 418 (75.7%) were bachelor's degree students, 45 (8.2%) were master's degree students, 28 (5.1%) were doctoral students, 5 (0.9%) held positions such as president, vice president, or assistant president, 15 (2.7%) held positions such as dean, deputy dean, director, or head of department, 40 (7.2%) were lecturers, and 1 (0.2%) did not provide a response regarding their position.

The table provides an overview of the distribution of respondents across different gender identities and positions. This information is essential for understanding the demographic composition of the sample and considering potential variations in perspectives and experiences among different groups. It allows for a more comprehensive analysis of the data and enables the identification of any patterns or trends that may emerge based on these demographic factors.

Table 4.2 Demographic Characteristics of the Respondents

General Data (n = 552)	Frequency	Percent
Gender		
Male	215	38.9
Female	278	50.4
LGBTQ	37	6.7
No response	22	4.0
Position		
Bachelor's degree student	418	75.7
Master's degree student	45	8.2
Doctorate student	28	5.1
President, vice president, assistant president	5	0.9
Dean, deputy dean, director, head of department	15	2.7
Lecturer	40	7.2
No response	1	0.2

4.3 Relationships between SDG-X and SDG-Y

In this study, the relationships between SDG-X (stakeholders' awareness towards the UN SDGs) and SDG-Y (the criteria set in the THEIR guideline) were examined using CFA and SEM. The analysis was conducted using the LISREL SEM software to assess the model fit and validate the relationships between the variables.

The results of the CFA indicated a good model fit with the following statistics: Chi-square ($\chi 2$) = 636.67, Degrees of Freedom (df) = 182, p-value = 0.000, $\chi 2/df$ = 3.498, RMSEA = 0.067, RMR = 0.030, GFI = 0.93, and CFI = 1.00. These statistics met the required thresholds for a well-fitting model (Hair Jr. et al., 2010; Hooper et al., 2008; Mueller & Hancook, 2001).

To assess the strength of the relationships between SDG-X and SDG-Y, the Direct Effect (DE) values were examined. A positive DE value indicates a direct positive relationship between SDG-X and SDG-Y, while a negative DE value indicates a direct inverse relationship. A DE coefficient of ≥ 0.80 or ≤ -0.80 is considered to indicate a strong relationship, while other values outside this range indicate a weak relationship (Nilsson et al., 2018).

The relationships between SDG-X and SDG-Y were visualized and presented in Figure 4.1. The DE values provided insights into the strength and direction of the relationships between the SDG-X and the SDG-Y. The analysis helped identify the factors that had a significant influence on the stakeholders' perceptions of the sustainability criteria and the alignment between awareness and policy implementation.

These findings highlight the importance of stakeholders' awareness towards the SDGs in driving the implementation of sustainable development policies in THEIs. The strong relationships observed between certain SDG-X and SDG-Y factors indicate the potential for targeted interventions and strategies to enhance sustainability efforts within THEIs. By understanding and leveraging these relationships, decision-makers and executive management can prioritize and implement effective policies and initiatives that align with the stakeholders' awareness and the desired sustainability outcomes.

The results of the SEM analysis are summarized in Table 4.3, which provides insights into the relationships between the latent variables representing the SDG-X and the SDG-Y. In Table 4.3 presents the R^2 values, which indicate the proportion of variance explained by each SDG-Y factor, as well as the DE values, which represent the strength and direction of the relationships between the SDG-X and the SDG-Y.

The analysis revealed that all SDG-X factors were significant, except for SDG-X17. This suggests that the stakeholders demonstrated a strong awareness of most of the SDGs. On the other hand, all SDG-Y factors were found to be significant, indicating that the criteria set in the THEIR guideline were well aligned with the SDGs.

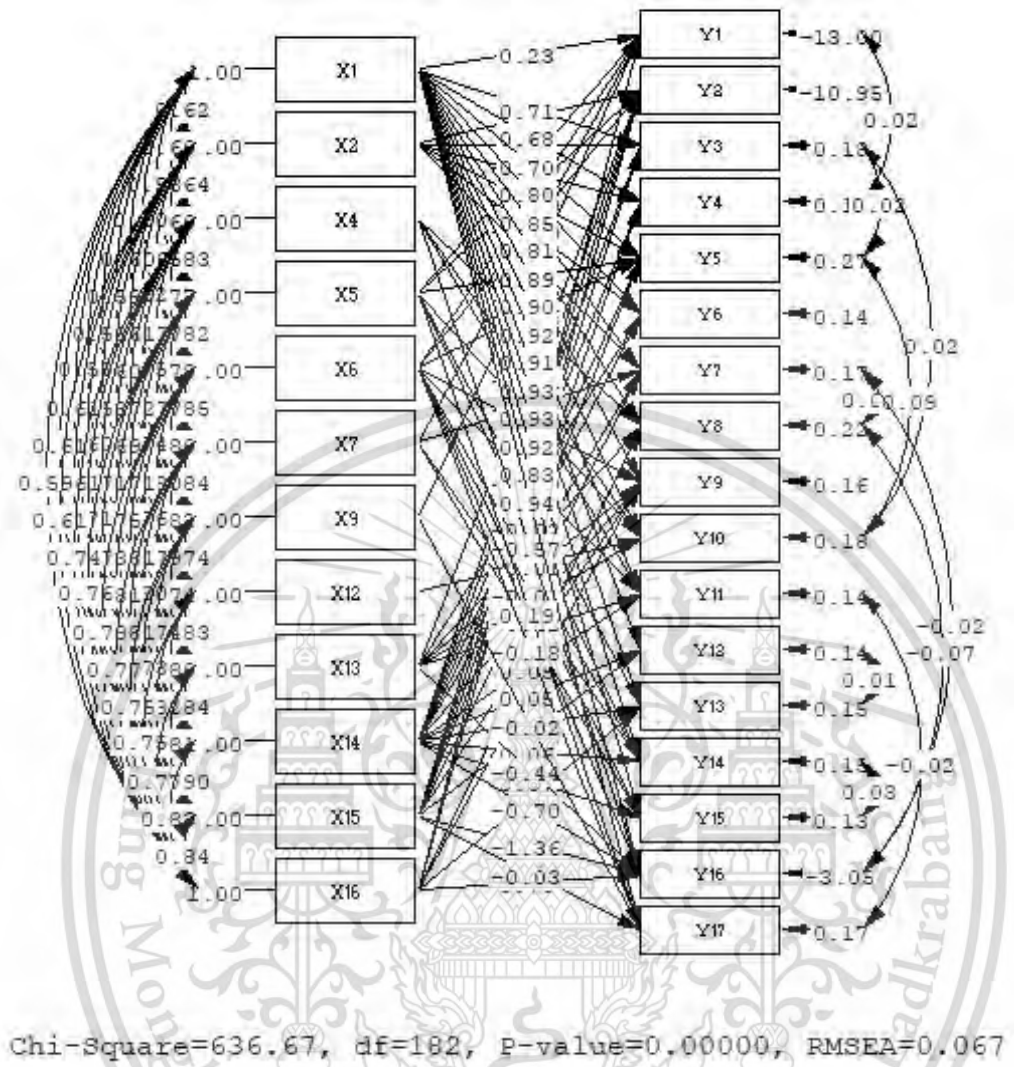

Figure 4.1 SEM of SDG-X and SDG-Y

The table highlights the strongest positive and negative relationships between specific SDG-X and SDG-Y factors. The strongest positive relationships were observed between SDG-X14 and SDG-Y2 (DE = 8.14), SDG-X9 and SDG-Y1 (DE = 7.11), and SDG-X1 and SDG-Y13 (DE = 1.00). These findings suggest that a higher level of awareness towards SDG-X factors, such as industry partnerships (SDG-X14) and resource consumption (SDG-X9), positively influenced stakeholders' perceptions and priorities related to specific SDG-Y factors.

Table 4.3 Summary of Structure Relationships Derived from SEM

Influence of latent variables	R^2	Direct effect (DE)
SDG-Y1 <- - SDG-X6	14.00	-1.02**
SDG-Y1 <- - SDG-X7	14.00	-3.44**
SDG-Y1 <- - SDG-X9	14.00	7.11**
SDG-Y2 <- - SDG-X6	11.95	-1.63**
SDG-Y2 <- - SDG-X13	11.95	-2.04**
SDG-Y2 <- - SDG-X14	11.95	8.14**
SDG-Y2 <- - SDG-X15	11.95	-4.36**
SDG-Y3 <- - SDG-X1	0.82	0.71**
SDG-Y3 <- - SDG-X2	0.82	0.37**
SDG-Y4 <- - SDG-X1	0.87	0.67**
SDG-Y4 <- - SDG-X2	0.87	0.45**
SDG-Y5 <- - SDG-X1	0.73	0.72**
SDG-Y5 <- - SDG-X2	0.73	0.36**
SDG-Y5 <- - SDG-X6	0.73	-0.26**
SDG-Y6 <- - SDG-X1	0.86	0.82**
SDG-Y7<- - SDG-X1	0.83	0.88**
SDG-Y8 <- - SDG-X1	0.78	0.80**
SDG-Y9 <- - SDG-X1	0.84	0.91**
SDG-Y9 <- - SDG-X6	0.84	0.30**
SDG-Y10 <- - SDG-X1	0.82	0.94**
SDG-Y11<- - SDG-X1	0.86	0.96**
SDG-Y12<- - SDG-X1	0.86	0.93**
SDG-Y13 <- - SDG-X1	0.82	1.00**
SDG-Y14<- - SDG-X1	0.85	0.97**
SDG-Y15<- - SDG-1	0.87	0.94**
SDG-Y16 <- - SDG-X1	4.05	0.86**
SDG-Y16<- - SDG-X15	4.05	-1.34**
SDG-Y17<- - SDG-X1	0.83	0.98**

Remark **p < 0.01 and R^2 > 0.70

Conversely, the strongest negative relationships were observed between SDG-X15 and SDG-Y2 (DE = -4.36), SDG-X7 and SDG-Y1 (DE = -3.44), and SDG-X13 and SDG-Y2 (DE = -2.04). These findings indicate that a higher level of awareness towards SDG-X factors, such as life on land (SDG-X15), industry innovations (SDG-X7), and climate change (SDG-X13), inversely influenced stakeholders' perceptions and priorities related to specific SDG-Y factors.

The table also provides information on the R^2 values, which indicate the amount of variance explained by each SDG-Y factor. Values above 0.70 indicate a substantial influence of the SDG-X factors on the corresponding SDG-Y factors.

Overall, the results of the SEM analysis reveal the complex relationships between the SDG-X and the SDG-Y. These findings provide valuable insights into the factors that significantly influence stakeholders' perceptions and priorities related to sustainability in HEIs. The identified relationships can guide decision-makers and executive management in formulating effective strategies and policies to promote sustainable development within THEIs.

Systemigram is a holistic tool for capturing the numerous factors of complex systems and develop a deeper understanding about how to analyze their characteristics (Malhan et al., 2022; Sauser et al., 2011; Squires et al., 2010). These strong connections were implemented into the SDG Systemigram presented as Figure 7. This SDG Systemigram illustrated the level of relationships and their effects. The node linked the other node with an arrow. And, the DE values were shown in the rectangle box on the center of arrow. The direct variation was shown in the green positive sign, while the inverse variation was shown in the red negative sign.

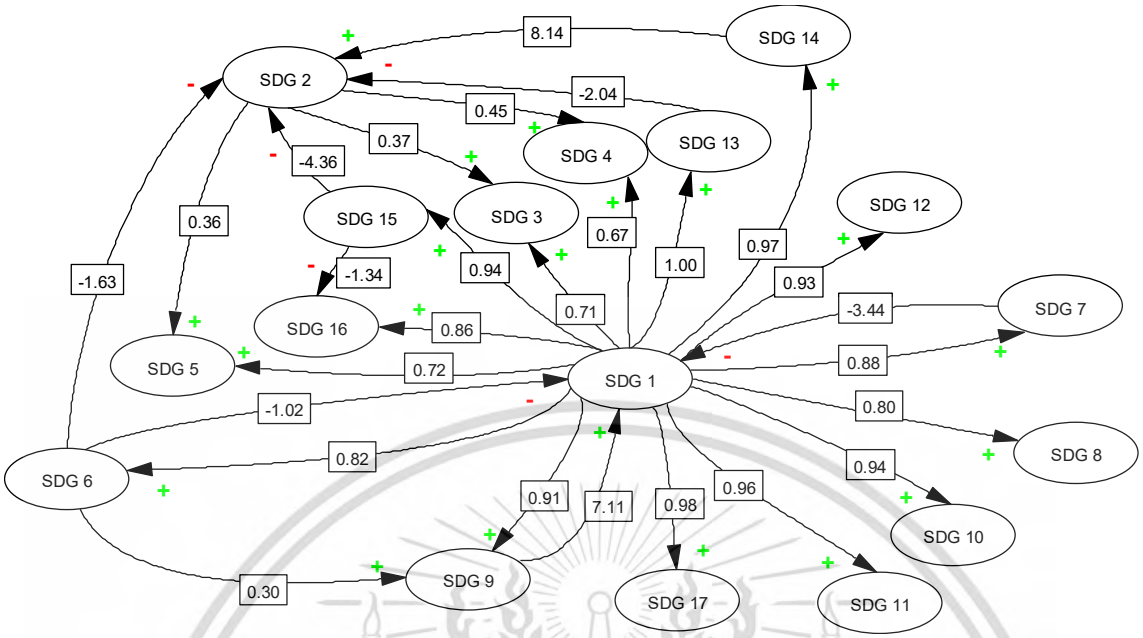

Figure 4.2 SDG Systemigram

SDG 1 (No Poverty) is probably the most important goal as it links to 15 other goals. Both SDG 2 (Zero Hunger) and SDG 6 (Clean Water and Sanitation) link to three other goals. SDG 15 (Life on land) links to two goals: SDG 2, SDG16 (Peace, Justice, and Strong Institutions). SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation, and Infrastructure), SDG 13 (Climate Action) and SDG 14 (Life Below Water), link to one goal only. Based on a study by THE, SDG 4 has the highest level of relevance to university's operations (Times Higher Education (THE), 2018). The Systemigram of this study showed that SDG 4, by THEI stakeholders' perspectives, has strong relationship with SDG 1 and SDG 2.

Some examples of result interpretations are as follows. Based on the DE value of 1.00 between SDG 1 and SDG 13, SDG 1 has a strong relationship with SDG 13. Some explanations might be the assumption that, when people are better-off, they can then spare some resources for education and research for tackling the climate change problem. This is especially true considering the fact that universities and students in developing countries still need some support, for example in forms of scholarships and technology transfers, from the developed world (Gay, 2021).

Next, with SDG 17 (Partnerships for the Goals) (DE = 0.98), stronger global partnerships and cooperation may improve access to sustainable technology and knowledge to drive,

support, and transfer (De la Poza et al., 2021; Marshall, 2018). Furthermore, regarding SDG 14 (DE = 0.97), THEIs should cooperate with their communities to design courses and events for management and conservation of their aquatic ecosystems.

Second, considering SDG 2 as the independent variable, it somewhat influenced SDG 4 (DE = 0.45). When their students were satisfied, they could focus on learning and THEI policy ensured everyone could equally join all activities, courses and events. In the same way, regarding SDG5 (Gender Equality) (DE = 0.36), THEI should form a gender equality policy for educator employment. For SDG 3 (Good Health and Well-being) (DE = 0.37), THEI should work side by side with healthcare units in their communities to encourage and drive all members of the community (León et al., 2016).

Last, SDG 6 had some effects on SDG 2. Clean water and sanitation are crucial for maintaining health and nutritional status. Waterborne diseases caused by poor sanitation can lead to malnutrition, even when there is enough food to eat. Diarrheal diseases, often caused by contaminated water, are a leading cause of malnutrition in children under five. Achieving SDG 6 can help reduce malnutrition, supporting progress towards SDG 2.

Complementing this, the role of institutions, such as campus canteens, is also significant in maintaining health and nutrition. They bear the responsibility of providing high-quality food at affordable prices to ensure the wellbeing of everybody on the campus (DE = -1.63). As per studies (Centers for Disease Control and Prevention, 2014; Zhang et al., 2016), a well-balanced and nutritionally dense diet from campus canteens can contribute positively to the overall health status and combat malnutrition. Therefore, such establishments indirectly further the cause of both SDG 2 and SDG 6, demonstrating the interconnectedness of these goals in various aspects of life.

SDG 6 also influenced SDG 1; People living in poverty often lack the financial means or access to clean, safe water and proper sanitation. This can lead to a vicious cycle, as diseases and illnesses related to unclean water or poor sanitation can prevent individuals from working or receiving an education, thereby perpetuating the cycle of poverty. THEI should set up university-business incubators (UBI) to help communities start new businesses, including consultancy and workshops about startups (DE = -1.02) (P.-E. Carmen & Enrique, 2018).

SDG 6 was linked to SDG 9 (DE = 0.30); THEI should focus on research by cooperating with enterprises to create innovation and develop infrastructure in (a) Science, Technology, Engineering and Mathematics (STEM), (b) healthcare, and (c) arts, humanities, and social sciences. The relationship between SDG 9 and SDG 1 was the most significant one with the highest DE (DE = 7.11).

4.4 Causal Loop Diagram and Leveraged SDGs

This section presents the result of Casual Loop Diagram (CLD) used to find leveraged SDGs. Leveraged SDGs mean the particular SDGs (independent variables) that have impacts towards multiple SDGs (dependent variables) (Arnold & Wade, 2015; Kim & Anderson, 2011; Zhang et al., 2016). If the leveraged SDG can be found, policymakers would be able to use the result to figure out where the resources should be allocated.

CLD presents closed loop relationships, in which the independent variable and dependent variable show their effect on each other in both directions. These relationships would enhance the impact of effort spent on SDG. They are in closed loops, which can be deemed as a leveraged SDG. There are 2 types of CLD. 1) Balancing loop brings counter effect to the paired SDGs, therefore generating a stable system. 2) A reinforcing loop is a loop that grows or declines at an ever-increasing rate (Kim, 2000; Zelinka & Amadei, 2019b; Zhang et al., 2016).

In this study, we observed 2 balancing loops (B1 and B2) and 1 reinforcing loop (R1). labelled as B1, B2, and R1 in Figure 4.2. These CLDs were Growth and Underinvestment systems archetype (Kim, 2000; Zelinka & Amadei, 2019b; Zhang et al., 2016). This archetype is one of the general system archetype patterns. It is defined as part of the System Dynamics. System Dynamics is used to understand, describe, and optimize the behavior of complex systems using CLD to find the leveraged loops (Ferri & Sedehi, 2018; Sterman, 2002; Zelinka & Amadei, 2019a).

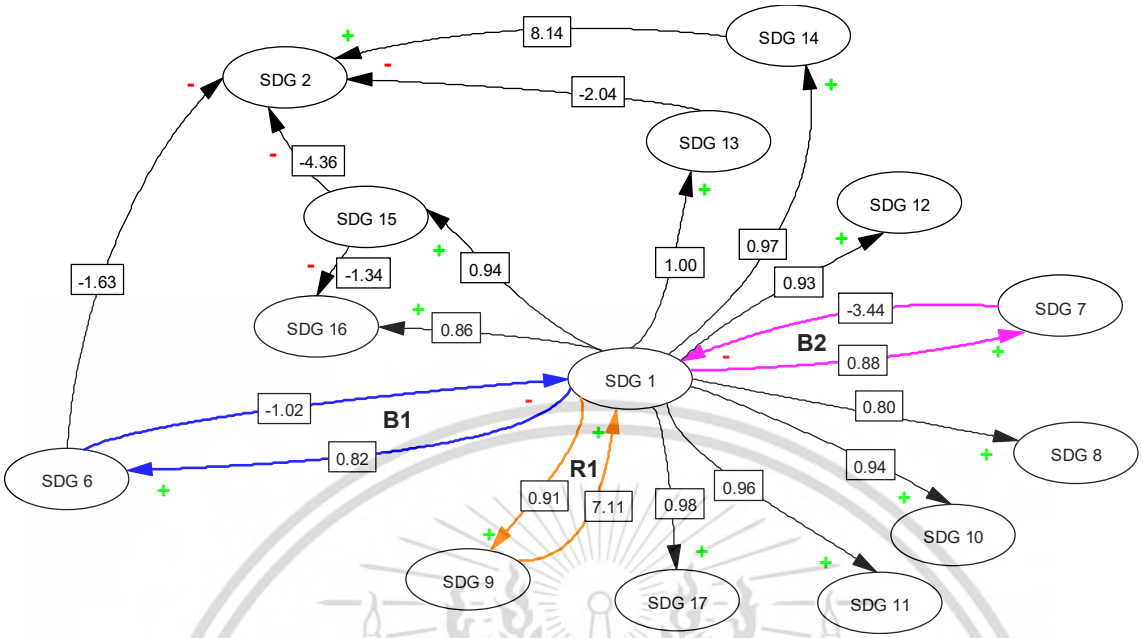

Figure 4.2 Strong Direct Effect Coefficient and CLD Based on the SDG Systemigram

The structure of systems can be driven by the leveraged point. When this point changes, it will impact the whole system effectively. With leveraged SDGs recognized, we could design a productive SDG policy.

The first balancing loop (B1) started from SDG 1 which directly contributed to SDG 6, while SDG 6 itself also inversely contributed to SDG 1 (Squires et al., 2010; Zelinka & Amadei, 2019b, 2019a; Zhang et al., 2016). Improving access to SDG 6 can directly impact efforts to SDG 1. For instance, having access to clean water and sanitation can reduce disease and improve health, leading to increased opportunities for work and education. It can also save the time that people, particularly women and girls, spend fetching water, which can be used for more productive activities. On the other hand, reduction SDG 1 will likely lead to increased resources and capacities to improve water and sanitation systems.

Similar relationship was observed between SDG 1 and SDG 7. For example, when people are better off enough to afford clean energy. Some externalities in forms of environmental problems and health impacts can be avoided, which would save some money for the people. The saved resources then can be spent on more clean energies for the society (Freidenfelds et al., 2018). The growth of this relationship will be eventually limited by the capacity of the system approaching a balance or stable status.

On the other hand, the first reinforcing loop (R1) started from SDG1 and closed the loop with SDG 9. For example, when some resources or funding are spent to eliminated poverty, those people then can spend more time on inventing more innovation and building more infrastructure. The innovations and infrastructures result in added values of the industries, which bring more prosperities to the people. The loop brings incremental effects at an ever-increasing rate.

Therefore, this study suggested a total of 4 leveraged SDGs including SDGs 1 (No Poverty), 6 (Clean Water and Sanitation), 7 (Affordable and Clean Energy), and 9 (Industry, Innovation, and Infrastructure). This results have confirmed what were found in the previous studies of Alshuwaikhat & Abubakar, 2018; Brinkhurst et. al., 2011; Disterheft et. al., 2012; Koester et. al., 2006; Zhang et. al., 2016; (Alshuwaikhat & Abubakar, 2008; Brinkhurst et al., 2011; Disterheft et al., 2012; Koester et al., 2006; Zhang et al., 2016). The appropriate policies derived from THEIR guidelines are suggested and listed in Table 4.4.

Table 4.4 Leveraged SDG Policies

SDG	Leveraged SDG Policies
1 No Poverty	SDG-Y 1.1 Set up the unit to administer, drive and support local students (Albareda-Tiana et al., 2018). SDG-Y 1.2 Set up the unit to help students from developing countries (Albareda-Tiana et al., 2018; Institute of International Education, 2016; Rosca et al., 2017). SDG-Y 1.3 University business incubators to help communities start new business e.g. consultancy and workshops (Bidmon & Knab, 2017; P.-E. Carmen & Enrique, 2018; Hoveskog et al., 2018; Joyce & Paquin, 2016; Rosca et al., 2017).
6 Clean Water and Sanitation	SDG-Y 6.1 Water conservation, promote water saving, technology for sustainable and prevention of sewage entering the system, including water pollution caused by accidents (Benjaoran & Parinyakulset, 2018; Centers for Disease Control and Prevention, 2014; Horan & O'regan, 2021). SDG-Y 6.2 Providing free drinking water for students, staff and visitors, e.g. water dispensers (Centers for Disease Control and Prevention, 2014). SDG-Y 6.3 Collaboration with local, regional, national, international governments in water security (Horan & O'regan, 2021; Ross & Laura, 2019).

SDG	Leveraged SDG Policies
7 Affordable and Clean Energy	SDG-Y 7.1 Policy to improve and build new buildings following energy efficient standards (Buzaboon et al., 2020; Nowotny et al., 2018). SDG-Y 7.2 Energy plan to reduce energy consumption, including upgrading existing buildings for better energy efficiency (Buzaboon et al., 2020; Jones, 2012; Nowotny et al., 2018). SDG-Y 7.3 Local service to improve energy efficiency and clean energy, e.g. energy assessment, workshops, renewable energy research (Buzaboon et al., 2020; Jones, 2012; Nowotny et al., 2018).
9 Industry, Innovation, and Infrastructure	SDG-Y 9.1 Research collaborating with enterprises to create innovation and develop infrastructure in Science, Technology, Engineering and Mathematics (STEM) (Suwartha & Fitri, 2013). SDG-Y 9.2 Research collaborating with enterprises to create innovation and develop infrastructure for healthcare (León et al., 2016). SDG-Y 9.3 Research collaborating with enterprises to create innovation and develop infrastructure in arts, humanities and social sciences (Albareda-Tiana et al., 2018; Hooi et al., 2012).

The leveraged SDG policies related to eradicating poverty (SDG 1) focus on supporting students, particularly those from disadvantaged backgrounds. The establishment of dedicated units and business incubators demonstrates the commitment of THEIs to contribute to poverty reduction. These initiatives can provide essential resources, mentorship, and opportunities for students to develop skills and create sustainable businesses. The implementation of these policies can help foster economic growth, empower individuals, and address the issue of poverty within the university's sphere of influence.

The leveraged SDG policies related to clean water and sanitation (SDG 6) emphasize sustainable water management within HEIs. These policies promote water conservation, pollution prevention, and access to clean drinking water. By implementing water-saving technologies, providing free drinking water, and collaborating with government entities, THEIs can contribute to environmental sustainability and ensure the well-being of their campus community. These policies align with global efforts to achieve clean water and sanitation targets and demonstrate the commitment of THEIs to sustainable practices.

The leveraged SDG policies related to affordable and clean energy (SDG 7) highlight the importance of sustainable energy practices within HEIs. These policies aim to reduce energy consumption, improve energy efficiency, and promote the use of clean and renewable energy sources. By implementing energy-efficient building standards, developing energy plans, and offering local services for energy efficiency improvement, THEIs can play a significant role in mitigating climate change and advancing sustainable energy solutions. These policies contribute to the overall goal of ensuring affordable and clean energy access for all.

The leveraged SDG policies related to industry, innovation, and infrastructure (SDG 9) emphasize the importance of HEIs' role in driving innovation and developing infrastructure across various fields. These policies highlight the need for research collaborations with enterprises to foster innovation and advancements in STEM, healthcare, and the arts, humanities, and social sciences. By actively engaging with industries and promoting interdisciplinary research, THEIs can contribute to technological advancements, economic growth, and societal development. These policies support the overall goal of creating resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation.

In summary, the analysis of the leveraged SDG policies reveals the proactive approach of HEIs towards addressing the UN SDGs. The policies discussed in this section showcase the commitment of THEIs to promote social, economic, and environmental sustainability. By implementing these policies, THEIs can create a positive impact within their communities and contribute to the global efforts towards achieving the SDGs. The findings underscore the importance of collaboration, innovation, and sustainable practices in THEIs as key drivers for transformative change.

Chapter 5

Conclusions and Recommendations

The findings of this study provide valuable insights into the awareness of stakeholders in THEIs regarding the UN SDGs, and their relationship to the criteria set in the THEIR. Through the application of both CFA and SEM, the study examined the linkages between SDGs and identified leveraged SDGs, that have significant relationships with other goals.

The results revealed that SDG 1, focused on eradicating poverty, exhibited the highest number of linkages with 15 other SDGs. Particularly strong relationships were observed between SDG 1 and SDG 9, indicating the potential for synergistic efforts in addressing poverty and fostering industry, innovation, and infrastructure. These findings emphasize the importance of integrating various SDGs and adopting a holistic approach to sustainability in THEIs.

The study highlights the significance of leveraging SDGs, specifically SDGs 1, 6, 7, and 9, in policy formulation for THEIs. Policymakers should give careful consideration to these relationships and prioritize these leveraged SDGs when designing and implementing SDG-related policies within their institutions. By aligning policies with stakeholders' preferences and focusing resources on leveraged SDGs, THEIs can maximize their impact and contribute effectively to sustainable development.

Furthermore, it is crucial for future research to explore the relationships between stakeholders' demographic characteristics and their opinions on SDGs. This will enable policymakers to develop more tailored and refined policies that account for the diverse perspectives and needs of different stakeholder groups. By incorporating demographic factors into policy planning, THEIs can ensure that their sustainability initiatives address the specific challenges and requirements of various stakeholders.

5.1 Recommendations

Based on the findings of this study, the following recommendations are proposed for THEI policymakers and practitioners to enhance their sustainability efforts

1. Prioritize leveraged SDGs: Executive management should prioritize SDGs with significant relationships to other goals, such as SDGs 1, 6, 7, and 9. These leveraged SDGs provide opportunities for integrated and impactful sustainability initiatives within THEIs.

2. Align policies with stakeholder preferences: Executive management should consider the preferences and priorities of stakeholders when formulating SDG-related policies. Engaging stakeholders in the policy development process can ensure that policies are relevant, effective, and widely accepted.

3. Optimize resource allocation: By focusing resources on leveraged SDGs and areas of significant impact, THEIs can optimize the allocation of financial, human, and technological resources. This strategic resource management approach will enable institutions to achieve greater sustainability outcomes with limited resources.

4. Incorporate demographic considerations: Future studies should investigate the relationships between stakeholders' demographic characteristics and their opinions on SDGs. This will enable executive management to develop tailored policies that address the specific needs and perspectives of diverse stakeholder groups.

5. Enhance interdisciplinary collaboration: THEIs should foster interdisciplinary collaboration among academic departments, research centers, and industry partners to drive innovation and address complex sustainability challenges. Collaboration across multidiscipline can generate creative solutions and advance sustainable development in diverse areas.

6. Continuous monitoring and evaluation: Regular monitoring and evaluation of the implemented policies and initiatives are essential to assess their effectiveness and identify areas for improvement. Executive management should establish mechanisms for ongoing evaluation and feedback from stakeholders to ensure the continuous refinement of sustainability practices.

In conclusions, this study has shed light on the awareness of THEIs' stakeholders towards SDGs and the relationships between SDGs and THEIR criteria. The findings provide valuable guidance for Executive management in developing and implementing SDG-related policies in THEIs. By aligning policies with stakeholder preferences, prioritizing leveraged SDGs, and fostering interdisciplinary collaboration, THEIs can enhance their contributions to sustainable development and create a positive impact on society and the environment. Continuous monitoring and evaluation will facilitate the iterative improvement of sustainability initiatives

Appendix I

Domain Expert

We invited a panel of five domain experts, as listed in Table A.1, to validate the questionnaire through an Index of Item-Objective Congruence (IOC) method. The IOC method, developed by Rovinelli and Hambleton in 1976 (Rovinelli & Hambleton, 1976), is a widely recognized procedure used in test development to assess content validity during the factors design stage. In this method, an IOC value greater than 0.6 is considered indicative of good content validity (C. Turner & Carlson, 2003).

Table A.1 The List of Domain Experts

Name	Position, Organization
Dr.Kankanit Kamolkittiwong	Head of Logistics Management Department, Faculty of Business Administration, Rangsit University, Thailand
Asst.Prof.Dr.Chodchanok Attaphong	Assistant Professor, Department of Civil Engineering, School of Engineering, KMITL, Thailand
Adhipat Warangkanand	Consultant, UNFPA Thailand and UNICEF Thailand
Dr.Weerawit Lertthaitrakul	Associate Dean, School of Logistics and Supply chain, Sripatum University, Thailand
Asst.Prof.Dr.Pornsri Laurujisawat	Assistant Professor, KMITL Business School, KMITL, Thailand

These domain experts were chosen for their expertise and experience in relevant fields related to the research topic. Their valuable input and feedback were instrumental in ensuring the questionnaire's validity and reliability. Their evaluations and assessments of the questionnaire helped to enhance its content validity, ultimately contributing to the overall robustness of the study.

Appendix II

The Questionnaire

To ensure clarity and comprehension, we have utilized the Thai language for the questionnaire that show in Figure A.2.

Table A.2 The Questionnaire

แบบสำรวจมุมมองบุคลากรในสถาบันการศึกษาต่อเป้าหมายการพัฒนาที่ยั่งยืน

(Sustainable Development Goals: SDGs) ขององค์การสหประชาชาติ (United Nations: UN)

คำอธิบาย: แบบสอบถามนี้จัดทำขึ้นเพื่อสำรวจระดับของความตระหนักของบุคลากรต่อมุมมองด้านนโยบายในสถาบันการศึกษาในประเทศไทยต่อเป้าหมายการพัฒนาที่ยั่งยืน (Sustainable Development Goals: SDGs) ขององค์การสหประชาชาติ (United Nations: UN) โดยการศึกษานี้เป็นส่วนหนึ่งของหัวข้อดุษฎีนิพนธ์ สาขาโลจิสติกส์และโซ่อุปทาน คณะวิศวกรรมศาสตร์ สถาบันเทคโนโลยีพระจอมเกล้าเจ้าคุณทหารลาดกระบัง

วัตถุประสงค์ เพื่อนำข้อมูลในการสำรวจนี้ไปใช้ในการตัดสินใจพัฒนาสถาบันการศึกษาของไทยที่ยั่งยืน

ข้อมูลทั้งหมดที่ได้รับจะนำไปใช้ในเชิงวิชาการเท่านั้น แบบสำรวจนี้จะไม่มีการระบุชื่อ และคำตอบของคุณจะถูกเก็บรักษาอย่างเป็นความลับ โปรดช่วยทางผู้จัดทำตอบคำถามทางด้านล่าง เพื่อไปปรับปรุงความเข้าใจในเรื่องเป้าหมายการพัฒนาที่ยั่งยืนในสถาบันการศึกษา

คำแนะนำ: คำถามจะแบ่งเป็น 3 ส่วน ดังนี้

- **ส่วนที่ 1** คำถามทั่วไป
- **ส่วนที่ 2** การรับรู้ถึง 17 เป้าหมายการพัฒนาที่ยั่งยืนในสถาบันการศึกษา
- **ส่วนที่ 3** ความตระหนักใน 17 เป้าหมายการพัฒนาที่ยั่งยืนของสถาบันการศึกษา
- **ส่วนที่ 4** นโยบายของ 17 เป้าหมายการพัฒนาที่ยั่งยืนของสถาบันการศึกษา

หากมีคำถาม หรือความคิดเห็น โปรดติดต่อ นายสิริพงศ์ ซึงถาวรรณ นักศึกษาปริญญาเอก มือถือ/ไลน์ 095-624-2449 อีเมล 59610005@kmitl.ac.th

ส่วนที่ 1 คำถามทั่วไป

1.1 ชื่อ-นามสกุล .....

1.2 มหาวิทยาลัย (ที่ประชุมอธิการบดีแห่งประเทศไทย, 2562)

- ☐ จุฬาลงกรณ์มหาวิทยาลัย
- ☐ มหาวิทยาลัยกาฬสินธุ์
- ☐ มหาวิทยาลัยเกษตรศาสตร์
- ☐ มหาวิทยาลัยขอนแก่น
- ☐ มหาวิทยาลัยเชียงใหม่
- ☐ มหาวิทยาลัยทักษิณ
- ☐ มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าธนบุรี
- ☐ มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าพระนครเหนือ
- ☐ มหาวิทยาลัยเทคโนโลยีสุรนารี
- ☐ มหาวิทยาลัยธรรมศาสตร์
- ☐ มหาวิทยาลัยนครพนม
- ☐ มหาวิทยาลัยนราธิวาสราชนครินทร์
- ☐ มหาวิทยาลัยนเรศวร
- ☐ มหาวิทยาลัยนวมินทราธิราช

☐ มหาวิทยาลัยบูรพา
☐ มหาวิทยาลัยพะเยา
☐ มหาวิทยาลัยมหาจุฬาลงกรณราชวิทยาลัย
☐ มหาวิทยาลัยมหามกุฏราชวิทยาลัย
☐ มหาวิทยาลัยมหาสารคาม
☐ มหาวิทยาลัยมหิดล
☐ มหาวิทยาลัยแม่โจ้
☐ มหาวิทยาลัยแม่ฟ้าหลวง
☐ มหาวิทยาลัยรามคำแหง
☐ มหาวิทยาลัยวลัยลักษณ์
☐ มหาวิทยาลัยศรีนครินทรวิโรฒ
☐ มหาวิทยาลัยศิลปากร
☐ มหาวิทยาลัยสงขลานครินทร์
☐ มหาวิทยาลัยสวนดุสิต
☐ มหาวิทยาลัยสุโขทัยธรรมาธิราช
☐ มหาวิทยาลัยอุบลราชธานี
☐ ราชวิทยาลัยจุฬาภรณ์
☐ สถาบันดนตรีกัลยาณิวัฒนา
☐ สถาบันเทคโนโลยีพระจอมเกล้าเจ้าคุณทหารลาดกระบัง
☐ สถาบันบัณฑิตพัฒนบริหารศาสตร์
☐ อื่น ๆ .....

1.3 พื้นที่จังหวัด .....
1.4 ชื่อหน่วยงาน .....

1.5 คณะหรือสาขาวิชาของท่าน (เกณฑ์มาตรฐานหลักสูตรระดับอุดมศึกษาและเกณฑ์มาตรฐานที่เกี่ยวข้อง, 2558)

☐ ศิลปศาสตร์
☐ วิทยาศาสตร์
☐ รัฐศาสตร์
☐ เศรษฐศาสตร์
☐ กายภาพบำบัด
☐ การแพทย์แผนไทย
☐ การแพทย์แผนจีน
☐ เทคนิคการแพทย์
☐ นิติศาสตร์
☐ พยาบาลศาสตร์
☐ วิศวกรรมศาสตร์
☐ ศึกษาศาสตร์
☐ ครุศาสตร์อุตสาหกรรม
☐ สถาปัตยกรรมศาสตร์
☐ สาธารณสุขศาสตร์
☐ ทันตแพทยศาสตร์
☐ ทัศนมาตรศาสตร์
☐ แพทยศาสตร์
☐ เภสัชศาสตร์
☐ สัตวแพทยศาสตร์
☐ การจัดการ
☐ กุริยางคศาสตร์
☐ นิเทศศาสตร์
☐ บริหารธุรกิจ
☐ บริหารรัฐกิจ
☐ สังคมสงเคราะห์ศาสตร์
☐ สารสนเทศศาสตร์
☐ เทคโนโลยีบัณฑิต
☐ อุตสาหกรรมศาสตร์
☐ อื่น ๆ .....

1.6 ตำแหน่ง:
☐ นักศึกษา
○ ปริญญาตรี ○ ปริญญาโท ○ ปริญญาเอก
☐ ผู้บริหารส่วนกลางของสถาบัน เช่น อธิการบดี รองอธิการบดี ผู้ช่วยอธิการบดี ฯลฯ
☐ ผู้บริหารในระดับหน่วยงาน (คณะ วิทยาลัย สาขาวิชา) เช่น คณบดี รองคณบดี ผู้ช่วยคณบดี ผู้อำนวยการ หัวหน้าภาควิชา หัวหน้าศูนย์ ฯลฯ

☐ สายวิชาการ .....
☐ สายสนับสนุน .....
☐ อื่น ๆ .....

1.7 ประสบการณ์ทำงาน/การเรียนในหน่วยงาน ..... ปี

1.8 เพศ ☐ ชาย ☐ หญิง

1.9 อายุ ☐ ต่ำกว่า 20 ปี ☐ 21 - 30 ปี ☐ 31 - 40 ปี ☐ 41 - 50 ปี ☐ 51 - 60 ปี ☐ 60 ปี ขึ้นไป

1.10 รายได้หรือค่าใช้จ่ายประจำส่วนตัวที่ได้รับจากผู้ปกครอง

☐ ต่ำกว่า 5,000 บ. ☐ 5,001 - 15,000 บ. ☐ 15,001 - 25,000 บ.

☐ 25,001 - 35,000 บ. ☐ 35,001 - 45,00 บ. ☐ มากกว่า 45,000 บ.

ส่วนที่ 2 การรับรู้ถึง 17 เป้าหมายการพัฒนาที่ยั่งยืนในสถาบันการศึกษา

2.1 คุณคิดว่าการรับรู้เป้าหมายการพัฒนาที่ยั่งยืนของคุณอยู่ในระดับใด โดยให้ระดับในข้อคำถาม ดังนี้
เมื่อ 1 คือ ไม่เห็นด้วยอย่างยิ่ง ถึง 5 คือ เห็นด้วยอย่างยิ่ง

หัวข้อคำถาม	1 ไม่เห็นด้วยอย่างยิ่ง	2 ไม่เห็นด้วย	3 เฉยๆ	4 เห็นด้วย	5 เห็นด้วยอย่างยิ่ง
คุณเคยได้ยินถึงเป้าหมายการพัฒนาที่ยั่งยืน (Sustainable Development Goals: SDGs) ของสหประชาชาติมาก่อน					
คุณรู้ว่าการพัฒนาที่ยั่งยืนนั่นมีความหมายอย่างไร					
คุณเคยเข้าร่วมการประชุม การสัมมนา และการฝึกอบรมเกี่ยวกับเป้าหมายการพัฒนาที่ยั่งยืน					
ปรัชญาเศรษฐกิจพอเพียงของไทย (Sufficiency Economy Philosophy: SEP) ก่อให้เกิดเป้าหมายการพัฒนาที่ยั่งยืน					
โดยทั่วไปแล้วคุณคิดว่าเป้าหมายการพัฒนาที่ยั่งยืนนั้นเกี่ยวข้องกับสถาบันการศึกษาหรือหน่วยงานของคุณ					

2.2 สถาบันการศึกษาของคุณรายงานการปฏิบัติที่เกี่ยวกับเป้าหมายการพัฒนาที่ยั่งยืนอย่างไร (สามารถเลือกได้มากกว่า 1 ข้อ)

เป็นส่วนหนึ่งของรายงานการพัฒนาที่ยั่งยืน	
เป็นส่วนหนึ่งของรายงานประจำปี	
รายงานบนเว็บไซต์ของสถาบันการศึกษา	
ไม่ได้รายงาน	
ฉันไม่ทราบ / ไม่แน่ใจ	

2.3 ข้อคำถามต่อไปนี้ถูกออกแบบขึ้นมาเพื่อถามถึงความตระหนักในเป้าหมายการพัฒนาที่ยั่งยืน ให้คะแนนความสำคัญตามความคิดเห็นของท่าน โดยคะแนนมีลำดับตามความสำคัญ ดังนี้

เมื่อ 1 คือ ไม่สำคัญ ถึง 5 คือ สำคัญมาก

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
SDG1. ขจัดความยากจนทุกรูปแบบในทุกพื้นที่					
1.1 รายได้เฉลี่ยต่อครอบครัวเพิ่มขึ้น ส่งผลให้หนี้สินต่อครอบครัวลดลง					
1.2 ประชาชนสามารถเข้าถึงทรัพยากร และสาธารณูปโภคขั้นพื้นฐาน					
1.3 ประเทศไทยมีนโยบายส่งเสริมและสนับสนุนการขจัดความยากจนทุกรูปแบบ					

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
SDG2. ขจัดความหิวโหย บรรลุความมั่นคงทางอาหาร ปรับปรุงโภชนาการและสนับสนุนการทำเกษตรกรรมที่ยั่งยืน					
2.1 ประชาชนได้รับสารอาหารครบ 5 หมู่ในแต่ละมื้ออาหารและได้ปริมาณอย่างเหมาะสม					
2.2 ประเทศไทยสนับสนุนการทำเกษตรกรรมอินทรีย์ เพื่อให้มีความมั่งคงทางอาหารที่ยั่งยืน					
2.3 ประเทศไทยมีการเพิ่มผลิตภาพและยกระดับการผลิตสินค้าเกษตรแปรรูป					
SDG3. สร้างหลักประกันให้คนมีชีวิตที่มีคุณภาพและส่งเสริมสุขภาวะทุกเพศทุกวัย					
3.1 องค์กรมีการส่งเสริมสุขภาพและความเป็นอยู่ที่ดีภายในหน่วยงาน					
3.2 องค์กรมีระบบสาธารณสุขและบริการทางสุขภาพครบครัน					
3.3 องค์กรให้ความรู้ด้านการวางแผนครอบครัว และสนับสนุนข้อมูลและการฝึกอบรมให้คนมีสุขภาพดี					
SDG4. สร้างหลักประกันให้การศึกษามีคุณภาพอย่างเท่าเทียม และครอบคลุม และส่งเสริมโอกาสในการเรียนรู้ตลอดชีวิตสำหรับทุกคน					
4.1 ไม่มีการแบ่งแยกเพศ ชนชั้น วรรณะ สัญชาติ และความพิการทางร่างกายในการเข้าสู่การศึกษาขั้นพื้นฐาน ตั้งแต่ระดับอนุบาลจนถึงอุดมศึกษา ตลอดจนการศึกษาตลอดชีวิต					
4.2 ส่งเสริมและพัฒนาการทักษะด้านต่าง ๆ เช่น การรู้หนังสือ อ่านออกเขียนได้ การคำนวณ เทคโนโลยีสารสนเทศ ฯลฯ ซึ่งเป็นทักษะพื้นฐานด้านการศึกษา					
4.3 สนับสนุนให้มีการเพิ่มปริมาณครูและอาจารย์ที่มีคุณภาพจากทั้งในและต่างประเทศ					
SDG5. บรรลุความเท่าเทียมระหว่างเพศ และเสริมสร้างความเข้มแข็งให้แก่สตรีและเด็กหญิง					
5.1 ไม่กีดกันทางเพศ ชาย หญิง และ LGBT (เลสเบี้ยน (Lesbian), เกย์ (Gay), ไบเซ็กชวล (Bisexual) และคนข้ามเพศ (Transgender/transsexual) มีความเท่าเทียมกัน					
5.2 ไม่มีการคุกคามและลวนลามทางเพศ รวมไปถึง การค้ามนุษย์และการแสวงประโยชน์ทางเพศการบังคับให้แต่งงาน และอื่น ๆ ในหน่วยงาน					
5.3 สร้างความมั่นใจว่าสตรีมีส่วนร่วมอย่างเต็มที่และมีประสิทธิภาพและโอกาสที่เท่าเทียมในการผู้นำในทุกระดับของการตัดสินใจ ทั้งในด้านการเมือง เศรษฐกิจ และสังคม					

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
SDG6. สร้างหลักประกันให้มีน้ำใช้ และมีการบริหารจัดการน้ำและการสุขาภิบาลที่ยั่งยืนสำหรับทุกคน					
6.1 การจัดการน้ำใช้ และน้ำเพื่ออุปโภคบริโภคอย่างมีประสิทธิภาพ					
6.2 ปรับปรุงคุณภาพของน้ำ และลดมลภาวะทางน้ำจากสารเคมี วัสดุต่าง ๆ รวมไปถึงการบริหารจัดการน้ำ เพื่อนำกลับมาใช้ใหม่ได้อย่างปลอดภัย					
6.3 ส่งเสริมและปกป้อง เพื่อมุ่งสู่การจัดการทรัพยากรทางน้ำในทุกภาคส่วน เช่น ภูเขา ป่าไม้ พื้นที่ชุ่มน้ำ ชั้นหินอุ้มน้ำและน้ำใต้ดิน แม่น้ำลำคลอง และทะเลสาบ เป็นต้น					
SDG7. สร้างหลักประกันให้ทุกคนสามารถเข้าถึงพลังงานสมัยใหม่ที่ยั่งยืนในราคาที่สามารถหาซื้อได้					
7.1 ประชาชนสามารถเข้าถึงพลังไฟฟ้าได้อย่างทั่วถึง และเพียงพอต่อการใช้งาน					
7.2 การส่งเสริม การวิจัย และพัฒนาเทคโนโลยีพลังงานทดแทนสะอาด (Clean energy) ให้มากขึ้น					
7.3 การส่งเสริมการลงทุนด้านโครงสร้างพื้นฐานทางพลังงานสะอาด					
SDG8. ส่งเสริมการเจริญเติบโตทางเศรษฐกิจที่ยั่งยืนและครอบคลุม และการจ้างงานเต็มอัตรา และงานที่มีคุณค่า (Decent work) สำหรับทุกคน					
8.1 ผลักดันการเจริญเติบโตทางเศรษฐกิจอย่างมีเสถียรภาพเพื่อเพิ่ม GDP ต่อประชากร					
8.2 มีอัตราการมีงานทำสูง ด้วยการใช้เทคโนโลยีเพื่อยกระดับนวัตกรรม เพื่อสร้างงานใหม่ ๆ ที่เพิ่มคุณค่าให้มากขึ้น					
8.3 ร่วมวิจัยและพัฒนากับหน่วยงานต่าง ๆ เพื่อยกระดับการเติบโตทางเศรษฐกิจ เช่น การสร้างผู้ประกอบการ การสร้างงาน การสร้างสรรค์และนวัตกรรม					
SDG9. สร้างโครงสร้างพื้นฐานที่มีความต้านทานและยืดหยุ่นต่อการเปลี่ยนแปลง ส่งเสริมการพัฒนาอุตสาหกรรมที่ครอบคลุมและยั่งยืน และส่งเสริมนวัตกรรม					
9.1 การส่งเสริมการวิจัยและพัฒนานวัตกรรม โครงสร้างพื้นฐานที่ยั่งยืน รวมไปถึงการพัฒนาโครงสร้างต่าง ๆ เพื่อการค้า สนับสนุนเศรษฐกิจ และความเป็นอยู่ที่ดีขึ้น					

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
9.2 การสร้างคุณค่าเพิ่มในทุกกิจกรรมและกระบวนการทางการศึกษา					
9.3 เพิ่มการเข้าถึงข่าวสารข้อมูลและเทคโนโลยีการสื่อที่ครอบคลุม และเครือข่ายสัญญาณอินเตอร์เน็ตในหน่วยงาน					
SDG10. ลดความไม่เท่าเทียมทั้งภายในและระหว่างประเทศ					
10.1 สร้างความมั่นใจ และลดความไม่เท่าเทียมกัน รวมถึงการกำจัดการเลือกปฏิบัติ ทั้งนโยบายและการปฏิบัติ รวมถึงการส่งเสริมกฎหมายนโยบายและการดำเนินการที่เหมาะสม					
10.2 ปรับปรุงกฎระเบียบ และการตรวจสอบตลาดและสถาบันการเงิน					
10.3 อำนวยความสะดวกในการอพยพย้ายถิ่นฐาน รวมถึงการดำเนินการตามนโยบายการย้ายถิ่นที่วางแผนไว้และมีการจัดการที่ดี เพื่อให้เกิดการย้ายถิ่นได้ง่าย					
SDG11. ทำให้เมืองและการตั้งถิ่นฐานของมนุษย์มีความปลอดภัย ความต้านทานและยืดหยุ่นต่อการเปลี่ยนแปลงอย่างครอบคลุมและยั่งยืน					
11.1 สามารถเข้าถึงที่อยู่อาศัยและบริการขั้นพื้นฐานที่เพียงพอ ปลอดภัย ราคาไม่แพง และลดความแออัดของชุมชนลง					
11.2 เข้าถึงระบบการขนส่งที่ปลอดภัย ราคาไม่แพง เข้าถึงได้ และยั่งยืนสำหรับทุกคน ปรับปรุงความปลอดภัยทางถนน โดยเฉพาะอย่างยิ่งการขยายการขนส่งสาธารณะสำหรับ คนพิการ เด็ก สตรี และผู้สูงอายุ					
11.3 สามารถเข้าถึงพื้นที่ปลอดภัย พื้นที่สีเขียว และพื้นที่สาธารณะ โดยเฉพาะอย่างยิ่งสำหรับคนพิการ เด็ก สตรี และผู้สูงอายุ					
SDG12. สร้างหลักประกันให้มีแบบแผนการบริโภคและการผลิตที่ยั่งยืน					
12.1 มีการวางแผนการบริหารจัดการทรัพยากรและการผลิตที่ยั่งยืน ลดการเกิดของเสีย (Reduce) โดยการป้องกัน การนำกลับมาใช้ซ้ำ (Reuse) และการรีไซเคิล (Recycle)					
12.2 มุ่งเน้นการใช้ผลิตภัณฑ์ที่เป็นมิตรต่อสิ่งแวดล้อม (Green product)					
12.3 สนับสนุนให้หน่วยงานต่าง ๆ โดยเฉพาะบริษัทขนาดใหญ่ และบริษัทข้ามชาตินำแนวทางการปฏิบัติที่ยั่งยืนมาใช้และนำข้อมูลใส่ลงในรายงานด้วย					

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
SDG13. ดำเนินการอย่างเร่งด่วนเพื่อต่อสู้กับสภาวะการเปลี่ยนแปลงสภาพภูมิอากาศและผลกระทบ					
13.1 หน่วยงานมีมาตรการในการช่วยลดผลกระทบต่อการเปลี่ยนแปลงสภาพภูมิอากาศ					
13.2 หน่วยงานรวมมาตรการเปลี่ยนแปลงสภาพภูมิอากาศเข้ากับนโยบายเชิงกลยุทธ์ และการวางแผนระดับประเทศ					
13.3 พัฒนาการศึกษา สร้างความตระหนัก เพิ่มขีดความสามารถ และกระตุ้นให้ลดผลกระทบและการเตือนภัยล่วงหน้าต่อการเปลี่ยนแปลงสภาพภูมิอากาศ					
SDG14. อนุรักษ์และใช้มหาสมุทร ทะเล และทรัพยากรทางทะเลอื่น ๆ เพื่อการพัฒนาที่ยั่งยืน					
14.1 บำบัดน้ำเสียก่อนปล่อยลงสู่แหล่งน้ำสาธารณะ					
14.2 ควบคุม และยุติการจับสัตว์น้ำที่ผิดกฎหมาย และดำเนินการตามแผนการจัดการบนพื้นฐานทางวิทยาศาสตร์ เพื่อรักษาลักษณะความหลากหลายทางชีวภาพของสัตว์น้ำ					
14.3 ผลักดันการเพิ่มความรู้ทางวิทยาศาสตร์ พัฒนาความสามารถในการวิจัยและการถ่ายโอนเทคโนโลยีทางทะเล					
SDG15. ปกป้อง ฟื้นฟู และส่งเสริมการใช้ระบบนิเวศบนบกที่ยั่งยืน การบริหารจัดการป่าไม้ การต่อต้านการแปรสภาพเป็นทะเลทราย หยุดยั้งการเสื่อมโทรมของดินและฟื้นฟูสภาพดิน และการสูญเสียความหลากหลายทางชีวภาพ					
15.1 คำนึงถึงการอนุรักษ์ ฟื้นฟู ใช้ทรัพยากรให้คุ้มค่าของระบบนิเวศ น้ำจืด ทั้งบนบกและในน้ำ โดยเฉพาะป่าไม้ พื้นที่ชุ่มน้ำ ภูเขา และพื้นที่แห้งแล้ง ที่ยั่งยืน					
15.2 ต่อต้านการทำให้ดินแห้งแล้ง รักษาที่ดิน และดินที่เสื่อมโทรม รวมถึงที่ดินที่ได้รับผลกระทบจากการกลายเป็นทะเลทราย ความแห้งแล้งและอุทกภัย					
15.3 ระดมทรัพยากรที่สำคัญจากทุกแหล่ง และทุกระดับ เพื่อสนับสนุนการจัดการป่ารวมถึงการอนุรักษ์และการปลูกป่าที่ยั่งยืน					
SDG16. สังคมสงบสุข ยุติธรรม ไม่แบ่งแยก					
16.1 ลดความรุนแรงทุกรูปแบบ และลดอัตราการเสียชีวิตลง					

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
16.2 ปราบปรามการฟอกเงินและอาวุธที่ผิดกฎหมาย					
16.3 ปราบปรามการคอร์รัปชั่น และการติดสินบนในทุกรูปแบบ รวมไปถึงการเปิดเผยข้อมูลให้สาธารณชนทราบถึงการดำเนินงานในองค์กร					
SDG17. เสริมสร้างความแข็งแกร่งของกลไกการดำเนินงานและฟื้นฟูหุ้นส่วนความร่วมมือระดับโลกเพื่อการพัฒนาที่ยั่งยืน					
17.1 ส่งเสริมการพัฒนา การถ่ายโอน และการเผยแพร่เทคโนโลยีที่เป็นมิตรกับสิ่งแวดล้อม					
17.2 องค์กรมีหน่วยงานผลักดันการพัฒนาที่ยั่งยืน					
17.3 องค์กรร่วมมือกับเครือข่ายอื่น ๆ ในการพัฒนาที่ยั่งยืน					

ส่วนที่ 3 นโยบายของ 17 เป้าหมายการพัฒนาที่ยั่งยืนของสถาบันการศึกษา

3.1 ข้อคำถามต่อไปนี้ถูกออกแบบขึ้นมาเพื่อถามถึงนโยบายการพัฒนาที่ยั่งยืนของสถาบันการศึกษา ให้คะแนนความสำคัญตามความคิดเห็นของท่าน โดยคะแนนมีลำดับตามความสำคัญ ดังนี้ 1. ไม่สำคัญ 2. ค่อนข้างไม่สำคัญ 3. ปานกลาง 4. ค่อนข้างสำคัญ 5. สำคัญมาก

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
SDG1. ขจัดความยากจนทุกรูปแบบในทุกพื้นที่					
1.1 หน่วยงานในการรับสมัคร ผลักดัน สนับสนุนนักศึกษาในประเทศที่ยากจนได้เข้าเรียน (นักศึกษาในประเทศ)					
1.2 หน่วยงานช่วยเหลือนักเรียนที่ยากจนจากประเทศอื่น เช่น ให้ทุนสนับสนุนการศึกษาฟรี					
1.3 หน่วยงานเพื่อช่วยให้ธุรกิจเริ่มต้นใหม่ (Startup) ที่ยั่งยืนผ่านการศึกษาหรือบริการที่เกี่ยวข้อง เช่น การให้คำปรึกษา การฝึกอบรมเชิงปฏิบัติการ					
SDG2. ขจัดความหิวโหย บรรลุความมั่นคงทางอาหาร ปรับปรุงโภชนาการและสนับสนุน การทำเกษตรกรรมที่ยั่งยืน					
2.1 การผลักดันหลักสูตรด้านความมั่นคงด้านอาหารและความหิวในหลักสูตรต่าง ๆ					

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
2.2 การคัดเลือกอาหารที่ดีต่อสุขภาพ และราคาไม่แพงสำหรับทุกวิทยาเขต					
2.3 ให้ความช่วยเหลือเกษตรกรในท้องถิ่น และผู้ผลิตอาหาร เข้าถึงสาธารณูปโภคในมหาวิทยาลัย (เช่น ห้องปฏิบัติการ เทคโนโลยี โรงงาน) เพื่อเพิ่มการปฏิบัติให้เกิดความยั่งยืนมากยิ่งขึ้น					
SDG3. สร้างหลักประกันให้คนมีชีวิตที่มีคุณภาพและส่งเสริมสุขภาวะทุกเพศทุกวัย					
3.1 ความร่วมมือกับสถาบันสุขภาพในท้องถิ่นหรือระดับสากล เพื่อปรับปรุงผลลัพธ์ด้านสุขภาพและความเป็นอยู่ที่ดี					
3.2 สถานที่ออกกำลังกายให้ชุมชนในท้องที่ และให้ประชาชนใช้					
3.3 นโยบายพื้นที่ปลอดบุหรี่					
SDG4. สร้างหลักประกันให้การศึกษามีคุณภาพอย่างเท่าเทียม และครอบคลุม และส่งเสริมโอกาสในการเรียนรู้ตลอดชีวิตสำหรับทุกคน					
4.1 ทรัพยากรทางการศึกษาสำหรับผู้ที่ไม่ได้เรียนที่มหาวิทยาลัย เช่น คอมพิวเตอร์ ห้องสมุด หลักสูตรออนไลน์ การเข้าฟังการบรรยาย					
4.2 เป็นเจ้าภาพจัดงานในและนอกมหาวิทยาลัยที่เปิดให้สาธารณชนทั่วไปเข้าร่วม เช่น การบรรยาย การบริการวิชาการ					
4.3 นโยบายที่รับรองว่าทุกคน สามารถเข้าถึงกิจกรรมต่าง ๆ โดยไม่คำนึงถึง เชื้อชาติ ศาสนา ความพิการ หรือเพศ					
SDG5. บรรลุความเท่าเทียมระหว่างเพศ และเสริมสร้างความเข้มแข็งให้แก่สตรีและเด็กหญิง					
5.1 การวัด ติดตามอัตราการสมัคร อัตราการตอบรับ การเข้าเรียนและอัตราการสำเร็จการศึกษาของสตรี และกลุ่ม LGBT (เลสเบี้ยน (Lesbian), เกย์ (Gay), ไบเซ็กชวล (Bisexual) และคนข้ามเพศ (Transgender/transsexual)					
5.2 นโยบาย การสมัคร การยอมรับ การเข้าร่วมและการมีส่วนร่วมของสตรี และกลุ่ม LGBT ในการเข้าเรียน					
5.3 นโยบายป้องกันการเลือกปฏิบัติ จากข้อด้อยทางการศึกษาหรือการจ้างงาน					

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
SDG6. สร้างหลักประกันให้มีน้ำใช้ และมีการบริหารจัดการน้ำและการสุขาภิบาลที่ยั่งยืนสำหรับทุกคน					
6.1 กระบวนอนุรักษ์น้ำ ส่งเสริมการใช้น้ำอย่างประหยัด เทคโนโลยีเพื่อใช้น้ำที่ยั่งยืน และการป้องกันน้ำเสียที่เข้าสู่ระบบ รวมถึงมลภาวะที่เกิดจากอุบัติเหตุด้วย					
6.2 การจัดหาน้ำดื่มฟรีให้กับนักเรียน เจ้าหน้าที่ และผู้มาติดต่อ (เช่น เครื่องกรองน้ำดื่ม)					
6.3 ความร่วมมือกับรัฐบาลท้องถิ่น ระดับภูมิภาค ระดับชาติ ระดับสากล เกี่ยวกับความมั่นคงทางน้ำ					
SDG7. สร้างหลักประกันให้ทุกคนสามารถเข้าถึงพลังงานสมัยใหม่ที่ยั่งยืนในราคาที่สามารถหาซื้อได้					
7.1 นโยบายในการปรับปรุง และการสร้างตึกใหม่ ตามมาตรฐานการใช้พลังงานในอาคารที่มีประสิทธิภาพ					
7.2 แผนที่จะการใช้พลังงานอย่างมีประสิทธิภาพ เพื่อลดการใช้พลังงาน รวมทั้งยกระดับอาคารที่มีอยู่ให้มีประสิทธิภาพการใช้พลังงานที่ดีขึ้น					
7.3 บริการแก่ท้องถิ่น เพื่อปรับปรุงประสิทธิภาพการใช้พลังงาน และพลังงานสะอาด (อาทิ การประเมินประสิทธิภาพการใช้พลังงาน การประชุมเชิงปฏิบัติการ การวิจัยพลังงานทดแทน)					
SDG8. ส่งเสริมการเจริญเติบโตทางเศรษฐกิจที่ยั่งยืนและครอบคลุม และการจ้างงานเต็มอัตรา และงานที่มีคุณค่า (Decent work) สำหรับทุกคน					
8.1 การจ่ายค่าตอบแทนให้กับอาจารย์และเจ้าหน้าที่มากกว่าหรือเท่ากับค่าครองชีพ					
8.2 สหภาพแรงงานและสิทธิแรงงาน สำหรับเจ้าหน้าที่ทุกคน รวมถึงเจ้าหน้าที่เพศหญิงและเจ้าหน้าที่ต่างชาติด้วย					
8.3 นโยบายการไม่เลือกปฏิบัติในสถานที่ทำงาน (รวมถึงการเลือกปฏิบัติจาก ศาสนา เพศ อายุ)					
SDG9. สร้างโครงสร้างพื้นฐานที่มีความต้านทานและยืดหยุ่นต่อการเปลี่ยนแปลง ส่งเสริมการพัฒนาอุตสาหกรรมที่ครอบคลุมและยั่งยืน และส่งเสริมนวัตกรรม					

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
9.1 การทำงานวิจัย ร่วมกับภาคธุรกิจ เพื่อสร้างนวัตกรรม และพัฒนาโครงสร้างพื้นฐาน ด้านวิทยาศาสตร์ เทคโนโลยี วิศวกรรม และคณิตศาสตร์ (STEM)					
9.2 การทำงานวิจัย ร่วมกับภาคธุรกิจ เพื่อสร้างนวัตกรรม และพัฒนาโครงสร้างพื้นฐาน ด้านแพทยศาสตร์					
9.3 การทำงานวิจัย ร่วมกับภาคธุรกิจ เพื่อสร้างนวัตกรรม และพัฒนาโครงสร้างพื้นฐาน ด้านศิลปศาสตร์ มนุษยศาสตร์ และสังคมศาสตร์					
SDG10. ลดความไม่เท่าเทียมทั้งภายในและระหว่างประเทศ					
10.1 นโยบายการรับสมัครที่ไม่เลือกปฏิบัติ หรือมีรายละเอียดที่อธิบายถึงเกณฑ์สำหรับนโยบายการเลือกปฏิบัติที่เหมาะสมในการรับสมัคร และประกาศเป็นสาธารณะ					
10.2 ตรวจสอบและติดตามผลของการสมัคร และการรับเข้าของกลุ่มผู้ด้อยโอกาส รวมถึงชนกลุ่มน้อย รายได้น้อย อายุมากกว่า 25 ปี ผู้หญิง นักเรียน LGBT นักเรียนพิการ เป็นต้น					
10.3 คณะกรรมการด้านความหลากหลายและความเสมอภาค เพื่อทำนโยบาย โครงการ การฝึกอบรม รวมถึงสิทธิมนุษยชนในมหาวิทยาลัย					
SDG11. ทำให้เมืองและการตั้งถิ่นฐานของมนุษย์มีความปลอดภัย ความต้านทานและยืดหยุ่นต่อการเปลี่ยนแปลงอย่างครอบคลุมและยั่งยืน					
11.1 การเปิดให้เข้าถึงพื้นที่ภายใน และภายนอกอาคาร เพื่อใช้ประโยชน์ในด้านต่าง ๆ					
11.2 การวัดหรือตั้งเป้าหมายสำหรับการคมนาคมที่ยั่งยืน เช่น การเดิน การปั่นจักรยาน การร่วมโดยสารไปในเส้นทางเดียวกันโดยรถเวียนโดยสาร ขนส่งสาธารณะ มอเตอร์ไซค์ สกู๊ตเตอร์ จักรยานยนต์คันเล็ก หรือยานหนะไฟฟ้าอื่น ๆ					
11.3 การสนับสนุนหรืออนุญาตให้พนักงานทำงานทางไกล โดยเป็นนโยบายที่มีการปฏิบัติ และมีการทำงานแบบนับชั่วโมงทำงานต่อสัปดาห์ให้ครบตามที่กำหนดไว้ เพื่อลดการเดินทางของพนักงาน					
SDG12. สร้างหลักประกันให้มีแบบแผนการบริโภคและการผลิตที่ยั่งยืน					
12.1 นโยบายด้านการจัดหาวัตถุดิบ อาหาร การค้าขาย และการกำจัดของเสีย ครอบคลุมถึงวัตถุอันตรายอย่างมีจริยธรรม					

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
12.2 นโยบายด้านการลดปริมาณการใช้พลาสติก สิ่งของที่ใช้ได้ครั้งเดียวแล้วทิ้ง					
12.3 นโยบายต่าง ๆ ครอบคลุมถึงการจัดซื้อจัดจ้าง การบริการจากองค์กรภายนอก ตลอดโซ่อุปทาน					
SDG13. ดำเนินการอย่างเร่งด่วนเพื่อต่อสู้กับสภาวะการเปลี่ยนแปลงสภาพภูมิอากาศและผลกระทบ					
13.1 สนับสนุนการใช้พลังงานจากแหล่งพลังงานที่มีคาร์บอนต่ำ เช่น ไม่ใช้เชื้อเพลิงฟอสซิล พลังงานทดแทน นิวเคลียร์					
13.2 จัดอบรมหรือให้ความรู้ในด้าน อันตราย ผลกระทบ การบรรเทา ลดผลกระทบ รวมถึงการเตือนภัยที่เกี่ยวกับการเปลี่ยนแปลงสภาพภูมิอากาศแก่บุคคลในท้องถิ่น					
13.3 แผนปฏิบัติการด้านการเปลี่ยนแปลงสภาพภูมิอากาศร่วมกับชุมชนหรือหน่วยงานท้องถิ่น					
SDG14. อนุรักษ์และใช้มหาสมุทร ทะเล และทรัพยากรทางทะเลอื่น ๆ เพื่อการพัฒนาที่ยั่งยืน					
14.1 หลักสูตร และกิจกรรมเกี่ยวกับระบบนิเวศทางน้ำ (การชลประทาน การจัดการ อนุรักษ์) สำหรับท้องถิ่น และชุมชนระดับประเทศ					
14.2 แผนในการลดการเปลี่ยนแปลงทางกายภาพ เคมี และชีวภาพของระบบนิเวศทางน้ำ					
14.3 ร่วมมือกับชุมชนในท้องถิ่นในการพยายามรักษาระบบนิเวศทางน้ำ					
SDG15. ปกป้อง ฟื้นฟู และส่งเสริมการใช้ระบบนิเวศบนบกที่ยั่งยืน การบริหารจัดการป่าไม้ การต่อต้านการแปรสภาพเป็นทะเลทราย หยุดยั้งการเสื่อมโทรมของดินและฟื้นฟูสภาพดิน และการสูญเสียความหลากหลายทางชีวภาพ					
15.1 หลักสูตรการสนับสนุน และจัดกิจกรรมเกี่ยวกับระบบนิเวศ การจัดการความยั่งยืนของทรัพยากรปฐพี สำหรับชุมชนท้องถิ่นและระดับชาติ					
15.2 ร่วมมือกับชุมชนในท้องถิ่นในการรักษาระบบนิเวศทางบก					
15.3 นโยบายลดขยะพลาสติก ขยะ และวัสดุอันตราย ในวิทยาเขต					
SDG16. สังคมสงบสุข ยุติธรรม ไม่แบ่งแยก					

เป้าหมายการพัฒนาที่ยั่งยืน (SDGs)	1	2	3	4	5
16.1 นโยบาย แนวทางปฏิบัติและความรับผิดชอบเกี่ยวกับผู้มีส่วนได้ส่วนเสีย และชุมชนภายนอกมหาวิทยาลัย					
16.2 เอกสารที่แสดงถึงหลักการและความมุ่งในการลดอาชญกรรม การคอรัปชั่น และติดสินบนในองค์กร					
16.3 นโยบายในการสนับสนุนอิสรภาพทางการศึกษา (อิสระในการเลือกแขนงการวิจัย และการนำเสนอ และสอน)					
SDG17. เสริมสร้างความแข็งแกร่งของกลไกการดำเนินงานและฟื้นฟูหุ้นส่วนความร่วมมือระดับโลกเพื่อการพัฒนาที่ยั่งยืน					
17.1 หน่วยงานที่รับผิดชอบเรื่อง นโยบาย SDGs โดยตรง รวมไปถึงการระบุปัญหา และความท้าทาย พัฒนานโยบาย ออกแบบอนาคต และแทรกแซงให้เกิดการพัฒนา ติดตาม รายงานผล และการจัดการต่าง ๆ ได้					
17.2 หน่วยงานที่ทำงานร่วมกับหน่วยสากล ทำวิจัย และทบทวน เปรียบเทียบวิธีการ และพัฒนาแนวทางปฏิบัติที่เป็นเลิศในเรื่อง SDGs					
17.3 หน่วยงานที่ทำงานร่วมกับ NGOs ภาคธุรกิจ ในการผลักดัน SDGs ผ่าน โครงการอาสาสมัคร การวิจัย (research programmes) และการพัฒนาสื่อสารการเรียนการสอน (development of educational resources)					

ขอบคุณที่เข้าร่วมตอบแบบสำรวจนี้ ทุกการตอบกลับสำคัญมากสำหรับเรา (ถ้ามี) ข้อเสนอแนะเพิ่มเติม

.....

.....

.....

.....

.....

.....

นายสิริพงศ์ จึงถาวรรณ
มือถือ/ไลน์ 095-624-2449

References

Abramo, G., & D'Angelo, C. A. (2015). Evaluating university research: Same performance indicator, different rankings. *Journal of Informetrics*, *9*(3), 514–525. https://doi.org/10.1016/j.joi.2015.04.002

Albareda-Tiana, S., Vidal-Raméntol, S., & Fernández-Morilla, M. (2018). Implementing the Sustainable Development Goals at University Level. *International Journal of Sustainability in Higher Education*, *19*(3), 473–497. https://doi.org/10.1108/IJSHE-05-2017-0069

Alonso-Almeida, M. del M., Llach, J., & Marimon Viadiu, F. (2014). A Closer Look At Global Reporting Initiative Sustainability Reporting : a Worldwide Sector a Closer Look At Global Reporting Initiative Sustainability Reporting : a Worldwide Sector Analysis. *Corporate Social Responsibility and Environmental Management*, *21*(6).

Al-Rawahy, K. H. (2013). Engineering Education and Sustainable Development: The Missing Link. *Procedia - Social and Behavioral Sciences*, *102*(Ifee 2012), 392–401. https://doi.org/10.1016/j.sbspro.2013.10.754

Alshuwaikhat, H. M., & Abubakar, I. (2008). An integrated Approach to Achieving Campus Sustainability: Assessment of the Current Campus Environmental Management Practices. *Journal of Cleaner Production*, *16*(16), 1777–1785. https://doi.org/10.1016/j.jclepro.2007.12.002

Amanda Lange, Salvia, Walter Leal, Filho, Luciano Londero, Brandli, & Juliane Sapper, G. (2019). Assessing research trends related to Sustainable Development Goals : local and global issues. *Journal of Cleaner Production*, *208*, 841–849. https://doi.org/10.1016/j.jclepro.2018.09.242

American Production and Inventory Control Society (APICS). (2016). *APICS CSCP Exam Content Manual (ECM): Module 1 Supply Chain Design* (4.0).

Annan-diab, F., & Molinari, C. (2017). Interdisciplinarity : Practical approach to advancing education for sustainability and for the Sustainable Development Goals. *International Journal of Management Education*, *15*(2), 73–83. https://doi.org/10.1016/j.ijme.2017.03.006

APICS. (2017). *SCOR: Supply Chain Operations Reference Model Version 12.0* (APICS, Ed.; 12.0). APICS.

Arnold, R. D., & Wade, J. P. (2015). A definition of systems thinking: A systems approach. *Procedia Computer Science*, *44*, 669–678. https://doi.org/10.1016/j.procs.2015.03.050

Association of University Leaders for a Sustainable Future. (2009). *Sustainability Assessment Questionnaire (SAQ) for Colleges and Universities*.

Barbat, G., Carteron, J., Hands, V., & Parkes, C. (2017). *Sulitest : A collaborative initiative to support and assess sustainability literacy in higher education lien D e Aur e*. *15*, 138–152. https://doi.org/10.1016/j.ijme.2017.02.006

Barbier, E. B., & Burgess, J. C. (2017). The sustainable development goals and the systems approach to sustainability. *Economics*, *11*(October). https://doi.org/10.5018/economics-ejournal.ja.2017-28

Basten, T., Hendriks, M., & Somers, L. (2012). Model-Driven Design-Space Exploration for Software-Intensive Embedded Systems. *10th International Conference on Formal Modeling and Analysis of Timed Systems (FORMATS 2012)*, 1–6.

Bastianoni, S., Coscieme, L., Caro, D., Marchettini, N., & Pulselli, F. M. (2019). The needs of sustainability : The overarching contribution of systems approach. *Ecological Indicators*, *100*(August), 69–73. https://doi.org/10.1016/j.ecolind.2018.08.024

Beddewela, E., Warin, C., Hesselden, F., & Coslet, A. (2017). Embedding responsible management education – Staff, student and institutional perspectives. *International Journal of Management Education*, *15*(2), 263–279. https://doi.org/10.1016/j.ijme.2017.03.013

Benjaoran, V., & Parinyakulset, P. (2018). Green initiative in Suranaree University of Technology in Thailand. *MATEC Web of Conferences*, *174*, 1–10. https://doi.org/10.1051/matecconf/201817401028

Berzosa, A., Bernaldo, M. O., & Fern, G. (2017). *Sustainability assessment tools for higher education : An empirical comparative analysis*. *161*, 812–820. https://doi.org/10.1016/j.jclepro.2017.05.194

Bidmon, C. M., & Knab, S. F. (2017). The three Roles of Business Models in Societal Transitions : New Linkages between Business Model and Transition Research. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2017.12.198

Bina, O., Balula, L., & Varanda, M. (2016). *Urban studies and the challenge of embedding sustainability : A review of international master programmes*. *137*, 330–346. https://doi.org/10.1016/j.jclepro.2016.07.034

Birta, L. G., & Arbez, G. (2013). *Modelling and Simulation: Exploring Dynamic System Behaviour* (2nd ed.). Springer.

Bjorkman, E. A., Sarkani, S., & Mazzuchi, T. A. (n.d.). Using model-based systems engineering as a framework for improving test and evaluation activities. *Systems Engineering*, *16*(3), 346–362. https://doi.org/10.1002/sys.21241

Boardman, J., & Sauser, B. (2008). *Systems Thinking: Coping with 21st Century Problems* (1st ed.). CRC Press.

Boardman, J. T. (1994a). A process model for unifying systems engineering and project management. *Engineering Management Journal*, *February*, 25–35. https://doi.org/10.1049/em:19940104

Boardman, J. T. (1994b). A process model for unifying systems engineering and project management. *Engineering Management Journal*, *February*, 25–35. https://doi.org/10.1049/em:19940104

Boonsthonsatit, K., & Jungthawan, S. (2015). Lean supply chain management-based value stream mapping in a case of Thailand automotive industry. *2015 4th IEEE International Conference on Advanced Logistics and Transport, IEEE ICALT 2015*, 65–69.

Brinkhurst, M., Rose, P., Maurice, G., & Ackerman, J. D. (2011). Achieving Campus Sustainability: Top-down, Bottom-up, or Neither? *International Journal of Sustainability in Higher Education*, *12*(4), 338–354. https://doi.org/10.1108/14676371111168269

Browning, T. R., Fricke, E., & Negele, H. (2006). Key Concepts in Modeling Product Development Processes. *Systems Engineering*, *9*(2), 104–128. https://doi.org/10.1002/sys.20047

Burmann, C., García, F., Guijarro, F., & Oliver, J. (2021). Ranking the Performance of Universities: The Role of Sustainability. *Sustainability*, *13*(23), 1–16. https://doi.org/10.3390/su132313286

Buzaboon, A., Alnaser, W., Alboflasa, H., Shatnawia, S., Albinalia, K., & Aljowder, T. (2020). Evaluation of Environmental Sustainability Higher in Education Ranking Systems: Towards a Flat Intraranking System. *Arab Gulf Journal of Scientific Research*, *38*(1), 11–28.

C. Turner, R., & Carlson, L. (2003). Indexes of Item-Objective Congruence for Multidimensional Items. *International Journal of Testing*, *3*(2), 163–171. https://doi.org/10.1207/S15327574IJT0302

Canedo, A., & Richter, J. H. (2014). Architectural design space exploration of cyber-physical systems using the functional modeling compiler. *24th CIRP Design Conference*, *21*, 46–51. https://doi.org/10.1016/j.procir.2014.03.183

Carmen, P. E., & Enrique, O.-M. (2018). Do the technical universities exhibit distinct behaviour in global university rankings? A Times Higher Education (THE) case study. *Journal of Engineering and Technology Management - JET-M*, *48*, 97–108. https://doi.org/10.1016/j.jengtecman.2018.04.007

Carmen, P.-E., & Enrique, O.-M. (2018). Do the Technical Universities Exhibit Distinct Behaviour in Global University Rankings? A Times Higher Education (THE) Case Study. *Journal of Engineering and Technology Management*, *48*(April 2017), 97–108. https://doi.org/10.1016/j.jengtecman.2018.04.007

Centers for Disease Control and Prevention. (2014). *Increasing Access to Drinking Water in Schools*.

Cesar Borges, J., Oranges, L., Capellaro, T., Cristina, A., & Caldana, F. (2017). *Student organizations and Communities of Practice : Actions for the 2030 Agenda for Sustainable Development Ot a*. *15*. https://doi.org/10.1016/j.ijme.2017.02.011

Chen, C. W., Wang, J. H., Wang, J. C., & Shen, Z. H. (2018). Developing indicators for sustainable campuses in Taiwan using fuzzy Delphi method and analytic hierarchy process. *Journal of Cleaner Production*, *193*, 661–671. https://doi.org/10.1016/j.jclepro.2018.05.082

Chin, A., & Jacobsson, T. (2016). TheGoals . org : mobile global education on the Sustainable Development Goals. *Journal of Cleaner Production*, *123*, 227–229. https://doi.org/10.1016/j.jclepro.2015.08.061

Cicmil, S., Gough, G., & Hills, S. (2017). Insights into responsible education for sustainable development : The case of UWE , Bristol. *International Journal of Management Education*, *15*(2), 293–305. https://doi.org/10.1016/j.ijme.2017.03.002

Cole, L. (2003). Assessing Sustainability on Canadian University Campuses: Development of a Campus Sustainability Assessment Framework. In *Royal Roads University*. https://doi.org/10.1002/cjce.20357

Company, G. (2002). *Sustainability Assessment of the University of Oregon* (Issue 541).

Cronbach, L. J. (1951). Coefficient Alpha and the Internal Structure of Tests. *Psychometrika*, *16*(3), 297–334. https://doi.org/10.1007/BF02310555

D. Blair, C., T. Boardman, J., & Brian, J. S. (2007). Communicating Strategic Intent with Systemigrams: Application to the Network-Enabled Challenge. *Systems Engineering*, *10*(4), 309–322. https://doi.org/10.1002/sys

Dagiliute, R., & Liobikiene, G. (2015). *University contributions to environmental sustainability : challenges and opportunities from the Lithuanian case*. *108*, 891–899. https://doi.org/10.1016/j.jclepro.2015.07.015

Davis, M. (2016). Can College Rankings Be Believed? *She Ji*, *2*(3), 215–230. https://doi.org/10.1016/j.sheji.2016.11.002

De Geus, A., & Sachs, J. (2019). Sustainable Development Report 2019: Transformations to Achieve the Sustainable Development Goals Includes the SDG Index and Dashboards. In *Pica*. https://doi.org/10.1017/CBO9781107415324.004

De la Poza, E., Merello, P., Barberá, A., & Celani, A. (2021). Universities' Reporting on SDGs: Using THE Impact Rankings to Model and Measure their Contribution to Sustainability. *Sustainability*, *13*(4), 1–28. https://doi.org/10.3390/su13042038

Disterheft, A., Ferreira Da Silva Caeiro, S. S., Ramos, M. R., & De Miranda Azeiteiro, U. M. (2012). Environmental Management Systems (EMS) Implementation Processes and Practices in European Higher Education Institutions - Top-down versus Participatory

approaches. *Journal of Cleaner Production*, *31*, 80–90. https://doi.org/10.1016/j.jclepro.2012.02.034

Dlouhá, J., & Pospíšilová, M. (2018). Education for Sustainable Development Goals in public debate: The importance of participatory research in reflecting and supporting the consultation process in developing a vision for Czech education. *Journal of Cleaner Production*, *172*, 4314–4327. https://doi.org/10.1016/j.jclepro.2017.06.145

Duke, C., & Hinzen, H. (2014). University engagement and the post-2015 agenda . What are the roles and functions to support adult education and lifelong learning ? *Procedia - Social and Behavioral Sciences*, *142*, 29–35. https://doi.org/10.1016/j.sbspro.2014.07.582

Dyer, G., & Dyer, M. (2017). Strategic leadership for sustainability by higher education: the American College & University Presidents' Climate Commitment. *Journal of Cleaner Production*, *140*, 111–116. https://doi.org/10.1016/j.jclepro.2015.08.077

Dzulkifli Abdul Razak, Zainal Abidin Sanusi, Govindran Jegatesen, & Hamoon Khelghat-Doost. (2013). Alternative University Appraisal (AUA): Reconstructing Universities' Ranking and Rating Toward a Sustainable Future. *Sustainability Assessment Tools in Higher Education Institutions*, 139–154. https://doi.org/10.1007/978-3-319-02375-5

EFMD Global Network. (2014). The Key Tool for Measuring your Business School' s Impact on the World Around It. In *EFMD Global Network*. https://doi.org/11.08.2015

Fadzil, Z. F., Hashim, H. S., Che-Ani, A. I., & Aziz, S. (2012). Developing a Campus Sustainability Assessment Framework for the National University of Malaysia. *World Academy of Science, Engineering and Technology*, *6*(6), 751–755.

Fan, X., Thompson, B., & Wang, L. (1999). Effects of sample size, estimation methods, and model specification on structural equation modeling fit indexes. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 56–83.

Ferri, G., & Sedehi, H. (2018). The System view of the Sustainable Development Goals. In *Center for Relationship Banking and Economics (CERBE)*. https://doi.org/10.4324/9781315640051-142

Foo, K. Y. (2013). A vision on the role of environmental higher education contributing to the sustainable development in Malaysia. *Journal of Cleaner Production*, *61*, 6–12. https://doi.org/10.1016/j.jclepro.2013.05.014

Food and Agriculture Organization of the United Nations. (2014). *Sustainability Assessment of Food and Agriculture Systesm (SAFA Tool) User Manual version 2.2.40*. https://doi.org/10.1016/0731-7085(90)80003-8

Freidenfelds, D., Kalnins, S. N., & Gusca, J. (2018). ScienceDirect ScienceDirect ScienceDirect ScienceDirect temperature function for a long-term heat Gusca demand forecast Silvija Nora district does environmentally sustainable higher education What does environmentally sustainable higher institution mean ? *Energy Procedia*, *147*, 42–47. https://doi.org/10.1016/j.egypro.2018.07.031

Gay, D. (2021). A Critical Reflection on International Support for Least Developed Countries. In *International Trade Working Paper* (Issue July).

Geng, Y., Liu, K., Xue, B., & Fujita, T. (2013). Creating a "green university " in China : A case of Shenyang University. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2012.07.013

Global University Network for Innovation (GUNI). (2019). *Implementing the 2030 Agenda at Higher Education Institutions: Challenges and Responses* (J. M. Vilalta, Ed.). Global University Network for Innovation (GUNI).

Gorobets, A. (2008). An independent Ukraine : Sustainable or unsustainable development ? *Communist and Post-Communist Studies*, *41*, 93–103. https://doi.org/10.1016/j.postcomstud.2007.12.002

Haertle, J., Parkes, C., Murray, A., & Hayes, R. (2017). PRME: Building a global movement on responsible management education. *International Journal of Management Education*, *15*(2), 66–72. https://doi.org/10.1016/j.ijme.2017.05.002

Hair Jr., J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate Data Analysis* (7th ed.). Pearson.

Haveman, S. P., & Bonnema, G. M. (2015). Communication of simulation and modelling activities in early systems engineering. *Procedia Computer Science*, *44*, 305–314. https://doi.org/10.1016/j.procs.2015.03.021

Holm, T., Sammalisto, K., & Vuorisalo, T. (2015). Education for sustainable development and quality assurance in universities in China and the Nordic countries: A comparative study. *Journal of Cleaner Production*, *107*, 529–537. https://doi.org/10.1016/j.jclepro.2014.01.074

Hooi, K. K., Hassan, F., & Mat, M. C. (2012). An Exploratory Study of Readiness and Development of Green University Framework in Malaysia. *Procedia - Social and Behavioral Sciences*, *50*, 525–536. https://doi.org/10.1016/j.sbspro.2012.08.056

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural Equation Modelling : Guidelines for Determining Model Fit. *The Electronic Journal of Business Research Methods*, *6*(1), 53–60. www.ejbrm.com

Horan, W., & O'regan, B. (2021). Developing a Practical Framework of Sustainability Indicators Relevant to All Higher Education Institutions to Enable Meaningful International Rankings. *Sustainability (Switzerland)*, *13*(2), 1–15. https://doi.org/10.3390/su13020629

Hoveskog, M., Halila, F., Mattsson, M., Upward, A., & Karlsson, N. (2018). Education for Sustainable Development: Business modelling for flourishing. *Journal of Cleaner Production*, *172*, 4383–4396. https://doi.org/10.1016/j.jclepro.2017.04.112

Institute of International Education. (2016). *Scholarships for Students from Developing Countries : Establishing a Global Baseline*.

Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Government Information Quarterly*, *32*(3), 221–236. https://doi.org/10.1016/j.giq.2015.07.001

Janowski, T. (2016). Implementing Sustainable Development Goals with Digital Government – Aspiration-capacity gap. *Government Information Quarterly*, *33*(4), 603–613. https://doi.org/10.1016/j.giq.2016.12.001

Jones, D. R. (2012). Looking through the "Greenwashing Glass Cage" of the Green League Table towards the Sustainability Challenge for UK Universities. *Journal of Organizational Change Management*, *25*(4), 630–647. https://doi.org/10.1108/09534811211239263

Jones, D. R. (2015). Opening up the Pandora's box of Sustainability League Tables of Universities: a Kafkaesque Perspective. *Studies in Higher Education*, *42*(3), 480–503. https://doi.org/10.1080/03075079.2015.1052737

Jöns, H., & Hoyler, M. (2013). Global geographies of higher education: The perspective of world university rankings. *Geoforum*, *46*, 45–59. https://doi.org/10.1016/j.geoforum.2012.12.014

Joyce, A., & Paquin, R. L. (2016). The Triple Layered Business Model Canvas: a Tool to Design more Sustainable Business Models. *Journal of Cleaner Production*, *135*(June 2016), 1474–1486. https://doi.org/10.1016/j.jclepro.2016.06.067

Jungthawan, S., Chearanai, T., & Suharitdamrong, V. (2017). The Framework of Lean Digital Supply Chain Transformation Case of Educational Institutions in Thailand. *The 12 Th International Congress on Logistics and SCM Systems*.

Jungthawan, S., Suharitdamrong, V., & Tiyarattanachai, R. (2019). Applying Systems Approach the Case Study of Tertiary Education Institutions in Thailand. *2019 IEEE 6th International Conference on Industrial Engineering and Applications, ICIEA 2019*, *6*, 682–688. https://doi.org/10.1109/IEA.2019.8714910

Jungthawan, S., & Tiyarattanachai, R. (2020a). Developing Factors of Sustainable Development Goals for Higher Education Institution in Thailand. *The 1st International Conference on Informatics, Agriculture, Management, Business Administration, Engineering, Science and Technology (IAMBEST2020)*, 29–40.

Jungthawan, S., & Tiyarattanachai, R. (2020b). Development of an Assessment Tool for Prioritizing Influencing Factors of Sustainability in Higher Education. *The 6th International Conference on Engineering, Applied Sciences and Technology (ICEAST 2020) Development*, *6*, 24–29.

Kaur Anand, C., Bisaillon, V., Webster, A., & Amor, B. (2015). Integration of sustainable development in higher education e a regional initiative in Quebec (Canada). *Journal of Cleaner Production*, *108*, 916–923. https://doi.org/10.1016/j.jclepro.2015.06.134

Keçetep, İ., & Özkan, İ. (2014). Quality Assurance In The European Higher Education Area. *Social and Behavioral Sciences*, *141*, 660–664. https://doi.org/10.1016/j.sbspro.2014.05.115

Khalili, N. R., Duecker, S., Ashton, W., & Chavez, F. (2015). From cleaner production to sustainable development: The role of academia. *Journal of Cleaner Production*, *96*, 30–43. https://doi.org/10.1016/j.jclepro.2014.01.099

Kim, D. H. (2000). *Systems Thinking Tools: A User's Reference Guide* (2nd ed.). Pegasus Communications.

Kim, D. H., & Anderson, V. (2011). Systems Archetype Basics: From Story to Structure. In *The Systems Thinker* (Digital Ve). Pegasus Communications.

Koester, R. J., Eflin, J., & Vann, J. (2006). Greening of the Campus: a Whole-systems Approach. *Journal of Cleaner Production*, *14*(9–11), 769–779. https://doi.org/10.1016/j.jclepro.2005.11.055

Kolb, M., Fröhlich, L., & Schmidpeter, R. (2017). Implementing sustainability as the new normal: Responsible management education – From a private business school's perspective. *International Journal of Management Education*, *15*(2), 280–292. https://doi.org/10.1016/j.ijme.2017.03.009

Koscielniak, C. (2014). A consideration of the changing focus on the sustainable development in higher education in Poland. *Journal of Cleaner Production*, *62*, 114–119.

Lauder, A., Fitri, R., Suwartha, N., & Tjahjono, G. (2015). Critical review of a global campus sustainability ranking : GreenMetric. *Journal of Cleaner Production*, *108*, 852–863. https://doi.org/10.1016/j.jclepro.2015.02.080

León, M. C., Nieto-Hipólito, J. I., Garibaldi-Beltrán, J., Amaya-Parra, G., Luque-Morales, P., Magaña-Espinoza, P., & Aguilar-Velazco, J. (2016). Designing a Model of a Digital Ecosystem for Healthcare and Wellness Using the Business Model Canvas. *Journal of Medical Systems*, *40*(6), 1–9. https://doi.org/10.1007/s10916-016-0488-3

Lozano, R. (2006). A Tool for a Graphical Assessment of Sustainability in Universities (GASU). *Journal of Cleaner Production*, *14*, 963–972. https://doi.org/10.1016/j.jclepro.2005.11.041

M. Law, A. (2014). *Simulation Modeling and Analysis (McGraw-hill Series in Industrial Engineering and Management)*. McGraw-Hill.

Malhan, A., Johnson L., L., & Pavur, R. (2022). Understanding Challenges and Solutions with Systemigrams : Application to Electronic Medical Record Systems. *Journal of International Technology and Information Management*, *30*(5).

Marshall, K. (2018). Global education challenges: Exploring religious dimensions. *International Journal of Educational Development*, *62*(April), 184–191. https://doi.org/10.1016/j.ijedudev.2018.04.005

Meadows, D. H. (2009). Thinking in systems: a primer. In *Environmental Politics*. Earthscan. https://doi.org/10.1080/09644016.2011.589585

Millot, B. (2015). International rankings: Universities vs. higher education systems. *International Journal of Educational Development*, *40*, 156–165. https://doi.org/10.1016/j.ijedudev.2014.10.004

Minister of Foreign Affairs. (2018). *Thailand's voluntary national review on the implementation of the 2030 agenda for sustainable development, June 2018* (Issue June).

Minister of Foreign Affairs. (2019). *Statement by the Prime Minister of the Kingdom of Thailand at the Opening Ceremony of the 52nd ASEAN Foreign Ministers' Meeting and Related Meetings* (Issue July).

Morse, G. D., Lombardo, J. C., Forrester, T., Fletcher, H., McDonald, A., Talal, A. H., Sethi, S., Tsuji, B., Govindaraju, V., DeHovitz, J., & Lindo, J. F. (2018). Development of a dual university system health research partnership as a foundation for the Sustainable Development Goals. *The Lancet Global Health*, *6*, S11. https://doi.org/10.1016/s2214-109x(18)30140-2

Mueller, R. O., & Hancook, G. R. (2001). Factor Analysis and Latent Structure, Confirmatory. *International Encyclopedia of the Social & Behavioral Sciences: Second Edition*, 5239–5244. https://doi.org/10.1016/B978-0-08-097086-8.42043-X

National Aeronautics and Space Administration. (2016). *Standard for Models and Simulations: NASA-STD-7009A*.

National Wildlife Federation. (2008). *Campus environment 2008: : A National Report Card on Sustainability in Higher Education*.

Nilsson, M., Chisholm, E., Griggs, D., Howden-Chapman, P., McCollum, D., Messerli, P., Neumann, B., Stevance, A. S., Visbeck, M., & Stafford-Smith, M. (2018). Mapping Interactions Between the Sustainable Development Goals: Lessons Learned and Ways Forward. *Sustainability Science*, *13*(6), 1489–1503. https://doi.org/10.1007/s11625-018-0604-z

Nixon, A. (2002). *Improving the Campus Sustainability Assessment Process*. Western Michigan University.

Nowotny, J., Dodson, J., Fiechter, S., Gür, T. M., Kennedy, B., Macyk, W., Bak, T., Sigmund, W., Yamawaki, M., & Rahman, K. A. (2018). Towards global sustainability: Education on environmentally clean energy technologies. In *Renewable and Sustainable Energy Reviews* (Vol. 81, Issue June 2016, pp. 2541–2551). Elsevier Ltd. https://doi.org/10.1016/j.rser.2017.06.060

Nuttle, T., & Bouwer, A. (2009). Supporting education about environmental sustainability: Evaluation of a progressive learning route for qualitative models. *Ecological Informatics*, *4*, 396–404. https://doi.org/10.1016/j.ecoinf.2009.09.005

Palacin-Silva, M. V., Seffah, A., & Porras, J. (2018). Infusing sustainability into software engineering education: Lessons learned from capstone projects. *Journal of Cleaner Production*, *172*, 4338–4347. https://doi.org/10.1016/j.jclepro.2017.06.078

Pavel, A. (2015). Global university rankings - a comparative analysis. *Economics and Finance*, *26*, 54–63. https://doi.org/10.1016/S2212-5671(15)00838-2

Pennsylvania State University. (2000). *Penn State Indicators Report 2000: Steps Toward A Sustainable University*.

Pipjelink, P. (2011). AISHE - Auditing Instrument for Sustainability in Higher Education. *Economy Transdisciplinarity Cognition*, *14*(1), 461–467.

Prins, R., Farr, J., McDonald, K., Fitzgerald, S., & Sanchez, D. (2015). Using Systemigrams and Fuzzy Cognitive Maps to Understand and Quantify Causality. *Proceedings of the 2015 Industrial and Systems Engineering Research Conference*, 193.

Ragazzi, M., & Ghidini, F. (2017). Environmental sustainability of universities: critical analysis of a green ranking Assessing the feasibility of using the heat demand-outdoor temperature

function for a long-term district heat demand forecast. *Energy*, *119*, 111–120. https://doi.org/10.1016/j.egypro.2017.07.054

Reddy, K. S., Xie, E., & Tang, Q. (2016). Higher education, high-impact research, and world university rankings: A case of India and comparison with China. *Pacific Science Review B: Humanities and Social Sciences*, *2*(1), 1–21. https://doi.org/10.1016/j.psrb.2016.09.004

Richter, L. M., Daelmans, B., Lombardi, J., Heymann, J., Boo, F. L., Behrman, J. R., Lu, C., Lucas, J. E., Perez-Escamilla, R., Dua, T., Bhutta, Z. A., Stenberg, K., Gertler, P., & Darmstadt, G. L. (2017). Investing in the foundation of sustainable development: pathways to scale up for early childhood development. In *The Lancet* (Vol. 389, Issue 10064, pp. 103–118). https://doi.org/10.1016/S0140-6736(16)31698-1

Roos, J. (2017). Practical wisdom: making and teaching the governance case for sustainability. *Journal of Cleaner Production*, *140*(May 2015), 117–124. https://doi.org/10.1016/j.jclepro.2015.10.135

Rosati, F., & Faria, L. G. D. (2019). Addressing the SDGs in sustainability reports: The relationship with institutional factors. *Journal of Cleaner Production*, *215*, 1312–1326. https://doi.org/10.1016/j.jclepro.2018.12.107

Rosca, E., Arnold, M., & Bendul, J. C. (2017). Business models for sustainable innovation – an empirical analysis of frugal products and services. *Journal of Cleaner Production*, *162*, S133–S145. https://doi.org/10.1016/j.jclepro.2016.02.050

Ross, D., & Laura, T. (2019). *Impact Rankings 2020: Measuring progress on the Sustainable Development Goals*.

Rovinelli, R. J., & Hambleton, R. K. (1976). On the Use of Content Specialists in the Assessment of Criterion-referenced Test Item Validity. *Laboratory of Psychometric and Evaluative Research Report*, *24*.

Ryan, J., Sarkani, S., & Mazzuchi, T. (2013). Leveraging Variability Modeling Techniques for Architecture Trade Studies and Analysis [The George Washington University]. In *The George Washington University*. https://doi.org/10.1002/sys.21247

Saadatian, O., Salleh, E., Tahir, O. M., Haw, L. C., & Sopian, K. (2011). A survey on Campus Sustainability Assessment Framework (CSAF) in Malaysia. *Journal of Design + Built*, *4*(1), 9–22.

Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., W. (2020). Sustainable Development Report 2020: The Sustainable Development Goals and Covid-19 includes the SDG Index and Dashboards. In *Cambridge University*. https://doi.org/10.1017/CBO9781107415324.004

Salvioni, D. M., Franzoni, S., & Cassano, R. (2017). Sustainability in the Higher Education System: An Opportunity to Improve Quality and Image. *Sustainability*, *9*(6), 1–27. https://doi.org/10.3390/su9060914

Sauser, B., Li, Q., & Ramirez-Marquez, J. (2011). Systemigram Modeling of the Small Vessel Security Strategy for Developing Enterprise Resilience. *Marine Technology Society Journal*, *45*(3), 88–102. https://doi.org/10.4031/MTSJ.45.3.5

Sivadasan, S., & Sauser, B. (2009). Understanding Plagiarism Using Boardman's Soft-systems Methodology. *American Society for Engineering Education*.

Sonetti, G., Lombardi, P., & Chelleri, L. (2016). True green and sustainable university campuses? Toward a clusters approach. *Sustainability (Switzerland)*, *8*(1), 1–23. https://doi.org/10.3390/su8010083

Squires, A., Pyster, A., Sauser, B., Olwell, D., Enck, S., Gelosh, D., & Anthony, J. (2010). Applying Systems Thinking via Systemigrams™ for Defining the Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE) Project. *INCOSE International Symposium*, *20*(1), 739–753. https://doi.org/10.1002/j.2334-5837.2010.tb01101.x

Squires, A., Wade, J., Dominick, P., & Gelosh, D. (2011). Building a Competency Taxonomy to Guide Experience Acceleration of Lead Program Systems Engineers. *9th Annual Conference on Systems Engineering Research (CSER)*, 1–10.

Sterman, J. D. (2000). *Business Dynamics Systems Thinking and Modeling for a Complex World.pdf* (1st ed.). McGraw-Hill.

Sterman, J. D. (2002). *System Dynamics : Systems Thinking and Modeling for a Complex World*.

Storey, M., Killian, S., & O'Regan, P. (2017). Responsible management education: Mapping the field in the context of the SDGs. *International Journal of Management Education*, *15*, 93–103. https://doi.org/10.1016/j.ijme.2017.02.009

Stough, T., Ceulemans, K., Lambrechts, W., & Cappuyns, V. (2018). Assessing sustainability in higher education curricula: A critical reflection on validity issues. *Journal of Cleaner Production*, *172*, 4456–4466. https://doi.org/10.1016/j.jclepro.2017.02.017

Sustainable Endowments Institute. (2012). *College Sustainability Report Card: A Review of Campus & Endowment Policies at Leading Institutiions*.

Suwartha, N., & Fitri, R. (2013). Evaluating UI GreenMetric as a Tool to Support Green Universities Development : Assessment of the Year 2011 Ranking. *Journal of Cleaner Production*, *61*, 46–53. https://doi.org/10.1016/j.jclepro.2013.02.034

Tavakol, M., & Dennick, R. (2011). Making Sense of Cronbach's Alpha. *International Journal of Medical Education*, *2*, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

The Association for the Advancement of Sustainability in Higher Education. (2019). *STARS Technical Manual Version 2.2* (Issue June).

Times Higher Education. (2019). *User Guide THE University Impact Rankings: Vol. 1.5.1* (Issue November). Times Higher Education.

Times Higher Education. (2020). *THE World University Rankings*.

Times Higher Education (THE). (2018). *Data Colleciton Portal: THE University Impact Rankings Version 1.5.1*.

Tiyarattanachai, R., & Hollmann, N. M. (2016). Green Campus initiative and its impacts on quality of life of stakeholders in Green and Non-Green Campus universities. *SpringerPlus*, *5*(1), 1–17. https://doi.org/10.1186/s40064-016-1697-4

Togo, M. (2008). Sustainability Assessment Using a Unit-based Sustainability Assessment Tool: The Case of Three Teaching Departments at Rhodes University, South Africa. *Southern African Journal of Environmental Education*, *25*.

Togo, Muchaiteye, & Lotz-Sisitka, H. (2009). *Unit-Based Sustainability Assesment Tool: A Resource Book to Complement the UNEP Mainstreaming Environment and Sustainability in African Universities Partnership*.

Topper, J. S., & Horner, N. C. (2013). Model-Baseed Systems Engineering in Support of Complex Systems Development. *John Hopskins Apl Technical Digest*, *32*(1), 419–432.

Torres-samuel, M., Vásquez, C. L., Cardozo, M. L., Bucci, N., Viloria, A., & Cabrera, D. (2019). Clustering of Top 50 Latin American Universities in SIR, QS, ARWU, and Webometrics

Rankings. *Procedia Computer Science*, *160*, 467–472. https://doi.org/10.1016/j.procs.2019.11.063

UN Sustainable Development Group (UNSDG). (2019). *Leaving No One Behind: A UNSDG Operational Guide for UN Country Teams* (Issue March).

United Nations. (2016). Transforming Our World: The 2030 Agenda for Sustainable Development. In *United Nations*. https://doi.org/10.1201/b20466-7

United Nations. (2019). *Sustainable Development Goals: Guidelines for the Use of the SDG Logo Including the Colour Wheel, and 17 Icons* (Issue August).

United Nations Development Programme (UNDP). (2018). What does it Mean to Leave No One Behind? A UNDP discussion paper and framework for implementation. In *UNDP discussion paper and framework for implementation* (Issue July).

Universitas Indonesia. (2020). Guideline UI GreenMetric World University Rankings 2020. In *Universitas Indonesia*. https://doi.org/10.31826/9781463235543-toc

Urquiza, F. J. (2013). *Adaptable Model to Assess Sustainability in Higher Education: Aplication to Five Chilean Institutions*. PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE ESCUELA DE.

Waheed, B., Khan, F. I., & Veitch, B. (2011). Developing a Quantitative Tool for Sustainability Assessment of HEIs. *International Journal of Sustainability in Higher Education*, *12*(4), 355–368. https://doi.org/10.1108/14676371111168278

Wang, R., & Dagli, C. H. (2011). Executable system architecting using systems modeling language in conjunction with colored Petri nets in a model-driven systems development process. *Systems Engineering*, *14*(4), 383–409. https://doi.org/10.1002/sys.20184

Watson, M. K., Lozano, R., Noyes, C., & Rodgers, M. (2013). Assessing curricula contribution to sustainability more holistically: Experiences from the integration of curricula assessment and students' perceptions at the Georgia Institute of Technology. *Journal of Cleaner Production*, *61*, 106–116. https://doi.org/10.1016/j.jclepro.2013.09.010

Yamane, T. (1973). Statistics: an Introductory Analysis. In *Harper & Row*. Harper & Row. https://doi.org/10.2307/2282703

Yaroker, Y., Perelman, V., & Dori, D. (2013). An OPM conceptual model-based executable simulation environment: Implementation and evaluation. *The Journal of The International Council on Systems Engineering*, *16*(4), 381–390. https://doi.org/10.1002/sys.21235

Zelinka, D., & Amadei, B. (2019a). A Systems Approach for Modeling Interactions Among the Sustainable Development Goals Part 2: Systems Dynamics. *International Journal of System Dynamics Applications*, *8*(1), 41–59. https://doi.org/10.4018/ijsda.2019010103

Zelinka, D., & Amadei, B. (2019b). Systems Approach for Modeling Interactions Among the Sustainable Development Goals Part 1: Cross-Impact Network Analysis. *International Journal of System Dynamics Applications*, *8*(1), 23–40. https://doi.org/10.4018/ijsda.2019010102

Zhang, Q., Prouty, C., Zimmerman, J. B., & Mihelcic, J. R. (2016). More than Target 6.3: A Systems Approach to Rethinking Sustainable Development Goals in a Resource-Scarce World. *Engineering*, *2*(4), 481–489. https://doi.org/10.1016/J.ENG.2016.04.010

Resume

Name-Surname	Mr.Siripong Jungthawan
Birth Date	15 March 1984 at Huachiew hospital, Bangkok
Address	113/3 Soi Borpla 1/5, Ladprao 101 Rd. Lane 48, Sub-district Khongchan, District Bangkapi, Bangkok 10240 Thailand Tel. 0-2736-9272
Education	2010 Master of Business Administration (General management), Ramkhamhaeng University, Bangkok 2006 Bachelor of Engineering (Industrial engineering), Silpakorn University, Nakhonpathom,
Expertise	1.) Logistics and Supply Chain Management 2.) Lean Management 3.) Sustainability in Higher Education

Experience and Research

2023 - Present	Co-founder and Chief Business Development Officer, MELOG Co., Ltd. - Develop and innovate Logistics platform for Logistics sector
2018 - Present	Founder, www.LEANxACADEMY.com - founder and editor of the website to share Lean business experiences and Lean community in Thailand
2015 - Present	Co-founder and LEAN Evangelist, Doing Less Getting More Co., Ltd. - Training and consultant with enterprises - Plan, organize, lead, and control the project for governmental units such Ministry of Industry, and Ministry of Commerce, Thailand - Researching in industrial management and business model topic
2012 - 2013	Assistant Factory Manager and Quality Management Representative, TTA Co., Ltd. (Asahi group), Samutprakarn, Thailand - Plan, organize, lead, and control the factory in these department; procurement, production, QC and QA, warehouse, and maintenance
2007 - 2011	Engineer, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakhonpathom, Thailand

	- Lecturing the bachelor student in class; Engineering Drawing, Industrial Marketing, Manufacturing process, Project for Industrial Engineering - Researching and consulting for enterprise in central region of Thailand
2006 - 2007	Industrial Engineer, Thanulux, PCL. (Saha Group), Bangkok. - Redesigning plant layout, time and work study, improvement process for more productivity