

Conference Paper

Becoming Lean: The Way towards Sustainability of Higher Educations Institutions

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Abstract

Sustainability has become a significant issue in today's business world, including in the education sector. The objective of this cross-sectional study is to examine the implications of lean higher education (LHE) implementation on HEIs sustainability performance. Data were collected from academicians at a technical university in Malaysia. The study found positive relationships between LHE and sustainability performance in terms of environmental, economic, institutional, and social. The finding implies that in order to be sustainable, a university could exert more efforts in implementing LHE practices. This study subsidized to the current literature through bridging the gap of the lacking investigations on the potentials of lean management in the context of HEIs. The Malaysian HEIs could gain benefits through providing alternative solutions and suggestions to improve their business process, moving towards achieving sustainability performance.

Keywords: Lean, Sustainability Performance, Higher Education Institutions, Malaysia

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Received: 5 August 2019

Accepted: 14 August 2019

Published: 18 August 2019

Publishing services provided by

Knowledge E

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Selection and Peer-review under the responsibility of the FGIC2019 Conference Committee.

1. Introduction

In Malaysia, sustainable development (SD) initiatives had started while the launching of the new economic policy (NEP) in the 1970s (Government of Malaysia, 2017). Afterward, a new economic model (NEM) was launched in 2009 to pursuit SD pointing high incomes, inclusivity, and sustainability (Government of Malaysia, 2017). These targets are consistent with the 2030 agenda for SD incorporating economics, social, and environmental development. One of the preferred areas in the Malaysian SD goal is the education sector (Government of Malaysia, 2017), especially the HEIs. As stated in the Education Blueprint (Higher Education) 2015-2025 (Ministry of Education Malaysia, 2015), one of the overriding national aspirations is to ensure financial sustainability. Nowadays, evidence indicated that HEIs worldwide is facing some critical issues. As

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highlighted by Montgomery (2017) the issues include the reduction of financial support and resources from governments and donors, struggle against increasing tuition fees, increasing operational costs, low student retention and completion rates, as well as pressure to deliver provision to corroborate economic development. The issues become complicated as the HEIs have a complex network of stakeholders, including students, faculty, parents, research sponsors, taxpayers, and other related educational institutions. At the same time, HEIs also have multifaceted activities done by other institutions, besides some unique HEIs activities. Among the activities are purchasing and procurement, financial assistance for students, immigration and visa operations, finance and related business activities, students admission, human resource-related activities, research and development, community service, and many more. These issues are also faced by HEIs in Malaysia, especially when the Malaysian Ministry of Education had established a rule that inspires HEIs to be independent and leverages their income by giving autonomy status to the institutions. These challenges demand a substantial commitment to embrace SD principles. Today, the sustainability agenda in the HEIs sector in Malaysia constantly magnets attention, such as environmental protection agencies, NGOs, and HEIs stakeholders. Albeit the agenda has been articulated into tactical policies, only a few HEIs have been stirring toward sustainable institutions (Abd-Razak, Abdullah, Nor, Usman, & Che-Ani, 2011). Hussin and Kunjuraman (2017) argued that the lack of understanding on the principles of sustainability within the HEIs context may cause this phenomenon, besides the fact that the concept is new and still in its infancy. Even though some studies addressed the HEIs sustainability issues, most of the studies emphasize limited dimensions of sustainability (i.e., environmental sustainability). For instances, Darus et al. (2009) and Kwami, Che-Ani, Tawil, Tahir, and Basri (2014) reported sustainable planning and strategy for Universiti Kebangsaan Malaysia (UKM). Zen and LatifSaleh (2013) deliberated the approach of institutionalizing HEIs sustainability and sustainable energy management program in Universiti Technology Malaysia (UTM). The implementation strategies for energy sustainability in UTM were also proposed by Low, Abdul, and Weng (2012). In addition, Abd-Razak, Mustafa, Che-Ani, Abdullah, and Mohd-Nor (2011) and Abdullah, Razman, and Muslim (2017) discussed the development, issues, and obstacles towards sustainable campus among four research universities in Malaysia (i.e., UKM, Universiti Sains Malaysia (USM), Universiti Malaya (UM), and Universiti Putra Malaysia (UPM)).

Leal Filho et al. (2018) included environmental, economic, social, and institutional sustainability issues as the significant challenges faced by the HEIs in their operations. In

the operations management perspective, one of the leading root causes of the issues is the existence of “waste” in their operations (Balzer, Brodke, & Thomas Kizhakethalackal, 2015; Montgomery, 2017). In the context of lean management, the waste was commonly defined as non-value added activities in operations or activities. According to Womack, Jones, and Roos (1990), waste may include any activities that absorb resources but generates no value. In order to afford a more unobstructed view on the sustainable idea and to incorporate them into the education, lean practices could be employed by HEIs in order to leverage its sustainability status and become more efficient and leaner in the way higher education operates. Even though some institutions have gained some benefits from its implementation, some institutions are currently facing issues related to its implementation. According to Montgomery (2017), the issues include lack of knowledge and experience on lean implementation, failure to recognize problems where lean is an appropriate approach to use, inappropriate practices and measures, inappropriate documentation, lack of standardization, lack of utilization of skills and talents, departmental politics, and lack of data-driven management system. Along with the issues highlighted in the literature, this study attempts to highlight the implementation of LHE practices in an HEI in Malaysia, quantify the level of its implementation, and investigate its impact on sustainability performance. The HEI in Malaysia is selected because the implementation of this principle has not well-explored besides a lack of investigations to inquiry the successful LHE implementation in the universities from the developing countries. Also, the implementation of lean and its potential effects on sustainability performance are potentially influenced by the national context (Phan & Matsui, 2010). Therefore, it is essential to keep investigating various contexts in order to establish a strong understanding of the effect of lean on sustainability, besides adding new standpoint to the state-of-the-art literature. Also, this study could contribute significantly to HEIs development in Malaysia. This paper starts with the introduction, followed by a review of the existing literature. Subsequently, research design and analysis results will be discussed. The subsequent section will present the research findings. Finally, this paper ends with implications, limitations, and suggestions for future studies.

2. Literature Review

2.1. Lean Higher Education (LHE) Practices

Lean is a method of continuous improvement in a workplace, which was initiated in Toyota Manufacturing Corporation in the 1980s. Womack et al. (1990) highlighted that lean thinking is the never-ending conversion of waste into value from the customer's viewpoint. Lean is both a methodology and management thinking, using many methods and tools, expected to enhance quality and eliminate waste. Lean can mean "less," and at the same time, "more." Less in term of wastes, cost, design time, fewer suppliers per customer, and fewer organizational layers. Conversely, it can also mean more in terms of flexibility and capability, employee empowerment, effectiveness and efficiency, customer satisfaction, quality, competitiveness, and profitability (Clare & Dennis, 2005b).

The topics of lean in the literature are broad. Nowadays, the philosophy of lean has been actively transferred to other sectors beyond the manufacturing sector, such as higher education, healthcare, pharmaceutical, tourism and hospitality, transportation, and distribution. Countless studies have addressed this philosophy to target waste elimination while leveraging organizational performance through maximizing values, understand work as a process, form a smooth flow, respond to pull and aim for perfection (Womack et al., 1990). As stated initially by Ohno (1988), there is seven cardinal waste, which lean aims to reduce. They are overproductions, inventory, defects, motions, over-processing, waiting, and transportation. Afterward, Womack and Jones (2003) familiarized the underutilized human capital as an addition to the cardinal waste. Douglas, Antony, and Douglas (2015) converted the waste in the manufacturing context to HEIs, as presented in Table 1. This study abbreviates the types of waste as TIMWOODS. These waste are endeavored to be reduced by the implementation of lean practices.

In the context of HEIs, there is a growing number of academic literature, which are emerging in the area such as Cudney, Venuthurumilli, Materla, and Antony (2018), Douglas et al. (2015), Malmbrandt and Åhlström (2013), and Narayanamurthy, Gurumurthy, and Chockalingam (2017). Even though some research has acknowledged important practices of LHE, there was no single opinion among the researchers concerning the significance of the lean practices. The lack of agreement becomes a reason why practitioners and researchers presented diverse sets of elements to cover the lean principles. The elements varied extensively based on the background of the scholars. Through an extensive literature review, this present study identified, compiled, a regrouped the scrambled practices to become seven related practices of LHE. Table 2 presents the

TABLE 1: Waste in HEIs.

Types of waste	Waste in HEIs context	Examples in HEIs
Transportation	The movement of materials (e.g., papers, multiple approvals, and hand-overs)	Multiple endorsements for conference attendance, moving paper, parts, and materials around buildings and between different departments
Inventory	More supply or materials than required. Records and documents held longer than usefully required	Too many marketing brochures, stationery, and other documents, photocopies of lecture notes, storage for all the above in offices or stockrooms
Motions	The unnecessary movement of staff and students. Departments scattered across various campuses.	Moving employees and students between classrooms or from one building to another
Waiting	Queuing for anything, waiting for documents to be approved, IT systems downtime, looking for files, books, and documents. It includes the time taken to respond to student queries	Waiting for multimedia systems to start up or classrooms to empty of previous occupants, waiting for maintenance technicians, waiting for approval, searching for books, papers, handouts, files, etc.
Over-processing	Overdesigning a product or a service. Multiple approvals or handovers. Multiple checks. A new program is launched without having the procedures ready to deliver	Too much info through e-mail, too many approvals required, and too many people involved. Too many student surveys and too many meetings
Overproduction	Producing more than what is needed. Unbalanced workload across semesters and uneven scheduling	Too many teaching handouts made in advance and then stored. The workload is uneven across semesters and timetabling of students is not level across days or weeks
Defect	Errors in inputting data and underutilized classrooms	Wrong grades input into the system, correcting, and checking data. Timetabling errors
Skills	Not using people's full talent. Giving people the wrong work	Staff not teaching their specialist subject area, not teaching postgraduate courses, no research or scholarly activity time

Source: adapted from Douglas et al. (2015)

practices and the main focus of each practice. Several studies on the implementation of lean proposed the holistic implementation of all practices simultaneously because of the complementarity nature among the practices (Furlan, Vinelli, & Dal Pont, 2011; Khanchanapong et al., 2014; Nawansir, Lim, Othman, & Adeleke, 2018). In other words, the practices are unidimensional. This implies that the implementation of one practice may support the implementation of other practices. Based on these empirical supports, this study proposes the higher order model of LHE.

A couple of studies, such as Balzer et al. (2015) and Dinis-Carvalho and Fernandes (2017) signified the positive implications of the lean implementation on the HEIs performance. For instances, Balzer et al. (2015) suggested the benefits of LHE implementation

TABLE 2: Practices of LHE.

Practices	Main focus
Waste identification	Identifying waste (i.e., non-value added activities) through value stream mapping of processes (Douglas et al., 2015; Hadid & Mansouri, 2014; Malmbrandt & Åhlström, 2013).
Work standardization	Whether or not there are standardized works and whether or not the standards are formalized (Douglas et al., 2015; Malmbrandt & Åhlström, 2013).
Level and balance workloads	Proactive efforts in service to level and balance workloads as much as possible (Douglas et al., 2015; Nawanir et al., 2018).
Built-in quality	Whether the quality is built-in or not. It is essential to ensure that quality is built-in from the start. Therefore, inspections and quality control are less required. (Malmbrandt & Åhlström, 2013).
Pull system	Focuses on the use of pull principles and the use of signal for starting an activity (Malmbrandt & Åhlström, 2013; Nawanir et al., 2018).
Multifunctional employees	Developing skills of employees in order to be multi-skilled and multi-functional (Nawanir et al., 2018).
Continuous improvement	Continuous improvement activities, employee participation in improvement agenda, improvement work, problem-solving, and improvements (Balzer et al., 2015; Thomas, Antony, Francis, & Fisher, 2015).

among universities in the US by highlighting its positive impacts on waste elimination besides also highlighting the reduction in operational costs of the HEIs after the lean implementation. The next sections of this paper will highlight the potential effects of LHE on the sustainability of HEIs.

2.2. Sustainability in HEIs

Over the most recent couple of years, some crucial investigations have been led on HEIs' engagement in executing SD agenda (Aleixo, Ulisses, & Susana, 2018a; Cebrián, Grace, & Humphris, 2015; Dyer & Dyer, 2017). There are the same cases of SD in various dimensions around the world and incorporated in the main activities of HEIs (Aleixo et al., 2018a; Fischer, Jenssen, & Tappeser, 2015). With regards to the sustainability of HEIs; while few researchers assert that SD has been applied in all HEI system (Lozano, 2011), it is perceived that a comprehensive approach has not been taken in light of the fact that activities have been classified and applied in just a single or two dimensions of the education system (Aleixo et al., 2018a; Lozano et al., 2015). Three pillars of SD have been recognized in the literature (Amaral Luís, Martins Nelson, & Gouveia Joaquim, 2015; Godemann, Bebbington, Herzig, & Moon, 2014) including environmental, social and economic sustainability. However, it is currently common to discover other SD dimensions, remarkably institutional (Aleixo et al., 2018a; Lozano, 2011; Lozano et al.,

2015) and cultural (Lozano et al., 2015). At the same time, four measurements of SD have additionally been proposed for the execution of SD in HEIs (Aleixo et al., 2018a; Lozano et al., 2015), specifically, economic, environmental, institutional/educational/political, and social/cultural (Aleixo et al., 2018a).

2.2.1. Economic sustainability

Economic sustainability refers to the sustain, safeguard, and use of resources (material and human) to generate long-range sustainable values by best recovery, use, and recycling. In other words, conserving natural resources today to ensure the forthcoming generations can fulfill their needs. The economic measurement of SD includes economic viability and classifies economic needs, for example, focus about plans to get better budget for practices encouraging SD, energy efficiency and economic performance (Aleixo et al., 2018a; Lozano, 2011). Several studies, such as Henao, Sarache, and Gómez (2018), Iranmanesh, Zailani, Hyun, Ali, and Kim (2019) and Hussain, Al-Aomar, and Melhem (2019), noted the significant positive effect of lean on economic performance indicators (e.g., profitability, profit margin, and return on investment). Also, the studies (Hines, Found, Griffiths, & Harrison, 2011; Moyano-Fuentes & Sacristán-Díaz, 2012) reported that the concept of lean positively affects economic sustainability performance. This clues the following hypothesis:

Hypothesis 1. LHE positively affects economic sustainability performance.

2.2.2. Environmental sustainability

Environmental sustainability is related to the issues about energy (petrol, electricity, solar, gas, oil, thermal, wind, and coal), transport, biodiversity (fauna and flora), water, resources like paper, computers, and ink (to eliminate their usage and their dumping as waste/pollution) and other packaging and resources being aware consumer (Aleixo et al., 2018a; Cathryn & Deborah, 2008). The environmental measurement suggests the combination of environmental with organizational strategies. For example, the construction of sustainable infrastructure on campus, sorting of waste, and its procedures for equipment and recycling to create renewable energy (Aleixo et al., 2018a; Lozano, 2011). Recent literature provided strong support on the significant impact of lean on environmental performance. Piercy and Rich (2015) and Iranmanesh et al. (2019) stated that lean met multiple sustainability consequences including environmental benefits in

terms of reduction on pollution, reduction on energy consumption while increasing the efficiency of energy usage. Other studies (Florida, 1996; King & Lenox, 2001; Moreira, Alves, & Sousa, 2010) agreed that the concept of lean affects environmental sustainability performance. This evidence leads to the following hypothesis:

Hypothesis 2. LHE positively affects environmental sustainability performance.

2.2.3. Institutional, educational and political sustainability

Institutional sustainability is associated with the execution of sustainability policies and simplification of making decisions (Pfahl, 2005). Moreover, it is about how organizations frame their values and strategy, and how diverse stakeholders sense the strategy to meet goals of SD (Lozano, 2011). The institutional sustainability also covers transparency in governance and ethical commitments of organizations (Piercy & Rich, 2015), besides organizational declarations and partnership to promote the SD (Aleixo, Azeiteiro, & Leal, 2018b). Literature included several factors to indicate this SD element, such as several types of research, training, publications, and collaborations related to campus sustainability. Looking at the LHE, it gives the impression that the LHE practices, such as value maximization, stakeholder involvement, and continuous improvement, could positively improve the institutional sustainability performance. Therefore, the following is hypothesized:

Hypothesis 3. LHE positively affects institutional sustainability performance.

2.2.4. Social and culture sustainability

Social sustainability focuses on generating successful sustainable places that encourage luxury by considering what people required from their workplaces (Scott, 2009). Social sustainability consists of corporate social responsibility (CSR) and the cases surrounding the welfare of students and staff such as safety, and workplace health, ethics, interconnectedness, inclusive community, partnerships, quality of life, integrity, respect, along with the capability to perform tasks in teams as the chance to understand and listen other's viewpoints (Aleixo et al., 2018a; Scott, 2009). It also assigns to activities either by the surrounding community or an organization's human resources for example, policies encouraging diversity and equality, participating and developing in cultural, recreational, or sports activities, initiatives and concerns for social inclusion, and scientific or cultural initiatives address the outside community (Aleixo et al., 2018a; Lozano,

2011). Also, according to Aleixo et al. (2018a), this sustainability element is associated with rules and activities regarding the labor practices and decent work, quality of life, work health and safety, training, and participation in social activities. From a systems perspective, according to Piercy and Rich (2015), lean provides social-foundation for sustainability and pairs it with a technical-system to implement improvement. Also, several studies (Mason-Jones, Naylor, & Towill, 2000; Moreira et al., 2010) agreed that the concept of lean affects social sustainability performance. Therefore, the following hypothesis is posited.

Hypothesis 4. LHE positively affects social sustainability performance.

3. Methodology

This cross-sectional study applied a quantitative design. The measurements for each indicator were adapted and adopted from several recent works of literature on lean management, and sustainable development as depicted in Appendix A. Data were collected by using a set of the close-ended survey with ordered choice questions ranging from 1 (strongly disagree) to 6 (strongly agree). In order to diminish the effect of temporary variations of the variables, the sustainability indicators were measured based on the attainments throughout the previous three years. Content validity, reliability, and brevity of the instrument were assured by relying on the judgment from experts consisting of academicians and practitioners in the area of lean and sustainability. Three hundred questionnaires were self-administered to the respondents, with 102 questionnaires were returned. However, 14 questionnaires were discarded from the analysis because of incomplete answers and outliers. Finally, 88 questionnaires were completed and usable for further analysis, with an effective response rate of 29.33%. Based on the usable responses, 43 (48.86%) of the participants were senior lecturers, 38 (43.18%) lecturers, and 7 (7.95%) associate professors. Based on their working experience, majority of the respondents (88.64%) have been working in the institution for more than five years, and 11.36% served the university for between three and five years. Based on these figures, the respondents were sufficiently knowledgeable to participate in the survey. Structural Equation Modeling (SEM) approach with SmartPLS 3.2.8 software were used to analyze the data because besides it can perform simultaneous estimation of all parameters in a model (Iacobucci, Saldanha, & Deng, 2007), it provides more comprehensive evidence about the extent to which the model is supported by data (Hair, Hult, Ringle, & Sarstedt,

2017; Latan et al., 2018). More importantly, the PLS-SEM provides a robust estimation for non-normal data and small sample size (Hair Jr, Hult, Ringle, & Sarstedt, 2016).

4. Results

4.1. Construct Validity

Construct validity confirms that a set of manifest variables represents the latent variable that is proposed to measure (Hair Jr et al., 2016). Convergent validity characterized by outer loading, average variance extracted (AVE), and composite reliability (CR) was assessed. The details of the convergent validity are depicted in Appendix A. It shows that all outer loadings are higher than 0.50, AVE values are more than 0.50, and CR values are above 0.70. Besides, as this study proposed a second-order model, the convergent validity of the 2nd order construct was also assessed. The assessment on the second-order model shows that outer loadings ranged from 0.713 to 0.880, AVE is 0.660, and CR is 0.930. Therefore, the convergent validity of both first and second-order constructs are satisfactory. Furthermore, discriminant validity was also measured to reflect the extent to which each of the constructs is unique and not redundant with other constructs (Hair Jr et al., 2016). The discriminant validity was examined by using the Heterotrait-Monotrait ratio of the correlations (HTMT) reflecting the average of the heterotrait-heteromethod correlations relative to the average of the monotrait-heteromethod correlations (Hair Jr et al., 2016). Table 3 shows the results of HTMT assessment indicating the sufficient discriminant validity with the highest HTMT values of 0.871, which is below the threshold value of 0.90 (Gold, Malhotra, & Segars, 2001). In a nutshell, the measurement model provided a satisfactory construct validity.

TABLE 3: Discriminant validity: Heterotrait-monotrait Ratio Statistics (HTMT).

	BINQ	CIMP	ECSP	ENSP	ISP	LBW	MFE	PULL	SSP	WID	WSTD
BINQ											
CIMP	0.741										
ECSP	0.537	0.754									
ENSP	0.619	0.390	0.584								
ISP	0.690	0.736	0.871	0.594							
LBW	0.671	0.663	0.652	0.528	0.619						
MFE	0.868	0.866	0.675	0.590	0.729	0.697					
PULL	0.828	0.660	0.629	0.644	0.733	0.579	0.647				
SSP	0.733	0.787	0.760	0.606	0.868	0.663	0.803	0.736			
WID	0.520	0.435	0.477	0.442	0.523	0.505	0.379	0.671	0.559		
WSTD	0.701	0.652	0.576	0.629	0.640	0.715	0.652	0.779	0.699	0.692	

Note: BINQ = Built-in Quality; CIMP = Continuous Improvement; ECSP = Economic sustainability performance; ENSP = Environmental sustainability performance; ISP = Institutional sustainability performance; LBW = Level and Balance Workload; MFE = Multi-functional Employees; PULL = Pull System; SSP = Social Sustainability Performance; WID = Waste Identification; WSTD = Work Standardization.

4.2. Structural Model Assessment: Hypothesis Testing

The hypothesized path model is presented in Figure 1. This study hypothesized that the implementation of LHE practices positively affects sustainability performance indicators (i.e., economic, environmental, institutional, and social sustainability performance). The PLS bootstrapping based on 5000 bootstrap samples to derive a 95 percent bias-corrected confidence interval was applied to test the hypotheses (Preacher & Kelley, 2011). Table 4 shows that all the standardized beta values relating to the LHE and dependent variables are significant at $p < 0.05$ ($t > 1.645$) with non-zero confidence intervals. As the intervals are zero free, the positive relationships between LHE and all the sustainability performance indicators (economic, environmental, institutional, and social sustainability performance) are tenable. Therefore, all the hypotheses are supported.

TABLE 4: Summary of Hypotheses Testing.

Hypotheses	Path	Std. Beta	Std. Error	t-value	Bias	Confidence Interval		R ²	Q ²	Decision
						5%	95%			
H1	LHU → ECSP	0.698	0.068	10.297	-0.007	0.571	0.793	0.488	0.374	Supported
H2	LHU → ENSP	0.622	0.091	6.824	-0.005	0.440	0.740	0.387	0.257	Supported
H3	LHU → ISP	0.766	0.055	13.928	-0.003	0.657	0.839	0.587	0.426	Supported
H4	LHU → SSP	0.807	0.044	18.349	-0.001	0.714	0.859	0.650	0.458	Supported

Note: $p < 0.05$ (1 tailed test)

R² values indicating the coefficient of determinations were used to assess the amount of explained variance in the endogenous constructs. According to Hair Jr et al. (2016), the R² values of 0.25, 0.50, and 0.75 for targeted constructs are considered weak, moderate, and substantial, respectively. Table 4 shows the R² values for all endogenous latent variables in the hypothesized model. Based on the table, there is a medium effect of LHE on economic sustainability performance with R² = 0.488, which indicates that LHE explains 48.80% of the total variances in economic sustainability performance. Also, the LHE explains 38.70%, 58.7%, and 65% of the total variances in the environmental,

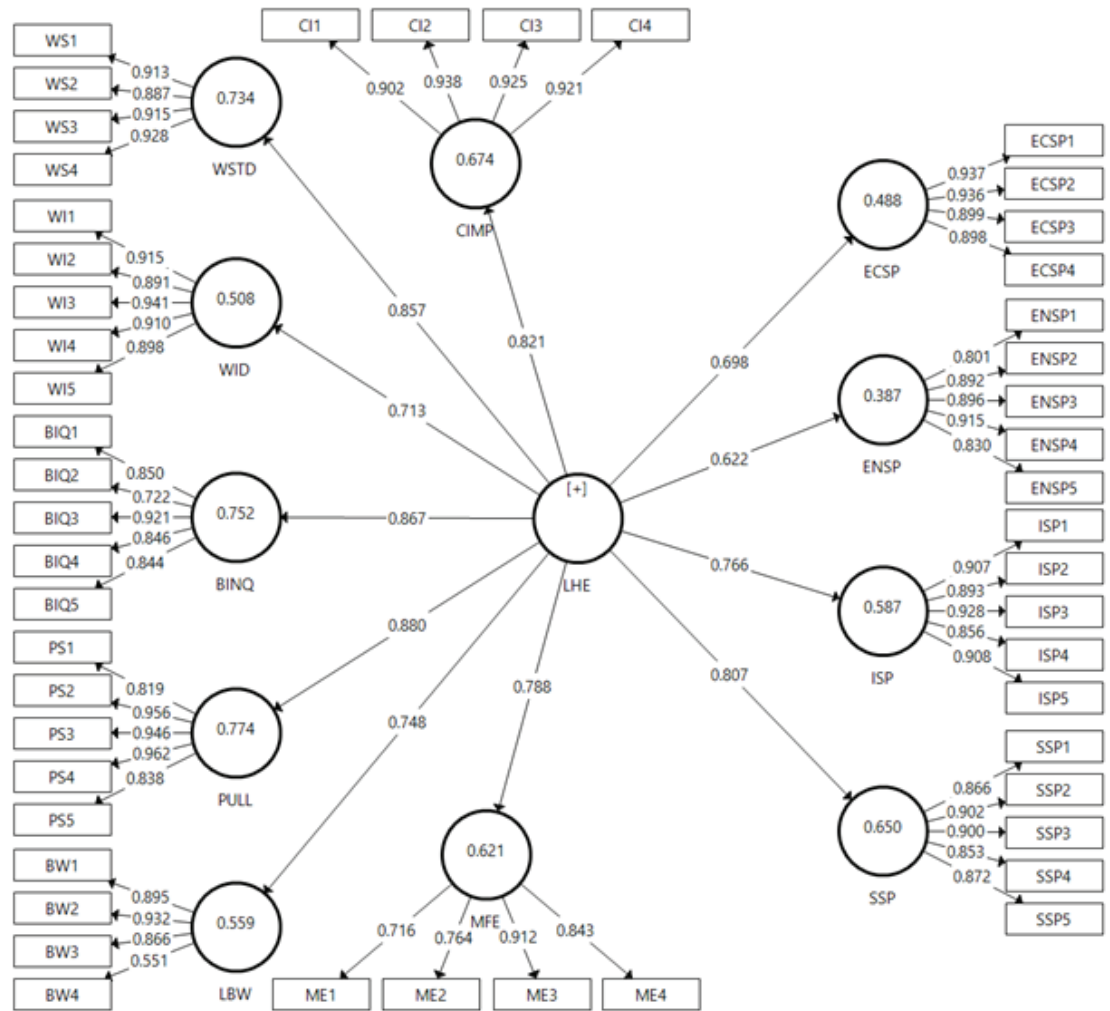


Figure 1: Hypothesized PLS Path Model.

institutional, and social sustainability performance, respectively. Hence the effects of LHE on economic and environmental performance are medium, whereas its effects on institutional and social performance are substantial. Also, a blindfolding was applied to ensure the predictive relevance (Q^2) of the model. The Q^2 shows the ability of a model in predicting endogenous variables. The results were obtained through the variable score from which cross-validated redundancy is extracted. Q^2 shows the relevance of 0.374, 0.257, 0.426, and 0.446, respectively, for economic, environmental, institutional, and social sustainability performance. As the Q^2 values in all the endogenous variables are more than zero, the model has a predictive relevance (Hair et al., 2017).

5. Discussion

This study was aimed at empirically investigating the effects of LHE on sustainability performance indicators. Four hypotheses relating LHE with each sustainability performance indicators (i.e., economic, environment, institutional, social) were tested by using PLS-SEM approach. The significant relationship between LHE and economic performance was proven with a confidence interval ranging between 0.571 and 0.793 and the estimated path coefficient β -value of 0.698. Based on the derived results, LHE practices were verified to be able to contribute to economic sustainability performance positively. Thus, it implies that in order to enhance economic sustainability performance, the universities could exert more efforts on implementing LHE practices. The respondents believed that LHE practices might increase the university's overall financial performance, return on investment, and energy efficiency while reducing the university's operational costs. The outcome of the present study provides further confirmation of previous studies (Hines et al., 2011; Martínez-Jurado & Moyano-Fuentes, 2014; Moyano-Fuentes & Sacristán-Díaz, 2012), which agreed that the concept of LHE has a positive effect on economic sustainability performance as they highlight the factors that clarify the sustained operational and financial consequences from the lean operation in the medium- and long-range.

The significant positive relationship between LHE and environmental sustainability performance was supported with the confidence interval ranging between 0.440 and 0.740, and the estimated path coefficient of 0.622. This result provides evidence that the employment of LHE contributes significantly to the achievement of environmental performance. It infers that to improve environmental sustainability performance, the universities should extensively apply LHE practices. The respondents believed that LHE practices lead to the use of energy-efficient equipment, tools, and machines; while reducing the consumptions of water, electricity, and fuel, besides the significant reduction in solid waste. This is because the main objective of LHE is to eliminate all types of waste in HEIs. This indicates that respondents believe that LHE practices could assist in increasing the university environmental performance and leading it to be more notable. The outcome of the present study confirms some of the previous studies, such as those of Florida (1996), King and Lenox (2001), and Moreira et al. (2010). These authors agreed that the concept of LHE positively affects environmental sustainability performance, as according to them that lean practices found to be inherently capable of facilitating the attainment of environmental objectives and enhancements in environmental outcomes.

Moreover, the study also found the significant relationship between LHE and institutional sustainability performance, with a path coefficient value of 0.766 and confidence interval ranging between 0.657 and 0.839. This finding implies that LHE practices are proven to be able to contribute positively to institutional sustainability performance. It implies that there is a simultaneous contribution of LHE practices to heighten institutional performance. The respondents tend to agree that the implementation of LHE may enhance the awareness and understanding among the HEIs stakeholders regarding the sustainable development-related issues. Also, this finding clues that LHE improve awareness among the stakeholders regarding the institutions' values as well as affect the way how the stakeholders perceived the visions, missions, values, and objectives of the institution (Aleixo et al., 2018a). Specifically, the number of researches to promote campus sustainability could be increased, besides the increase in the number of research and development projects related to the university's sustainable development, and participation of stakeholders in on-campus sustainable development activities.

Finally, the positive effect of LHE on social sustainability performance was supported with a confidence interval ranging between 0.714 and 0.859 and the estimated path coefficient of 0.807. The analysis revealed that LHE practices synergistically improve social sustainability performance. This suggested that the respondents believe that the implementation of LHE practices could encourage the outstanding application of HRM principles in universities, outstanding support service, excellent occupational health service, impactful CSR, and beneficial recreational, cultural or sports activities. Meaning to say, the respondents believe that LHE practices could assist the improvement of the overall social sustainability performance and driving it to be more outstanding. The outcome of the present study supports some previous studies, such as Mason-Jones et al. (2000), Moreira et al. (2010), and Womack et al. (1990) which agreed that the concept of lean affects social sustainability performance. According to Moreira et al. (2010), it is insufficient for institutions to achieve their performance; they must also manage their business conscientiously, and to be aware of the impact of their activities on society.

6. Conclusion and Implications

To conclude, this study provided empirical evidence that LHE practices contribute positively to sustainability performance in term of economic, environmental, institutional, and social. It implies that to enhance sustainability performance, the HEIs could exert more

efforts on implementing LHE practices within the institutions. This study contributes to the body of knowledge in bridging the gap of the lack of study in the HEIs context focusing on the effect of LHE towards sustainability performance in term of economic, environment, institutional and social as it is considered a new idea, especially in the Malaysian HEIs. This paper also contributes to the practitioners, such as policymakers of HEIs through providing the areas that enable them to survive and thrive and to decide whether to invest in these areas or not (Doman Mark, 2011). More importantly, this study is potential to contribute by providing the causes of the high operating costs, which are found to be wasted while proposing the methods that enable HEIs to eliminate the waste and reduce the operating costs.

7. Limitation and Suggestion for Future Research

While this study provides several contributions practically and theoretically, some limitations should be highlighted, which in turn may provide opportunities for upcoming studies. The first limitation is related to the context of the study, which focused on a single technical university in Malaysia. Even though the data were collected from different faculties and centers, the implementations of LHE concepts in each faculty and center closely resemble with each other as they are still under the same umbrella. The future studies should focus on multiple institutions, which can provide a more unobstructed view related to LHE implementation and its implications on the sustainability of Malaysian HEIs. Second, the sample of this study consisted of 88 academicians from a university, which could be considered small. Even though the data were analyzed by using SmartPLS, which is robust and effectively able to address the issue of sample size, future study should consider larger sample size, which will help to generate more convincing results. Third, this study is a cross-sectional study in which the data were collected once and represented at one point in time. As discussed in the literature, lean management is a long-term initiative and requires a long-term commitment (Vamsi Krishna Jasti & Kodali, 2014), and their benefits sometimes cannot be realized in the short term. Given that, the effect of lean university principles on economic, environmental, institutional, and social sustainability performance can be analyzed relative to the time of their implementations. In other words, a longitudinal study would be essential to accurately examine how LHE principles leverage the institutions' sustainability.

Acknowledgment

We want to thank Faculty of Industrial Management and FIM's Governance and Integrity Centre, Universiti Malaysia Pahang for the financial support by sponsoring this paper to be presented in the FGIC 2nd Conference on Governance and Integrity 2019.

Appendix A: Measurement Items

Construct	Code	Item	Literature Support	Outer loading	AVE	CR
BINQ	BIQ1	In general, our employees have high-quality awareness	Ahlstrom (2004); Malmbrandt and Åhlström (2013)	0.850	0.704	0.922
	BIQ2	We implement methods of assuring quality in work without having to control.		0.722		
	BIQ3	Most areas are actively working to ensure built-in quality.		0.921		
	BIQ4	Employees control quality themselves before finishing a job.		0.846		
	BIQ5	Work tasks have been specifically designed to assure that quality is built-in		0.844		
LBW	BW1	We have proactive planning to balance workloads among the employees	Apte and Goh (2004); Malmbrandt and Åhlström (2013)	0.895	0.681	0.892
	BW2	Our employees' workloads are relatively fixed from time to time.		0.932		
	BW3	We emphasize a more accurate forecast to avoid overload in activities		0.866		
	BW4	We emphasize to equate workloads on each employee		0.551		
CIMP	CI1	All employees actively participate in process improvement where they are part of	Malmbrandt and Åhlström (2013); Womack et al. (1990)	0.902	0.850	0.958
	CI2	Continuous improvement is part of everyday work for all employees		0.938		
	CI3	Employees are proficient in problem-solving techniques for continuous improvement		0.925		

Construct	Code	Item	Literature Support	Outer loading	AVE	CR
	CI4	We have clear focuses for continuous improvement		0.921		
MFE	ME1	If an employee has no/fewer jobs, she/he can do other works within the same department/division	Bowen and Youngdahl (1998); Malmbrandt and Åhlström (2013)	0.716	0.660	0.885
	ME2	If one employee is absent, another employee can take the same responsibilities		0.764		
	ME3	Our employees are capable of performing several different jobs		0.912		
	ME4	Our staff are cross-trained in order to be able to perform several different jobs		0.843		
PULL	PS1	Most of the operations in our university are performed based upon specific needs	Malmbrandt and Åhlström (2013); Radnor (2010)	0.819	0.821	0.958
	PS2	We do a particular job as necessary, no more and no less		0.956		
	PS3	Each step in the chain of processes is aware of the status of the previous and next step of the operations		0.946		
	PS4	Each step has a signal for when to start working		0.962		
	PS5	We do a particular job only when requested for by its users		0.838		
WID	WI1	We conducted value stream mapping to identify non-value-added activities at our university	Malmbrandt and Åhlström (2013); Stentoft Arlbjørn, Vagn Freytag, and de Haas (2011)	0.915	0.830	0.961
	WI2	Non-value-added activities are identified based on recurring internal problems		0.891		
	WI3	Non-value-added activities are identified based on the customer perspective		0.941		
	WI4	Process maps are visualized in the workplace		0.910		
	WI5	Process maps are updated regularly		0.898		
WSTD	WS1	We use formal work standards in most of the work areas	Malmbrandt and Åhlström (2013); Papadopoulos, Radnor, and Merali (2011)	0.913	0.829	0.951

Construct	Code	Item	Literature Support	Outer loading	AVE	CR
	WS2	We have explicit, detailed and written standards for most of the jobs		0.887		
	WS3	Our work standards are continuously challenged and updated		0.915		
	WS4	We standardize the works to reduce works' processing times		0.928		
ECSP	ECSP1	Overall return on investment has increased	Aleixo et al. (2018a); Lozano et al. (2015)	0.937	0.843	0.955
	ECSP2	Energy efficiency has increased		0.936		
	ECSP3	Operational costs of our university have reduced		0.899		
	ECSP4	Overall financial performance of our university has been outstanding		0.898		
ENSP	ENSP1	Water consumption has significantly reduced	Aleixo et al. (2018a); Lozano et al. (2015)	0.801	0.753	0.938
	ENSP2	The use of electricity has significantly reduced		0.892		
	ENSP3	Total fuel consumption used in transportation has significantly reduced		0.896		
	ENSP4	Solid waste disposals have significantly reduced		0.915		
	ENSP5	The number of energy efficient equipment has increased		0.830		
ISP	ISP1	The number of researches to promote campus sustainability has increased	Aleixo et al. (2018a); Lozano (2011)	0.907	0.808	0.955
	ISP2	Level of stakeholders' understanding of the sustainability issues has increased		0.893		
	ISP3	The number of R & D projects on university's sustainable development has increased		0.928		
	ISP4	Participations of our staff in on-campus sustainable development activities have increased		0.856		
	ISP5	Overall institutional sustainability performance of our university has been outstanding		0.908		

Construct	Code	Item	Literature Support	Outer loading	AVE	CR
SSP	SSP1	Practices of human resource management in our university have been outstanding	Aleixo et al. (2018a); Lozano (2011)	0.866	0.772	0.944
	SSP2	Student residence services have been outstanding		0.902		
	SSP3	Our occupational health service has been outstanding		0.900		
	SSP4	Recreational, cultural or sports activities (e.g., sports events) were done more frequent		0.853		
	SSP5	Corporate social responsibility (CSR)-related activities have done frequently		0.872		

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