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Experiencing Lean soft lean factors in Higher Education

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Abstract

Purpose – Lean Management plays an important role in improving the delivering quality systems in higher education institutions. Despite this, the adaptation of soft lean and lean tools remains a concept and early stages in higher education. Hence, the objective of this study is to investigate and perform a structural equation modeling analysis of the lean management construct in higher education.

Design/methodology/approach – Questionnaires were distributed to 128 Technical Vocational Educational Training (TVET) institution higher education, both Polytechnic, and Community Colleges. Analysis of the data was performed using the Statistical Statistical Package for the Social Science (SPSS) and Partial Lease Square (PLS-SEM).

Findings – The results from the current study demonstrated that Data were obtained from 383 respondents from top management and lean officer posts among TVET institutions. This paper presents the results of the measurement model analysis and structural equation model in soft lean practices in higher education. The study highlighted that soft lean determined positive change in the institutions and that strong leadership, employee commitment as well teamwork with appropriated lean tools were the keys to successfully enhancing cost-efficiency implementation of Lean.

Research limitations/implications – The study has several limitations; for instance, the sample of this study was drawn only from TVET higher education. The research may have been extended to other higher education institutions.

Practical implications – A road map to guide an effective, soft lean, and lean tools transformation of lean management in HEIs is proposed, while potential areas in which HEIs could be improved are presented**.** The results show four LHE constructs that are acceptable for further analysis.

Originality/value – This may be the first study to report project examples of soft lean and lean tools in Higher Education. The study outcomes can also be used as benchmarks with related studies in other Higher Education fields so the impact of certain management practices of lean management can be better understood.

Keywords: Lean Management; lean higher education; soft lean, leadership, employee commitment, teamwork, lean tools, cost efficiency, measurement equation modeling; structural equation modeling; higher education

Paper type - Research

1.0 Introduction

Higher education refers to a structural management institution that consists of a mass service sector with highly labor-intensive needs, with fundamental participation by academics and administrators. Higher education symbolizes students in an organization as a subculture with norms, values, practices, beliefs, and assumptions that guide the behavior of an individual and a group of people in an event, or action on and off-campus (Bendermacher *et al.*, 2017) to enhance systematic evaluation systems and quality improvements.

Therefore, the higher education system must move from its traditional pathway to a more value-added process of implementation in technical and vocational training to guarantee the fiscal sustainability of the tertiary learning structure by decreasing HEIs' dependence on government funds and by requesting that the direct stakeholders assist in the efforts. On behalf of this aspiration, the Malaysian Government established a regulation that has inspired HEIs to be autonomous and leverage their revenue by granting institutions self-governing capability and ensuring that higher education in Malaysia remains relevant and efficient (Malaysia Education Blue Print, 2015-2025).

The policy accelerated to TVET institutions in the 11th Malaysian Development Plan 2016-2020 which comprises refining the job market to hasten commercial development, changing components in TVET to fulfill industry's requirements, consolidating lifelong education for the improvement of skills, and increasing the quality of the education system to enhance learners' outcome and boost the efficiency of learning institutions. It is also aligned with UNESCO's 2030 Agenda for Sustainable Development Goals (SDG4) where it aspires to ensure an inclusive and equitable higher quality education system.

The implementation of the needs analysis has provided quality, relevant, and receptive Polytechnic and Community College education that accomplishes the trials of globalization, non-compliance issues, as well as fulfill the

nation's requirement for a higher-income economy. These were formulated and are responsible for in enhancing the objective of ensuring that higher education in Malaysia remains relevant and efficient according to the First Phase Strategic Plan 2018-2022 (JPT SP 2018-2022) and Second Phase 2021-2025 (Ministry of Higher Education Malaysia, 2017).

Another issue raised is the reduction in government funding which causes the initiative to consider activities that provide added values and elimination of waste in higher education which is contained in the lean philosophy toward continuous improvement as well as respect for people to sustain the reducing costs. With these issues in mind, this paper aims to assess the implementation of lean management in increasing institution governance. Additionally, this paper looks at the methods of implementation of lean in TVET institutions. Furthermore, there are numerous studies in lean beneficial (Antony, 2014; Thomas *et al.*, 2017; Vukadinovic, Djapan and Macuzic, 2017; Sremcev *et al.*, 2018) but very limited studies pursue in empirically with quantitative numbers to generalizable the finding. This research aims to identify experiences of soft lean implementation in HEIs to facilitate the initiation and to share best practices of Lean with appropriate lean tools.

2.0 Theoretical issues of Lean implementation in higher education

Overview of Lean

The notion of Lean is not novel; large and small business organizations worldwide have applied the approach in numerous arrangements for many years. The label given to Lean can define the act of sustaining an insistent emphasis on delivering values to consumers, revering individuals, and implementing a stance of non-stop knowledge acquisition (Warren, 2019) and daily advancements. Individuals who adopt Lean appear to be relentlessly dedicated in their practices and routines, not as a trend but as a fixed culture (Williams, 2007).

Lean employs methods to decrease disparities and eradicate wastage in the long run for improving value, not only domestically, but also internationally, through the entire "value stream" that will be generated precisely at the appropriate occasion from customers' demand. Lean not only focuses on outcomes in its leadership but emphasizes on how those outcomes can be attained, by creating customer value and employees' capabilities. Lean creates long-term affiliations, fitness-based processes, development of individuals, culture, and leadership for consistent resolutions of complications (de Almeida *et al.*, 2017; Solaimani, Haghighi Talab and van der Rhee, 2019) with all stakeholders, which include employees, managers, owners, suppliers, customers, community, society, and the environment.

Lean Management

Lean Management revolves around two substantial ideals: respecting others and improving continuously. Lean thinking has been highlighted as a substantial operational philosophy at improving quality (Shradha Gupta Monica Sharma Vijaya Sunder M, 2016; Yorkstone, 2016); it approaches and focuses on "what, when, and where" a customer needs (Helio Aisenberg Ferenhof, Andre Henrique Da Cunha, Andrei Bonamigo, 2017) maximum value (Paro and Gerolamo, 2017). Lean thinking is described as a set of practices that creates value, removes waste, and reduces cost (Paro and Gerolamo, 2017), which occurs in many organizations as part of change management (Uluskan, McCreery a, nd Rothenberg, 2018). Thus, lean thinking may solve problems continuously and improve the whole organization's material and information flow processes (Raju, 2021).

Lean Higher Education

In the context of higher education, the lean improvement process includes approval of course content (Emiliani, 2006), Lean teaching in teaching experience and teaching outcomes for students and ultimately to create value to employers and society at large with one main goal of Lean is to increase the value of goods and services for end-uses customers(Simonyte, Adomaitiene and Ruzele, 2021).

A systematic flow can be achieved when there is a reduction of varying processes (Williams, 2015). Accordingly, if a higher education institution implements a steady process without any discrepancies, the lean thinking system could be applied efficaciously. According to Liker and Morgan (2006), lean thinking does not only focus on the implementation of instruments but also on human resource management with integrated process or method, which promotes "task alignment" (Serina Al-Haddad Timothy Kotnour, 2015), re-organized by people or human-based practices (Helio Aisenberg Ferenhof, Andre Henrique Da Cunha, Andrei Bonamigo, 2017; Sangwa and Sangwan, 2018) and instruments to produce a comprehensible system in lean thinking execution (Srichuachom, 2015). Jones and Mitchell (2006) in a previous study, mentioned that the reduction of accidents and mistakes will allow for work to be done sooner, improve throughput while using the same resources, and accelerate momentum in developing a standard system in lean management (Theresa Waterbury, 2015).

LHE principles and practices are absorbed into the culture of tertiary-learning institutions, involving faculty and staff in analyzing and enhancing the underlying procedures of higher education to ensure effectiveness and efficiency. LHE focuses on two categories: respecting others (Coetzee, van Dyk and van der Merwe, 2019), and continuous improvement (Byers, 2019). The foundation of lean is to sustain financial improvement (Koromyslova *et al.*, 2018) and cost reduction objectives (Narayanamurthy, Gurumurthy and Chockalingam, 2017) as a huge and potential strategy in solving the problems for inadequate funding (William K Balzer Michelle H Brodke Elsy Thomas Kizhakethalackal, 2015; Magalhães *et al.*, 2019), inefficient remediation, lack of development in learning opportunities, and the usage of core technology in delivering instructions and administrative support.

Balzer 2015 proposed measures to run lean in HEI on respective activities starting with small Lean projects and gradually moving to broader initiatives(Balzer *et al.*, 2016) by identifying process recipients and the things they value most; analyzing the current process to eliminate waste by improving the flow between the remaining steps; reshape new processes using appropriate Lean tools and techniques to

reduce waste, improve flow and meet - or exceed - what recipients want; implement and evaluate new processes using metrics that reflect what beneficiaries expect from the process; and constantly repeating activities and achieving perfection (Raju, 2021). With this Lean tools can shape decisions during Lean implementation. HEIs have a unique culture, structure, and process(Lu, Laux, and Antony, 2017)

In conclusion, the term lean is pronounced and recognised in higher education for process improvement, to refer and report continuous improvements, business improvements, service improvements, and project management. The term to be used in research is Lean Higher Education and implemented in human resources, finance, academic department, student facilities, administration, counseling, and information technology. (Yorkstone, 2019).

Overview of Lean Practises in Malaysia

The notion takes place where the implementation of lean higher education in Malaysia started in University Putra Malaysia (UPM) in 2013 after the continuation of the organization's successful quality management implementation program. Previous research studied the lean thinking concept regarding awareness by postgraduate students in construction from the Faculty of Civil Engineering, University Technology Mara (UiTM). Another study had been conducted in resources optimization at University Technology MARA (UiTM), which identified thirty-five (35) types of waste and the actions are taken to eliminate the waste by category (Raju, 2021).

Lean management has been a tested and proven tool in achieving significant performance to reduce operational costs (Suhaimi *et al.*, 2017). University Utara Malaysia (UUM) had applied lean management in their library system to identify the agreed level of waste in the UUM library and to analyze the issues about the existence of waste in the library by comparing demographic factors. The findings comparison was linked to the offering, inventory management, and processing time (Choo Han Yau, Lee En Shin, Lok Yee Peng, Ng Shi Hui, 2013). The International Islamic University of Malaysia (IIUM) had researched the level of lean awareness in the Faculty of Engineering (FoE) as a case study for a local university. It sought to find typical FoE staff's perception of lean regarding its advantages and impediments in implementation. A web-based survey using questionnaires was conducted for 215 respondents comprising FoE's academic and administrative staff. The findings summarized that the level of lean awareness among the university's community was low, which might have hindered the lean concept implementation at that time, since it was still in the early stage as a new style of philosophy, especially in Malaysia's tertiary-learning institutions (Azim Khairi and Rahman, 2018).

Lean Consultant and Agency in Malaysia

The Malaysian Productivity Corporation (Abbreviated MPC) is a Statutory Body under the Ministry of International Trade and Industry (Abbreviated MITI) responsible for coordinating lean management to increase efficiency. among the lean practices applied are Kaizen practices, process improvement, and best practices in specific areas among employees are fundamental things that will contribute to basic development and excellence(Malaysia Productivity Corporation (MPC), 2013). Lean Management is also recognized by the SIRIM Best Practice Recognition Scheme. Recognition is given to organizations that have a track record in translating strategy into action and constantly strive to improve performance. The Lean Management recognition scheme is offered to organizations from all sectors. Currently, lean management recognition has been conducted for good practices of companies and small and medium enterprises (SMEs) (SIRIM, 2017)(Mahathir Fansuri Azizan, 2014). Meanwhile, lean activity training was conducted at the Aminuddin Baki Institute (Abbreviated IAB) of the institute of education management and Universiti Putra Malaysia (Abbreviated UPM) in Malaysia which enhanced training for staff in the top management of schools on lean.

Lean Practices in TVET institution

Currently, the lean activities have been adapted in administration process enhancement. The histogram below displays the numbers of lean activities divided by clusters conducted in higher education Polytechnic and Community College explain in figure 2.1:

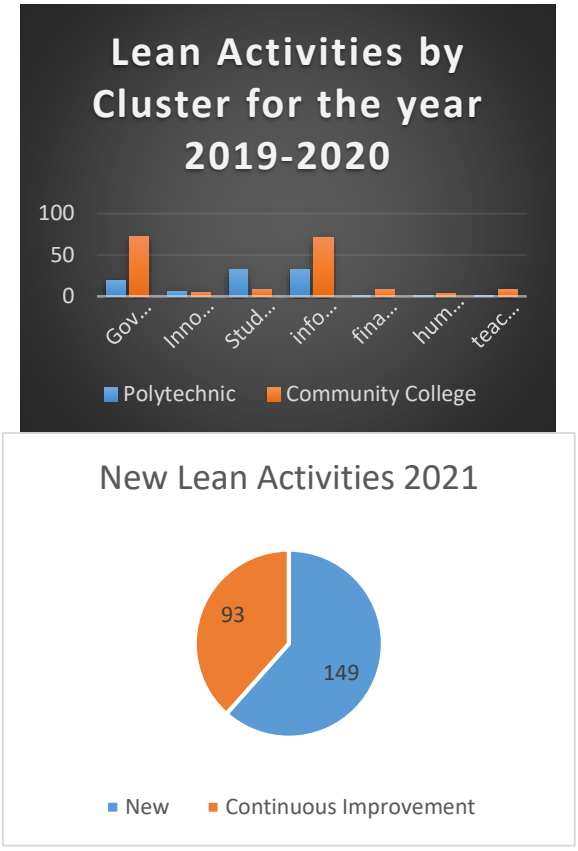

Figure 2.1: Data of Lean Activities by Cluster Histogram 2019 and 2020

The lean activities continuous 2021 shows in the next pai chart below display the numbers of lean activities conducted in 2021 shows in figure 2.2:

For the year 2021 the TVET institution comes up with more lean activities process enhancement consisting of 149 new activities and 93 are the existences process enhancement

carried forward from 2020. The organizational culture built by the TVET institution to established continuous improvement and develop organization efficiency(JPPKK, 2019, 2020).

Soft lean Factors

Lean practices should include soft lean elements in improvement programs; without the support of top management as facilitators, improvements will not succeed; it may be difficult to achieve employee participation in process improvement because they are unaware of the tools or methods; it is not easy to achieve that all tools used should be part of a broader initiative aimed at cultural change and collaboration within the group is of paramount importance (Raju, 2021).

Lean implementation not only depends on the implementation tools and techniques but also needs consistent participation by the top management (Aij, Visse and Widdershoven, 2015) because when the leader leads, the attitude of the employee is empowered (Narayanamurthy, Gurumurthy and Moser, 2018). Failure occurs due to the lack of human resource training (Theresa Waterbury, 2015), the lack of emphasis on the client, unnecessary procedures, people working in isolation, the lack of awareness (Shradha Gupta Monica Sharma Vijaya Sunder M, 2016), improper strategic planning, the lack of systematic vision and process flow, the reliance on inappropriate organisational culture (de Almeida *et al.*, 2017), and communication failure (Kumar, Dhingra and Singh, 2018).

Leaders in an organization must alter their mentalities and manners (H. van Dun and Wilder, 2016) by working together with employees on the front line (Rymaszewska, 2017; Costa *et al.*, 2019) to guide and inspire them toward constant enhancement, root cause scrutiny, and esteem for others (H. van Dun and Wilderom, 2016) to attain the organisation's long-term vision or culture for advancement (Knapp, 2015; Merlino *et al.*, 2015; Bendermacher *et al.*, 2017; Loh, Mohd Yusof and Lau, 2019) and to trust subordinates as part of a devoted and loyal workforce (Theresa Waterbury, 2015) .

Leadership needs to be combined with tasks related to employee empowerment, which is an important dimension in Lean implementation to sustain teamwork (Alefari, Salonitis and Xu, 2017; Dombrowski, Krenkel and Richter, 2017; Weerasooriyan and Alwis, 2017; Loh, Mohd Yusof and Lau, 2019)

The leader with teamwork may communicate more efficiently and have clear expectancies provided thorough directives related to duty or assignments, discover the option of upgrading proficient members to be assigned to other duties, assure the upkeep of Lean thinking amongst employees (Hamdulay and Vidhani, 2018), handle fluctuations in all areas of business, and enhance the organization's overall productivity (Agrawal, 2019).

Lean Tools

Lean is also known as a collection of principles and methods or management tools (Krause-Jensen, 2017) that focuses on identifying activities that have no added value to customers, which were originally designed for the manufacturing sector, and have recently been adopted more consistently in the services, academic, and administrative sectors (Narayanamurthy, Gurumurthy and Chockalingam, 2017).

Lean is also recognized as a powerful tool achieved by using certain methods or techniques. Some examples include value stream mapping (VSM) (Helio Aisenberg Ferenhof, Andre Henrique Da Cunha, Andrei Bonamigo, 2017), pinpointing waste (TYAGI, 2015), cause and effect analysis to sustain processes (Carsten Svensson Jiju Antony Mohamed Ba-Essa Majed Bakhsh Saja AlbliwiAuthors, 2015), collaboration among groups of individuals to form cohesive and effective cross-functional teams (Holweg and Maylor, 2018; Alkhoraif, Rashid and McLaughlin, 2019), the Kanban system, fast troubleshooting, newsletters, job rotations, *Gemba* walk (Paro and Gerolamo, 2017; Barcelos and Freitas, 2018), visual management (Seidel *et al.*, 2019), and 5S(Rodríguez *et al.*, 2017) and seven waste (van der Merwe, 2017); all of which have been highlighted as sub-work that can bring changes.

There is a link between 5S and visual management, where labeling is reflected onto the visual information of the product, which shows the good practice of the workplace itself, as well as the overview of the current organization (Rodríguez *et al.*, 2017; Sremcev *et al.*, 2018; Magalhães *et al.*, 2019; Adam, Hofbauer and Stehling, 2020). Another conceptual parallel that needs to be seen is "agile movement," referring to a movement based on a new paradigm in software development or IT concept that will cut the daily coordination meeting by segregating the process into smaller work using Kanban (Holweg and Maylor, 2018)

With this, the literature review presented above, it can be stated that the implementation of Lean will be more successful in HEIs if adapted to soft lean or human factors with the help of appropriate lean tools. The scenario still shows very few research studies conducted focusing on soft lean and lean tools and their benefit to the education sector especially in the teaching and learning process (Andrew J. Thomas Jiju Antony Mark Francis Ron Fisher, 2015; Tılfarlıoğlu and Anwer, 2017; Sremcev *et al.*, 2018) and administration department (Magalhães *et al.*, 2019). Below figure 2.3 are the proposed conceptual framework:

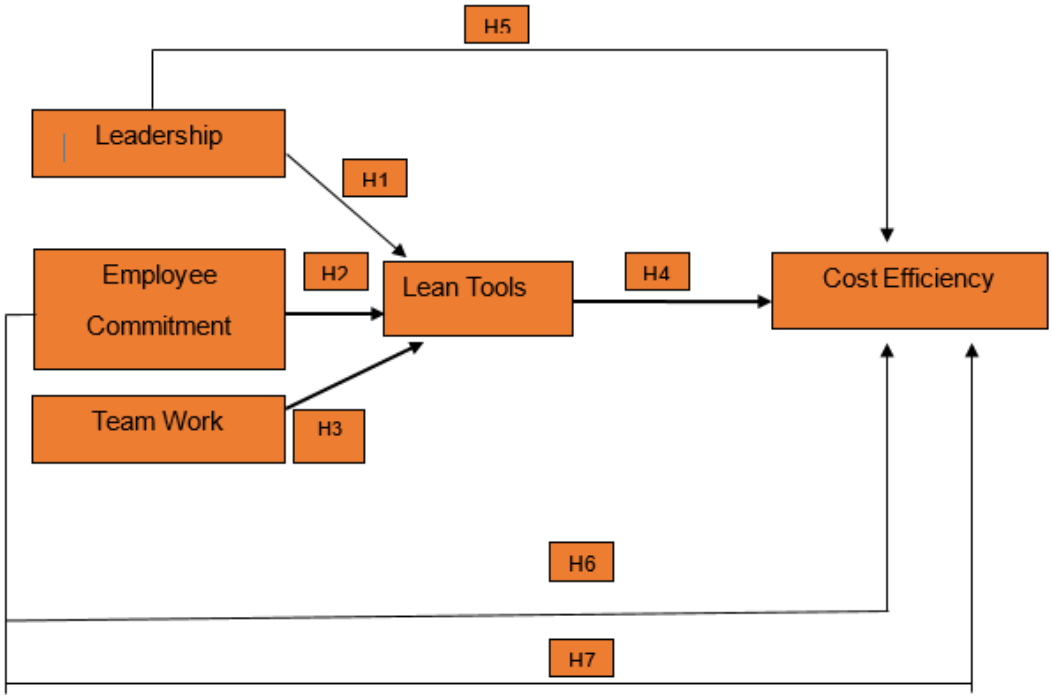

Figure 2.2: Proposed Conceptual Model framework for Soft Lean Practises LMHE

3.0 Methodology

The method used in this study is a hypothesis testing method that uses a cross-sectional design. Specifically, this study examines the relationship that exists between the independent variables (soft lean factors) with the variables (cost efficiency) and the role played by lean tools through hypotheses that have been built based on previous theories and empirical studies. Simple Random Sampling techniques are used. A web-based survey method was utilized to collect data because it is a relatively simple way to collect quantitative data. The questionnaires were sent through telegram, email, and other online mediums to the top management in the TVET institution. The context of the study focuses on Malaysia's TVET higher education. institution. The population is taken from TVET higher education institution data-based www.esis.gov.my and the sample size calculated from the Krejcie and Morgan table.

In this study, some measurement instruments from previous studies for leadership variables (Urban, 2015; Evangelia Siachou, 2016; André Seidel, Tarcísio Abreu Saurin, Giuliano Almeida Marodin, José Luis Duarte Ribeiro, 2017; Marsono and Sadeghifam, 2017; Vlachos and Siachou, 2018; Loh, Mohd Yusof and Lau, 2019; Seidel *et al.*, 2019; Sfakianaki and Kakouris, 2019; Seidel and Saurin, 2020) were used to help shape the questionnaire; employee commitment variable from (Uluskan, McCreery and Rothenberg, 2018;Sfakianaki and Kakouris, 2019;Nawanir, Binalialhajj and Lim, 2019); team work from (Antony, 2014 Bortolotti, Boscari and Danese, 2015; Nordin and Deros, 2017 Abu-Rish Blakeney *et al.*, 2019), lean tools (Vinod 2015 Kadarova and Demecko, 2016;van der Merwe, 2017;Anete Petrusch, Guilherme Luís Roehe Vaccaro, 2018'Pakdil, Toktaş and Leonard, 2018;Nawanir, Binalialhajj and Lim, 2019 and cost efficiency (Pakdil, Toktaş and Leonard, 2018;Nawanir, Binalialhajj and Lim, 2019).

The survey questionnaire is divided into 3 parts, namely Part A which contains several questions that describe the characteristics of the organization by focusing on the main question of demographic information. In section B, respondents were asked to assess the extent of their agreement for each of the factors using a scale of 5: strongly agree as to the critical success factor of soft lean use and scale 1: strongly disagree.

The data obtained through the questionnaire were entered into the Statistical Package for the Social Science (SPSS 21.0) software for initial analysis aimed at testing descriptive statistics to obtain the mean and standard deviation of each item related to the constructs studied. For subsequent data analysis, a component-based SEM or PLS-SEM (Partial Least Squares-Structural Equation Modeling) approach was used with Smart PLS software.

PLS-SEM is used in this study because the objective of this study is more to predict (prediction) the extent to which cost-efficiency (dependent variable) is explained by soft lean factors (dependent variable). Data analysis using PLS-SEM 3.33 was divided into two parts; in the measurement model, the researcher can test the strength of the study instrument (measurement model) which is evaluated through the analysis of validity and reliability. Whereas, in the structural model, the study hypothesis was tested through the value of the flow coefficient and the t-value to determine the significance of the relationship between the independent variable and the dependent variable

4.0 Result and discussion

4.1 Descriptive Statistic Analysis

A complete questionnaire from 500 respondents was received and all of them were suitable for data analysis.

Sample size 375 according to Krejcie and Morgan's (Memon *et al.,* 2020) table according to simple random sampling method. A total of 387 questionnaires were received after reviewing the data management process. 383 usable responses for the descriptive analysis. The questionnaires were completed 97.4% using Google Form by all the respondents.

Mean score analysis showed that leadership achieved the highest mean score of 4.17, with a standard deviation of 0.51144. Employee commitment was 4.04, with a standard deviation of 0.58445; teamwork was 4.06, with a standard deviation of 0.57766; the lean tool showed a mean score, with a value of 4.07 with a standard deviation of 0.64981 and, finally, the mean for cost efficiency was 4.12, with a standard deviation of 0.54096 and. In conclusion, the mean score revealed that the soft lean factor and lean tools show a very satisfactory level in achieving cost efficiency in lean management.

4.2 Analysis of Lean implementation aspects in higher education institutions

Measurement Model Assessment

Data analysis in this study uses the partial least squares structural equation modeling technique which has two levels of evaluation, namely measurement model evaluation, and structural model evaluation. This data analysis technique requires that the reliability and validity of the variables in the measurement model be proven first before the evaluation of the structural model can proceed. The measurement model of this study is of the reflective type. Therefore, four evaluation criteria that include indicator load, instrument reliability, convergent validity, and discrimination validity need to be determined(Hair, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, 2017)

This study found that the reliability of all indicators was achieved for Cronbach's alpha between 0.760 and 0.951 where the reliability of the questions provided reached a maximum limit of the threshold of 0.70. The Average Variance Extracted (AVE) obtained 0. 511 and 0.764 which surpassed the base level of 0.5. Table 4.1 shows the Average Variance Extracted (AVE) testing which presents strong evidence that the constructs of the model have good convergent validity. From the convergence validity test, the composite reliability identified that all indicators reached between 0.957-0.838 as explained in Table 4.2.

AVE was estimated with the highest correlation for all constructs of leadership, employee commitment, teamwork, lean tools, and cost efficiency which meet the thresholds (Fornell and Larcker, 1981; Henseler, Ringle and Sarstedt, 2015; Hair, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, 2017; Hair *et al.,* 2019)

Table 4.1: Average Variance Extracted (AVE)

Construct	Cronbach Alpha	AVE	Acceptable Cut-Off	Status
Leadership(L)	0.932	0.596	>0.5	Acceptable
Employee Commitment(EC)	0.937	0.614	>0.5	Acceptable
Teamwork(TW)	0.951	0.672	>0.5	Acceptable
Lean tools (LT)	0.760	0.511	>0.5	Acceptable
Cost Efficiency	0.845	0.764	>0.5	Acceptable

Table 4.2: Convergent Reliability (CR)Validity Acceptance

Construct	CR 0.60-0.90	Acceptable Cut-Off	Good	Status
Leadership(L)	0.942	>0.6	>0.7	Good
Employee Commitment(EC)	0.946	>0.6	>0.7	Good
Teamwork(TW)	0.957	>0.6	>0.7	Good
Lean tools (LT)	0.838	<0.6	>0.7	Good
Cost Efficiency	0.907	>0.6	>0.7	Good

Discriminant validity was assessed using the Fornell–Larcker criterion. Hair et al. (2014, p. 105) mentioned that the Fornell–Larcker method "compares the square root of the AVE values and the latent variable correlations" where "the square root of each construct's AVE should exceed its highest correlation with any other construct" shows in table 4.3.

Table 4.3: Discriminant Validity – Fornell and Larcker creation

Construct	CE	EC	L	TW	TW
CE	0.874				
EC	0.639	0.784			
L	0.644	0.835	0.772		
LT	0.504	0.469	0.520	0.715	
TW	0.618	0.847	0.811	0.551	0.820
CF: Cost Efficiency EM: Employee Commitment L: Leadership LT: Lean tools T: Teamwork					

In particular, the assessment of the cross-loadings completely detects discriminant validity issues where LCVC16 and TFP6 had to be deleted. Other cross-loading items, EEA5, EEA10, EEA11, LCU 1, LCU3, LFP8, LT5, LT6, and LT7, had been deleted to solve the HTMT value issue of more than 0.85 for leadership (L) and teamwork (TW) constructs.

According to Henseler, Ringle, and Sarstedt (2015), cross-loading and the Fornell-Larcker criteria are two tests that are often used in the determination of discriminant validity but often fail to detect the absence of discriminatory validity. Therefore, they suggest that the Heterotrait-Monotrait correlation ratio (HTMT) method be used in determining the validity of discrimination. Schedule. Estimates of inter-construct correlations were calculated using HTMT. For the measurement model, all HTMT values between any two latent factors satisfied the requirement that the outcome should not be greater than the 0.85 thresholds in Table 4.4. In addition to the HTMT tests, the interval value was checked. If the top interval value for each construct does not exceed 1, then the discriminant between constructs is verified. Therefore, these four constructs are applicable for measuring the lean implementation for Malaysian TVET higher education institutions as shown in figure 4.1.

Table 4.4: Heterotrait-Monotrait Ratio (HTMT)

Construct	CE	EC	L	LT	TW
CE					
EC	0.710				
L	0.723	0.888			
LT	0.607	0.533	0.604		
TW	0.684	0.889	0.862	0.639	
CF: Cost Efficiency EM: Employee Commitment L: Leadership LT: Lean tools T: Teamwork					

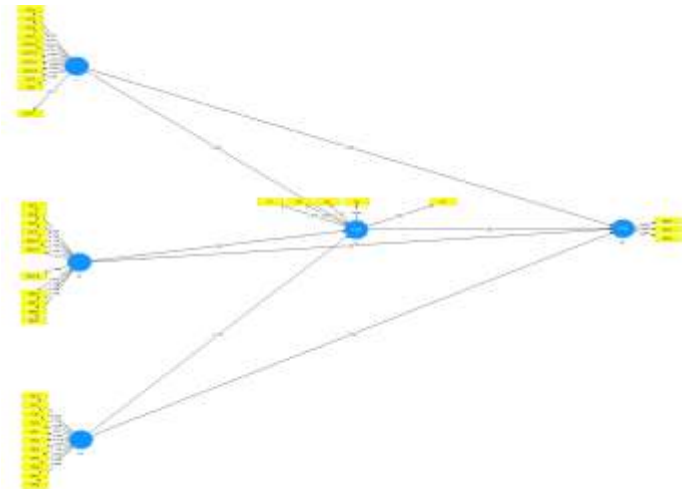

Figure 4.1: Re specified Measurement Model Assessment: PLS Algorithm results

Result for Structural Equation Model

From the analysis of the PLS structure model, the values of the flow coefficients and t-statistics for the relationship and influence between the general variables of critical success factors and external factors are shown in Table 5 and figure 4.2. To obtain the results, bootstrapping method is used and the results obtained can answer the research hypothesis. Leadership (L) →Cost efficiency (CE) (t =3.388) (p = 0.001), Employee Commitment (EC)→Cost Efficiency (CE) (t =3.643) (p = 0.000), Teamwork (TW)→Cost Efficiency (CE) (t =0.673) (p = 0.501),

All were significant, having the following values: Leadership (L)→lean tools (LT) (t = 3.932) (p=0.000), Employee Commitment (EC)→Lean Tools (LT) (t =1.577) (p=0.115), and Teamwork (TW)→Lean tools (LT) (t =4.338) (p=0.000), respectively. In addition, the endogenous latent variable lean tools had an indirect effect on the endogenous construct of cost-efficiency. This was significant and had the following values: Lean tools (LT) →Cost Efficiency (CE) (t = 2.760) (p=0.006). This provides partial support for H1, H3, and H5, with values that are significant but which are not significant for H2.

The results of the bootstrapping method for the structural model signified the t-values and causal relationships between the constructs. At a 5% significance interval. Thus, hypothesis H1, H3, H4, H5 is supported and hypothesis H2 and H7 are rejected.

Table 4.5 :

Hypothesis	Relationship	t-Statistics	p values
H1	Leadership (L) -> Lean tools (LT)	3.932	0.000
H2	Employee Commitment (EC) -> Lean tools (LT)	1.577	0.115
H3	Teamwork (TW) -> Lean tools (LT)	4.338	0.000
H4	Leadership (L) -> Cost Efficiency (CE)	3.388	0.001
H5	Employee Commitment (EC) -> Cost Efficiency (CE)	3.643	0.000
H6	Lean Tools (LT) -> Cost Efficiency (CE)	2.760	0.006
H7	Teamwork (TW) -> Cost Efficiency (CE)	0.673	0.501

Table 4.6

Hypothesis	Relationship	Decision
H1	Leadership (L) -> Lean tools (LT)	Significant
H2	Employee Commitment (EC) -> Lean tools (LT)	Not Significant
H3	Teamwork (TW) -> Lean tools (LT)	Significant
H4	Leadership (L) -> Cost Efficiency (CE)	Significant
H5	Employee Commitment (EC) -> Cost Efficiency (CE)	Significant
H6	Lean Tools (LT) -> Cost Efficiency (CE)	Significant
H7	Teamwork (TW) -> Cost Efficiency (CE)	Not Significant

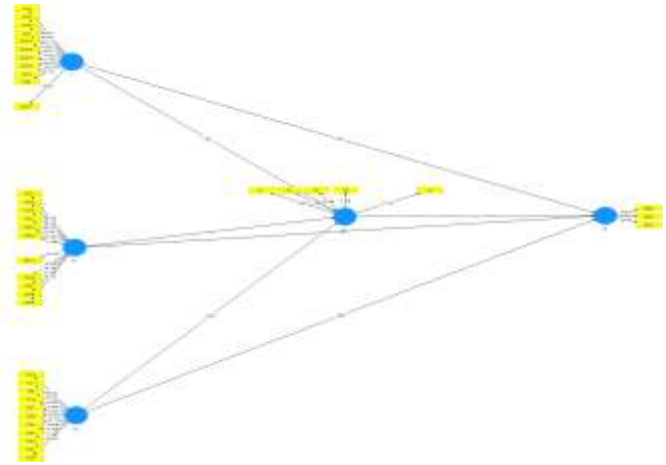

Figure 4.2: Re-Specified Structural Equation Model Assessment: PLS Algorithm results

5.0 Discussion and Conclusion

The findings of this study can produce empirical results for Lean Management Higher Education (LMHE) to improve cost efficiency performance indicators. Seven hypotheses can be demonstrated in Lean Higher Education with cost efficiency performance indicators (leadership, employee commitment, and teamwork) and the application of lean tools was tested using the PLS-SEM approach.

Studies have shown that soft lean has helped enhance Lean initiatives and activities in HEIs for their administration and academic improvement process and services, internal process efficiency, employee productivity, increase student satisfaction and other stakeholders, by conducting value-added activities, eliminating waste, and creating culture institutions of continuous improvement.

Leadership support plays an important role for the lean higher education needed; for example, leaders will be involved at all levels, as well as within or across divisions. Leaders have a deep understanding of the work being done and share their knowledgeable attitudes with their subordinates. Previous study contribution to leadership (van Assen, 2016).

The leader's usage abilities of lean tools usage(Reiner, 2018; Witt, Sandoe and Dunlap, 2018; Nurcahyo *et al.*, 2019; Yahya *et al.*, 2019); employee knowledge with lean tools (Malik and Abdallah, 2020)

While employees are the backbone of an organization. who are involved with the continuous improvement of Kaizen and they are the people closest to the work process and best suited to identify areas in need of improvement. Previous research conducted (Weerasooriyan and Alwis, 2017; Roslin *et al.*, 2019; Allaoui and Benmoussa, 2020)

For team collaboration findings involving teamwork, project team leaders are formed voluntarily or by management to address one or more clusters of waste and weak flows. They provide a more in-depth analysis of the area so that the most appropriate action can be taken. The previous research on teamwork contribution(Luz Tortorella *et al.*, 2020) with the usage abilities of lean tools(Tortorella *et al.*, 2020)(Cheah, Prakash and Ong, 2020).

soft lean has a significant relationship with cost-efficiency. the previous supported the studies (Nielsen and Kristensen, 2020)(Nawanir, Binalialhajj and Lim, 2019)(Cano, Moyes and Kobi, 2016)(Sahoo, 2021)(Jandali and Sweis, 2018)(Bortolotti, Boscari and Danese, 2015)(Vijaya Sunder M, 2017).

The Integration with the skinny philosophy will lead to continuous improvement and respect for people. Continuous improvement in process improvement in organizations, while human practices enable lean activities to be achieved. The lean journey of an organization is not just focused on the gradual implementation of tools and techniques. It requires strong leadership and commitment of senior managers with skinny executors being employees, who are involved with skinny activities and are the champions of these activities. Without effective lean team navigation in every project or changing activities, lean will fail. The challenge is to get employees 'full commitment to change initiatives. This commitment is conditioned by the belief that only regular engagement leads the organization to success. Emiliani and Emiliani emphatically outline the need to respect people while traveling lean(Emiliani, 1998).

As a conclusion could be derived from the previous studies, lean implementation in the education sector brings more value-added process enhancement in management, administration teaching, and learning. Data were collected from 128 TVET institutions and the research model was tested using PLS-SEM. PLS-SEM estimates simultaneously the measurement and structural model after the measurement model evaluation to ensure construct reliability and validity have met the accepted threshold. Based on the reliability and validity test, all the constructs are valid for TVET higher education institutions to be used in The research. The structural equation model to elaborate the relationship between soft lean and lean tools to sustain cost efficiency among Malaysian TVET higher education institutions establishing soft lean and the lean tools to achieve cost reduction. The limitation of the study, the respondents only focused on lean activities in TVET institutions and based on the cross-sectional study. The soft lean and the lean tools established during the literature review were to some degree subjective, as they were based on personal opinions and interpretations.

Future studies are suggested that this research method could be improved with the use of more quantitative study, a longitudinal study, an experimental study, and action research as part of a field study. More soft lean attributes, such as reward systems, training, customer involvement, supplier partnerships, strategic deployment, organization culture, student customer value, waste identification, and other tools, need to be utilized empirically. An expansion of Lean Six Sigma tool utilization. The adaptation of more specific lean tools, such as standardization and 5S for long-term lean management improvement, maybe tested through measurements in other study contexts.

Reference

1. Adam, M., Hofbauer, M. and Stehling, M. (2020) 'Effectiveness of a lean simulation training: challenges, measures and recommendations', *Production Planning and Control*, 0(0), pp. 1–11. doi: 10.1080/09537287.2020.1742375.
2. Agrawal, N. M. (2019) 'Modeling Deming's quality principles to improve performance using interpretive structural modeling and MICMAC analysis', *International Journal of Quality and Reliability Management*, 36(7), pp. 1159–1180. doi: 10.1108/IJQRM-07-2018-0204.
3. Aij, K. H., Visse, M. and Widdershoven, G. A. M. (2015) 'Lean leadership: An ethnographic study', *Leadership in Health Services*, 28(2), pp. 119–134. doi: 10.1108/LHS-03-2014-0015.
4. Alefari, M., Salonitis, K. and Xu, Y. (2017) 'The Role of Leadership in Implementing Lean Manufacturing', *Procedia CIRP*, 63, pp. 756–761. doi: 10.1016/j.procir.2017.03.169.
5. Alkhoraif, A., Rashid, H. and McLaughlin, P. (2019) 'Lean implementation in small and medium enterprises: Literature review', *Operations Research Perspectives*, 6(July 2018), p. 100089. doi: 10.1016/j.orp.2018.100089.
6. Allaoui, A. and Benmoussa, R. (2020) 'Employees' attitudes toward change with Lean Higher Education in Moroccan public universities', *Journal of Organizational Change Management*. doi: 10.1108/JOCM-08-2018-0232.
7. de Almeida, J. P. L. *et al.* (2017) 'Lean thinking: planning and implementation in the public sector', *International Journal of Lean Six Sigma*, 8(4), pp. 390–410. doi: 10.1108/IJLSS-06-2016-0027.
8. Andrew J. Thomas Jiju Antony Mark Francis Ron Fisher (2015) '"A comparative study of Lean implementation in higher and further education institutions in the UK"', *International Journal of Quality & Reliability management*, 32(9), pp. 982–996. doi: 10.1108/JFM-03-2013-0017.
9. Antony, J. (2014) 'Readiness factors for the Lean Six Sigma journey in the higher education sector', *International Journal of Productivity and Performance Management*. doi: 10.1108/IJPPM-04-2013-0077.
10. van Assen, M. F. (2016) 'Exploring the impact of higher management's leadership styles on Lean management', *Total Quality Management and Business Excellence*, 29(11–12), pp. 1312–1341. doi: 10.1080/14783363.2016.1254543.
11. Azim Khairi, M. and Rahman, M. A. (2018) 'Implementing lean in Malaysian universities: Lean awareness level in an engineering faculty of a local university', *IOP Conference Series: Materials Science and Engineering*, 290(1). doi: 10.1088/1757-899X/290/1/012027.
12. Balzer, W. K. *et al.* (2016) 'A review and perspective on Lean in higher education', *Quality Assurance in Education*. doi: 10.1108/QAE-03-2015-0011.
13. Barcelos, M. R. dos S. and Freitas, A. L. P. (2018) 'Developing and Testing a Methodological Approach to Assess the QWL in Retail Banks', *Advances in Intelligent Systems and Computing*, 1, pp. 503–516. doi: 10.1007/978-3-319-60372-8.
14. Bendermacher, G. W. G. *et al.* (2017) 'Unravelling quality culture in higher education: a realist review', *Higher Education*, 73(1), pp. 39–60. doi: 10.1007/s10734-015-9979-2.
15. Bortolotti, T., Boscari, S. and Danese, P. (2015) 'Successful lean implementation: Organizational culture and soft lean practices', *International Journal of Production Economics*, 160, pp. 182–201. doi: 10.1016/j.ijpe.2014.10.013.
16. Byers, E. J. J. (2019) *LEADERSHIP ACTION-LOGICS AND APPLICATION OF LEAN IN AN ORGANIZATIONAL HEALTH CARE SETTING by Ernest Jasper James Byers Dissertation Committee : Professor Lyle Yorks , Sponsor Professor Nancy Charlotte Wallis Approved by the Committee on the Degree of Doct*. Columbia University.
17. Cano, M., Moyes, D. and Kobi, A. (2016) *A framework for implementing lean operations management in the higher education sector*, *19th Toulon-Verona International Conference Excellence in Services*.
18. Carsten Svensson Jiju Antony Mohamed Ba-Essa Majed Bakhsh Saja AlbliwiAuthors (2015) 'A Lean Six Sigma program in higher education', *International Journal of Quality & Reliablility Management*, 32(9). doi: 10.1179/str.2006.53.4.005.
19. Cheah, C. K., Prakash, J. and Ong, K. S. (2020) 'An integrated OEE framework for structured productivity improvement in a semiconductor manufacturing facility', *International Journal of Productivity and Performance Management*, 69(5), pp. 1081–1105. doi: 10.1108/IJPPM-04-2019-0176.
20. Choo Han Yau, Lee En Shin, Lok Yee Peng, Ng Shi Hui, N. A. S. M. R. & A. A. (2013) 'WASTES EXIST IN LIBRARY SERVICES', *school of technology management and logistic*, pp. 849–856.
21. Coetzee, R., van Dyk, L. and van der Merwe, K. R. (2019) 'Towards addressing respect for people during lean implementation', *International Journal of Lean Six Sigma*, 10(3), pp. 830–854. doi: 10.1108/IJLSS-07-2017-0081.
22. Costa, F. *et al.* (2019) 'How to foster Sustainable Continuous Improvement: A cause-effect relations map of Lean soft practices', *Operations Research Perspectives*, 6(December 2018), p. 100091. doi: 10.1016/j.orp.2018.100091.
23. Dombrowski, U., Krenkel, P. and Richter, T. (2017) 'Dynamic Coordination within a Lean Enterprise', *Procedia Manufacturing*, 11(June), pp. 2147–2155. doi: 10.1016/j.promfg.2017.07.360.
24. Emiliani, M. L. (1998) 'Lean behaviors', *Management*, 36(9), pp. 615–631.
25. Emiliani, M. L. (2006) 'Improving management education', *Quality Assurance in Education*, 14(4), pp. 363–384. doi: 10.1108/09684880610703956.
26. Fornell, C. and Larcker, D. F. (1981) 'Evaluating Structural Equation Models with Unobservable Variables and Measurement Error', *Journal of Marketing Research*, 18(1), p. 50. doi: 10.2307/3151312.
27. H. van Dun, D. and Wilderom, C. P. M. (2016) 'Lean-team effectiveness through leader values and members' informing', *International Journal of Operations and Production Management*, 36(11), pp. 1530–1550. doi: 10.1108/IJOPM-06-2015-0338.
28. Hair, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2017) *A primer on partial least squares structural equation modeling (PLS-SEM)*. Los Angeles: SAGE

Publications.
29. Hair, J. F. *et al.* (2019) 'When to use and how to report the results of PLS-SEM', *European Business Review*, 31(1), pp. 2–24. doi: 10.1108/EBR-11-2018-0203.
30. Hamdulay, F. and Vidhani, H. (2018) 'The evolution of lean thinking at K-Way: where to next?', *Emerald Emerging Markets Case Studies*, 8(1), pp. 1–24. doi: 10.1108/eemcs-03-2017-0046.
31. Helio Aisenberg Ferenhof, Andre Henrique Da Cunha, Andrei Bonamigo, F. A. F. (2017) 'Toyota Kata as a KM solution to the inhibitors of implementing lean service in service companies"'.
32. Henseler, J., Ringle, C. M. and Sarstedt, M. (2015) 'A new criterion for assessing discriminant validity in variance-based structural equation modeling', *Journal of the Academy of Marketing Science*, 43(1), pp. 115–135. doi: 10.1007/s11747-014-0403-8.
33. Holweg, M. and Maylor, H. (2018) 'Lean leadership in major projects: from "predict and provide" to "predict and prevent"', *International Journal of Operations and Production Management*, 38(6), pp. 1368–1386. doi: 10.1108/IJOPM-02-2017-0100.
34. Jandali, D. and Sweis, R. (2018) 'Assessment of factors affecting maintenance management of hospital buildings in Jordan', *Journal of Quality in Maintenance Engineering*, 24(1), pp. 37–60. doi: 10.1108/JQME-12-2016-0074.
35. JPPKK (2019) *Laporan Impak Perlaksanaan Lean*.
36. JPPKK (2020) *Laporan Impak Perlaksanaan Lean 2020*.
37. Knapp, S. (2015) 'Lean Six Sigma implementation and organizational culture', *International Journal of Health Care Quality Assurance*. doi: 10.1108/IJHCQA-06-2015-0079.
38. Koromyslova, E. *et al.* (2018) 'Implementing lean practices in an academic department: A case study', *ASEE Annual Conference and Exposition, Conference Proceedings*, 2018-June.
39. Krause-Jensen, J. (2017) 'Trimming the social body: An analysis of Lean management among family counsellors in a Danish municipality', *Journal of Organizational Ethnography*, 6(2), pp. 68–86. doi: 10.1108/JOE-01-2017-0005.
40. Kumar, S., Dhingra, A. K. and Singh, B. (2018) 'Process improvement through Lean-Kaizen using value stream map: a case study in India', *International Journal of Advanced Manufacturing Technology*, 96(5–8), pp. 2687–2698. doi: 10.1007/s00170-018-1684-8.
41. Loh, K. L., Mohd Yusof, S. and Lau, D. H. C. (2019) 'Blue ocean leadership in lean sustainability', *International Journal of Lean Six Sigma*, 10(1), pp. 275–294. doi: 10.1108/IJLSS-06-2016-0029.
42. Lu, J., Laux, C. and Antony, J. (2017) 'Lean Six Sigma leadership in higher education institutions', *International Journal of Productivity and Performance Management*. doi: 10.1108/IJPPM-09-2016-0195.
43. Luz Tortorella, G. *et al.* (2020) 'An empirical investigation on learning and teaching lean manufacturing', *Education and Training*, 62(3), pp. 339–354. doi: 10.1108/ET-11-2018-0232.
44. Magalhães, J. C. *et al.* (2019) 'Improving processes in a postgraduate office of a university through lean office tools', *International Journal for Quality Research*, 13(4), pp. 797–810. doi: 10.24874/IJQR13.04-03.
45. Mahathir Fansuri Azizan (2014) *ISO 9000 Pemangkin lonjakan organisasi*.
46. Malaysia Productivity Corporation (MPC) (2013) 'Pengurusan LEAN di Pejabat'.
47. Malik, M. and Abdallah, S. (2020) 'The relationship between organizational attitude and lean practices: an organizational sense-making perspective', *Industrial Management and Data Systems*, 120(9), pp. 1715–1731. doi: 10.1108/IMDS-09-2019-0460.
48. Memon, M. A. *et al.* (2020) 'Sample Size for Survey Research: Review and Recommendations', *Journal of Applied Structural Equation Modeling*, 4(2), pp. i–xx. doi: 10.47263/jasem.4(2)01.
49. Merlino, J. P. *et al.* (2015) 'Leading with Lean: Getting the Outcomes we Need with the Funding we Have', *Psychiatric Quarterly*, 86(3), pp. 301–310. doi: 10.1007/s11126-015-9376-0.
50. van der Merwe, K. R. (2017) 'A longitudinal study of the efficacy of lean learning experienced through a simulated working environment (SWE)', *International Journal of Productivity and Performance Management*, 66(5), pp. 651–661. doi: 10.1108/IJPPM-07-2016-0143.
51. Ministry of Higher Education Malaysia (2017) *JPT Strategic Plan 2018 - 2022*.
52. Narayanamurthy, G., Gurumurthy, A. and Chockalingam, R. (2017) 'Applying lean thinking in an educational institute – an action research', *International Journal of Productivity and Performance Management*, 66(5), pp. 598–629. doi: 10.1108/IJPPM-07-2016-0144.
53. Narayanamurthy, G., Gurumurthy, A. and Moser, R. (2018) '"8A" framework for value stream selection – an empirical case study', *Journal of Organizational Change Management*, 31(5), pp. 1001–1026. doi: 10.1108/JOCM-06-2017-0234.
54. Nawanir, G., Binalialhajj, M. and Lim, K. T. (2019) 'Becoming Lean : The Way towards Sustainability of Higher Educations Institutions', 2019, pp. 603–626. doi: 10.18502/kss.v3i22.5078.
55. Nielsen, H. and Kristensen, T. B. (2020) 'Impact of lean operations on the roles of finance functions and their application of lean', *European Business Review*, 32(4), pp. 731–763. doi: 10.1108/EBR-10-2019-0277.
56. Nurcahyo, R. *et al.* (2019) 'The Analysis of the Implementation of 5-S Principles Integrated With ISO 9001 Requirements at Higher Education Level', *SAGE Open*, 9(3). doi: 10.1177/2158244019870773.
57. Paro, P. E. P. and Gerolamo, M. C. (2017) 'Organizational culture for lean programs', *Journal of Organizational Change Management*, 30(4), pp. 584–598. doi: 10.1108/JOCM-02-2016-0039.
58. Raju, V. (2021) 'Implementing Flexible Systems in Doctoral Viva Defense Through Virtual Mechanism', *Global Journal of Flexible Systems Management*, 22(2), pp. 127–139. doi: 10.1007/s40171-021-00264-y.
59. Reiner, M. (2018) 'Leadership to lean', *2018 IEEE Technology and Engineering Management Conference, TEMSCON 2018*, pp. 1–11. doi: 10.1109/TEMSCON.2018.8488413.
60. Rodríguez, D. *et al.* (2017) 'Determinants of job satisfaction in a lean environment', *International Journal of Lean Six Sigma*, 8(2). doi: 10.1108/ijlss-01-2016-0002.
61. Roslin, E. N. *et al.* (2019) 'The impact of employee involvement and empowerment in Lean Manufacturing

System implementation towards organizational performances', *International Journal on Advanced Science, Engineering and Information Technology*, 9(1), pp. 188–193. doi: 10.18517/ijaseit.9.1.7116.
62. Rymaszewska, A. (2017) 'Lean implementation and a process approach – an exploratory study', *Benchmarking: An International Journal*, 24(5), pp. 1122–1137. doi: 10.1108/BIJ-02-2016-0018.
63. Sahoo, S. (2021) 'Lean practices and operational performance: the role of organizational culture', *International Journal of Quality and Reliability Management*. doi: 10.1108/IJQRM-03-2020-0067.
64. Sangwa, N. R. and Sangwan, K. S. (2018) 'Development of an integrated performance measurement framework for lean organizations', *Journal of Manufacturing Technology Management*, 29(1), pp. 41–84. doi: 10.1108/JMTM-06-2017-0098.
65. Seidel, A. *et al.* (2019) 'How can general leadership theories help to expand the knowledge of lean leadership?', *Production Planning and Control*, 30(16), pp. 1322–1336. doi: 10.1080/09537287.2019.1612112.
66. Serina Al-Haddad Timothy Kotnour (2015) ','"Integrating the organizational change literature: a model for successful change"', *Journal of Organizational Change Management*, 28(2), pp. 234–262.
67. Shradha Gupta Monica Sharma Vijaya Sunder M (2016) 'Lean Services : a Systematic Literature Review', *International Journal of Productivity and Performance Management*, 65(8), pp. 1025–1056.
68. Simonyte, S., Adomaitiene, R. and Ruzele, D. (2021) 'Experience of lean application in higher education institutions', *International Journal of Lean Six Sigma*. doi: 10.1108/IJLSS-11-2020-0208.
69. Solaimani, S., Haghighi Talab, A. and van der Rhee, B. (2019) 'An integrative view on Lean innovation management', *Journal of Business Research*, 105(March), pp. 109–120. doi: 10.1016/j.jbusres.2019.07.042.
70. Sremcev, N. *et al.* (2018) 'Improving teaching and learning process by applying Lean thinking', *Procedia Manufacturing*, 17, pp. 595–602. doi: 10.1016/j.promfg.2018.10.101.
71. Srichuachom, U. (2015) *The Impact of Lean Approaches to Support Quality Developments in Thailand: "An Investigation of a Claim of Universality of Lean Thinking", University Of Southampton*. UNIVERSITY PF SOUTHAMPTON.
72. Suhaimi, R. *et al.* (2017) 'Lean Management: A Case of a Malaysian Multi-Campus University', *Eares.Org*.
73. Theresa Waterbury (2015) 'Learning from the pioneers', *International Journal of Quality & Reliability Management*, Vol. 32 Is, pp. 934–950. doi: 10.1179/str.2006.53.4.005.
74. Thomas, A. *et al.* (2017) 'Implementing Lean Six Sigma into curriculum design and delivery – a case study in higher education', *International Journal of Productivity and Performance Management*, 66(5), pp. 577–597. doi: 10.1108/IJPPM-08-2016-0176.
75. Tılfarlıoğlu, F. Y. and Anwer, J. K. (2017) 'Integration of Lean method in English Language Teaching and Learning: A New Perspective', *Journal of Education and Training Studies*, 5(9), p. 230. doi: 10.11114/jets.v5i9.2625.
76. Tortorella, G. *et al.* (2020) 'Pandemic's effect on the relationship between lean implementation and service performance', *Journal of Service Theory and Practice*. doi: 10.1108/JSTP-07-2020-0182.
77. TYAGI, S. K. (2015) *LEAN THINKING FOR LEAD-TIME REDUCTION AND EFFICIENT KNOWLEDGE CREATION IN PRODUCT DEVELOPMENT DOMAIN by SATISH K TYAGI Submitted to the Graduate School of Wayne State University , Detroit , Michigan in partial fulfillment of the requirements for the degre*.
78. Uluskan, M., McCreery, J. K. and Rothenberg, L. (2018) 'Impact of quality management practices on change readiness due to new quality implementations', *International Journal of Lean Six Sigma*, 9(3), pp. 351–373. doi: 10.1108/IJLSS-05-2017-0049.
79. Vijaya Sunder M, S. M. (2017) 'An empirical investigation of implementing Lean Six Sigma in', *International Journal of Quality & Reliability Management*.
80. Vukadinovic, S., Djapan, M. and Macuzic, I. (2017) 'Education for lean & lean for education: A literature review', *International Journal for Quality Research*, 11(1), pp. 35–50. doi: 10.18421/IJQR11.01-03.
81. Warren, P. C. (2019) *THE IMPACT OF LEAN TECHNIQUES ON OPERATIONAL EFFECTIVENESS IN BOTH DOMESTIC AND INTERNATIONAL ORGANIZATIONS by Philip Carl Warren Dissertation Submitted to the Faculty of Trevecca Nazarene University School of Graduate and Professional Studies in Partial*. Trevecca Nazarene University.
82. Weerasooriyan, N. W. M. R. and Alwis, A. C. De (2017) 'Impact of Employee Engagement on Lean Manufacturing: An Empirical Study in Sri Lanka', *FIIB Business Review*, 6(2), pp. 33–42. doi: 10.1177/2455265820170206.
83. William K Balzer Michelle H Brodke Elsy Thomas Kizhakethalackal (2015) '"Lean higher education: successes, challenges, and realizing potential"', *International Journal of Quality & Reliability Management*, 32(9), pp. 924–933.
84. Williams, B. (2007) *Lean For Dummies*.
85. Williams, D. S. P. F. S. J. (2015) ','"How did the publication of the book The Machine That Changed The World change management thinking? Exploring 25 years of lean literature"', *International Journal of Operations & Production Management*, 35 Iss 10, pp. 1386–1407.
86. Witt, C. M., Sandoe, K. and Dunlap, J. C. (2018) '5S Your Life: Using an Experiential Approach to Teaching Lean Philosophy', *Decision Sciences Journal of Innovative Education*, 16(4), pp. 264–280. doi: 10.1111/dsji.12167.
87. Yahya, M. S. *et al.* (2019) 'Awareness, implementation, effectiveness and future use of lean tools and techniques in Malaysia organisations: A survey', *Journal of Physics: Conference Series*, 1150(1). doi: 10.1088/1742-6596/1150/1/012010.
88. Yorkstone, S. (2016) 'Lean Universities', *in Netland, T. and Powell, D. (Eds), The Routledge Companion worktribe/output-325272/lean-universities.pdf (accessed 12 February 2019). to Lean Management, Routledge, Abingdon*.
89. Yorkstone, S. (2019) *Global Lean for Higher Education, Global Lean for Higher Education*. doi: 10.4324/9780429399688.