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Critical success factors for Lean Six Sigma in business school: A view from the lecturers

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ABSTRACT

Lean is a process improvement approach to improve organization's efficiency by identifying and eliminate non-value-added activities, while Six Sigma is a methodology focused on reduction of process variation. The integration of both, namely Lean Six Sigma (LSS) drives organization on waste elimination, variation reduction and value creation, which ultimately enhancing organizational performance. LSS has been viewed by prior scholars as one of effective approach for business improvement regardless of manufacturing or services industry. However, the research of LSS in education sector, particularly for business school is relatively lacking. Hence, this research aimed to identify the critical success factors (CSFs) for LSS within a business school in Malaysia. The research also aimed to explore the relationship between the LSS, CSFs, and organization performance. There were six CSFs identified from literature review, while organization performance is assessed via the concept of system theory. The research was quantitative based with the lecturers in the business school as the targeted population. Questionnaire was distributed based on stratified sampling plan with 69 responded. Descriptive and Pearson correlation analysis result revealed that lecturers within the business school perceived that all the six LSS CSFs as "very important", and strongly correlated with organization performance, except CSF "project selection and prioritization". As implication, finding from this research suggested that the adaption of LSS between manufacturing and education sectors shared the commonality in term of CSF. However, the business school should look into project proposal from the lecturers' perspective as an alternate source of process improvement opportunity.

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1. INTRODUCTION

Lean is commonly viewed as practices that could enhance operation and business efficiency by identify, reduce and eliminate non-value-added activities across the operation and business processes, while Six Sigma methodology improves operation and business performance by minimize the variation of operation and business' processes [1]. The combination of both Lean and Six Sigma approaches is known as Lean Six Sigma (LSS). LSS integrates the concept of value maximization and variation reduction to optimize operational and business performance via quality improvement, lead time, and cost reduction, with the ultimate aim to create customer satisfaction and loyalty [2].

The concept of LSS had been widely integrated into the operational and business practices within manufacturing and commercial service sectors. As such, there are a number of studies that have been done on LSS within manufacturing and commercial services sectors, ranged from research that focused on the development of LSS implementation framework to the studies that exploring determinants, practices, success factors, issues and challenges faced during the implementation stage [1], [3], [4]. However, the adoption of LSS within education sector is still at the introduction stage [3]. Finding from prior scholar [4] revealed that although LSS has been increasingly adopted in the manufacturing and commercial services sectors, LSS has received only "a passing attention" within the higher education field, particularly for non-engineering institution, such as business schools in higher education institutions (HEIs).

Nowadays, the roles played by HEI is beyond the traditional function of knowledge transfer, whereby HEI is viewed as one of the important drives for the nation's economic prosperity and social cohesion. As such, on top of dealing with various stakeholders, such as government bodies, industrial partners, students, employees and society in order to understand their respective expectations and demands, HEI is also need to assure that the programs offered is in relevant to the knowledge and skill that expected by the workforce market [5]. The enlargement of HEI roles and responsibility had led to the need of a more comprehensive and complicated operational processes. Hence, one of the biggest challenges faced by HEI is on how to improve the effectiveness and efficiency of their operational processes continuously [6].

LSS has been well recognized within manufacturing and commercial services industries as the most effective approach to improve operational and business process via the elimination of non-value-added activities, and minimization of process variation [7]. However, the research of LSS in education sector, particularly for business school is relatively lacking. Meantime, finding from prior research [3], [5], [7], [8] also suggested that the factors that driving the success of LSS in manufacturing sectors could be bring across to service and education sectors. As such this research is initiated to assess the compatibility of the manufacturing based LSS critical success factors (CSF) toward the education sector. In line with this, the research aimed to identify the LSS CSF for HEI in Malaysia, with the focus on one of the top business schools in Malaysia. The research was also exploring the relationship between the LSS CSF with the perceived performance of the business school. In conjunction with this, two research objectives are developed for this research, which are: i) To identify the LSS CSF for a business school in Malaysia; and ii) To explore the relationship between LSS CSF and the perceived organization performance within the business school in Malaysia.

2. LITERATURE REVIEW

2.1. Lean Six Sigma

Lean concept was originally developed by Toyota Motor Corporation as tactical cornerstone to promote effective and excellent working culture [9]. The concept was named as Toyota Production System (TPS), whereby the core focus of TPS is to reduce three main "wastes" across the production process, which are: *Muda* (or non-value-added activities), *Muri* (or over loading on equipment and people), and *Mura* (or variation on production process). Fundamentally, the reduction of *Muda* and *Muri* could be addressed by lean practices, while the improvement on *Mura* reduction could be tackled via six sigma practices [10].

The concept of TPS views source of *Muda* from seven perspectives, which are waste originated during transportation, inventory, motion, waiting, over-produced, over-process, and defect, or namely TIMWOOD [11]. Identifying and eliminating non-value-added activities across these seven areas is the core principle for Lean [11], [12]. Sort, set in order, shine, standardize, and sustain (5S) is the common lean tool used to assess, reduce or eliminate these forms of waste.

Muri is viewed as the result of uneven distribution of workload across available resources. The presence of *Muri* will lead to *Muda*, such as over-produced, defect, inventory and waiting. *Muri* could be address by align the pace of each production station (production rate) according to customer demand. The process of analyzing and balancing of production workload across available resource is done via a lean tool, namely Takt Time chart or Take Time analysis [13]. The third category of TPS's waste *Mura* is dealing with process variation, which leading to inconsistent business performance. Traditionally, *Mura* is addressed by process standardization. However, standardization of process via standard operating procedure does not guarantee the consistency of process. In addition, the roof causes of variation is not sufficiently explored and addressed via process standardization [11].

The integration Lean and Six Sigma bridges the incompleteness of TPS in dealing with *Mura*. Six Sigma focuses on continuous and breakthrough improvement to minimize process variation [13]. Six Sigma is originated in Motorola as a continuous improvement approach to analyze the causes of defects in manufacturing processes [14]. The improvement process is carried out based on the six sigma DMAIC framework, which representing the five important steps of LSS improvement. The first step "D" denotes to "define" the improvement opportunity (defect or problem) for the process that understudy; while "M" refers

to “measure” or data collection to assess the current process performance. This is followed by “analysis” of data at “A” step to identify the causes of the problem. The fourth step “I” relates to identification of “improvement solution”, and the last step “C” representing “control” which is referring to sustaining the improvement [15], [16].

2.2. Lean Six Sigma critical success factors

LSS has been widely recognized as one of the process improvement methodologies that could enhance organization performance. Prior research on LSS covered a broad perspective, ranged from the development of LSS implementation framework to the exploration of determinants, practices, success factors, issues, and challenges throughout the implementation stage [17]. However, majority of prior study on LSS were done based manufacturing setting, in addition, the main stream of prior LSS research are focused on the CSF for LSS [18]. Table 1 summarizes the 10 LSS CSF revealed by prior scholars.

As refer to Table 1, there are seven common LSS CSF suggested by prior scholar. They are top management commitment (TMC), project selection and prioritization (PSP), continuous improvement culture (CUL), communication (COM), training (TRA), employee reward and recognition (ERR), and strategy and visionary leadership. While CSF financial capability, product design, and benchmarking are only suggested by one scholar respectively.

According to previous study, LSS is relatively a new process improvement methodology that could be adopted by educational institutions to enhance their operational process [19]. Nevertheless, prior researchers viewed that manufacturing and educational sectors shared a commonality in term of operation process management and improvement [3], [9]. Hence, LSS success factors for manufacturing setting could be bring across to service and education setting. As such, six factors are adopted in this research, which are top management commitment (TMC), project selection and prioritization (PSP), continuous improvement culture (CUL), communication (COM), training (TRA), and employee reward and recognition (ERR).

Financial capability, product design and benchmarking are excluded from this research not only because of they are uncommon factors used in prior study, also due to the three factors are irrelevant to the nature of population. In addition, one of the common factors used in previous study “strategy and visionary leadership” is also omitted from the study due the factor is beyond the control of the population under study, i.e., the business school, instead, it is managed at the university level.

Table 1. Prior studies on LSS CSF

LSS CSF	Research							Total
	[5]	[20]	[21]	[22]	[23]	[24]	[25]	
Top management commitment		√	√		√	√	√	5
Project selection and prioritization	√	√		√		√	√	5
Continuous improvement culture	√	√			√		√	4
Communication	√				√	√	√	4
Training	√	√	√		√		√	5
Employee reward and recognition		√		√			√	3
Financial capability							√	1
Strategy and visionary leadership	√	√				√		3
Product design		√						1
Benchmarking		√						1

2.2.1. Top management commitment (TMC)

Top management involvement and provision of appropriate resources and training is an important strategy in implementing a success LSS methodology [20], [21]. Top management within the context of this research refers to the management team of the business school, which including dean, deputy dean, program directors, and members of executive team. While commitment from the perspective of LSS refers to the delegation and obligation of the top management team toward continues process improvement in both tangible (such as resource allocation) and intangible form (such as involvement and appreciation) [20]. In addition, the awareness and recognition of LSS’s concept by and among the top management team members is another important driver for LSS success. Setting a strategy that integrating the LSS concept of value maximization and variation reduction into the organization culture and operation process become one imperative role for top management team [21].

2.2.2. Project selection and prioritization (PSP)

Project selection and prioritization (PSP) is a process of dealing with a large number of proposed projects with the ultimate aim to identify those projects that will maximize the organization’s return and

performance. Project in the business school setting encompass students or curriculum development program, research project, co-curriculum activity, and social development program. PSP process involves comparison of the proposed projects based on a set of project selection and prioritization criteria [22]. Generally, there are three categories of project selection criteria proposed by prior scholar [24], which are business benefits criteria (impact on meeting external customer requirement; financial impact; and impact on core competencies), feasibility criteria (resources required; complexity; and expertise available) and organizational impact criteria (cross-functional benefits and learning benefits such as new knowledge gained about the business, customers and processes). Prior scholar general agreed that PSP is one of the important CSFs for LSS implementation [22], [24].

2.2.3. Continuous improvement culture (CUL)

A successful implementation of LSS requires the adaptation and adjustments on the organizational culture and a change in employee's attitudes to make it aligned with the fundamental principle of LSS, i.e. continuous improvement via waste elimination and variation reduction [23]. Culture is the general customs, characteristics, beliefs, and knowledge of a particular group of people. While organizational culture is a system of shared values, assumptions and beliefs of the people behave in organizations. The implementation of LSS required the combination of changing the way of getting work done by changing processes and educating people in new ways of understanding processes and solving problems [23], hence promoting and establishing the culture of continuous improvement is the fundamental requirement for the success of LSS. Organizations must reorganize to promote cultural change and make LSS part of daily life on waste reduction and process improvement [2], [13], [23]. With the cultural revolution in an organization, the organization will always ready and in the trackway of achieve organization goals and good performance.

2.2.4. Communication (COM)

Communication is a way to convey meanings from one to another entity or group by mutually understood signs, symbols, and semiotic rules. Within the context of LSS, through effective communication, employees will be more engaged and work as a team for various problem-solving scenarios, as the result, organizations can establish a common language for continuous improvement [26]. Typically, a regular LSS meeting to review LSS progress and results is a communication platform that will provide the opportunity to review LSS project status and to identify the potential issue or gap for improvement [25]. In addition, an effective commination ensures organization strategy, stakeholders and customer requirements are propagated across all the entire organization [27].

2.2.5. Training (TRA)

Effective LSS training program would provide the platform to groom LSS experts and LSS project leaders, equipped with comprehensive LSS knowledge [22]. It is critical to provide the opportunity for employees to improve their skill and knowledge and connects the employees into the LSS world through training. Identify the need of training and development of training content are the two fundamental steps to ensure an effective training program. Within the context of LSS, the needs and scopes of training are defined, structured and classified into a "belts" system as shown in Table 2 [13], [28].

Table 2. Lean Six Sigma belt system

	Green belts	Black belts
Profile	Technical background	Technical degree
	Respected by peers	Respected by peers and management
	Proficiency in basic and advanced tools	Master of basic and advanced tools
Role	Leads important process improvement teams	Leads strategic, high impact process improvement projects
	Leads, train, and coach on tools and analysis	Change agent
	Assists black belts	Team members
	Typically part-time on a project	Full-time project leader

The LLS "belt" system is structure based on the need and scope of training. As refer to Table 2, generally, the mode of LSS training consist of champion, black. Belts and green belts training. The "profile" section of Table 2 reflects the group of employees who need to be trained, while the "role" represents the scope and content of the training program. A group of trained green belts and trained champion are the basic need for any LSS project.

2.2.6. Employee reward and recognition (ERR)

Reward and recognition (ERR) is a one of the crucial factors for the successful implementation of LSS [17], [20], [27]. Generally, reward and recognition can be defined as am approach to motivate employees based on the output contribute by the employee. ERR could be either in the form of monetary (bonuses) or in non-monetary (acknowledgement during a regular team meeting or in a company newsletter). Finding from prior studies revealed that 61% of the top performing companies promote ERR system that link to their business strategies, while lower performing companies created minimal linkage. As such, an effective reward and recognition system must be aligned with the LSS project objectives and goals [22], [23].

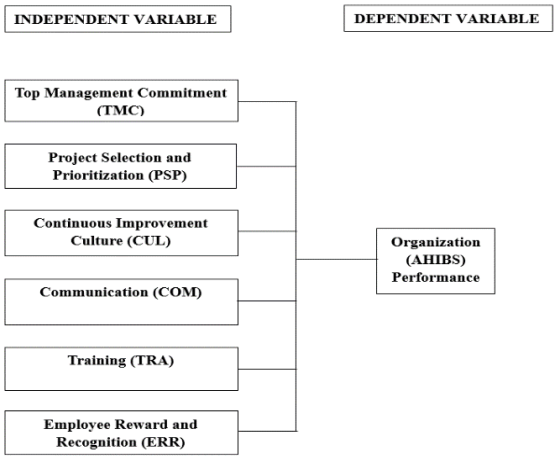
2.3. Organization performance

LSS integrates the concept of value maximization and variation reduction to optimize organizational performance in term of resource utilization, process efficiency improvement, quality improvement, lead time and cost reduction, with the ultimate aim to create customer satisfaction [29]. From LSS perspective, "customers" could be further split into internal customers. Within the context of this study, internal customers refer to employees who received the services from the business schools, such as lecturers and administrative staffs. While external customers denoted to individuals or organizations outside the business that received the services, such as students, parents, government bodies and industry partners. Promoting strong internal customer service can help boost the morale of an organization and help facilitate more effective and efficient operational process [29], [30], as such this study views organization performance from internal customers perspective, or namely the perceived organizational performance.

Perceived organizational performance refers to internal customers' perceptions regarding their organization's overall performance. Perceived organizational performance is related with the effectiveness of resources utilization and the efficiency of operational process. As such, this research views perceived organizational performance from three perspectives as proposed by previous studies [6], [30], which are inconsistent with the theory of system: i) Inputs performance-human resources, physical resources and financial resources utilization; ii) Processes performance–efficiency of teaching, learning, research, administration and knowledge transformation process; and iii) Output performance-tangible results, such as value added to the service process.

2.4. Research framework

The research framework for this study is developed based on the theory of constraints and supported by framework developed by prior scholars [4], [14], [15], [20], [22]. Theory of constraint is an approach to surmount the system constraint to achieve a high-level performance management philosophy. Within the context of LSS, theory of constraints is an approach of identifying the constraint of the operational process (the most important factors) in order to achieve the organizational goal [28]. As such, the research framework for this study views the six LSS CSF identified in literature review as the independent variables, and the perceived organizational performance dependent variable. In line with the research framework, six research hypotheses are developed as shown in Figure 1.



H1: Top management commitment (TMC) is positively correlated to the organization performance level in AHIBS.

H2: Project selection and prioritization (PSP) is positively correlated to the organization performance level in AHIBS.

H3: Continuous improvement culture (CUL) is positively correlated to the organization performance level in AHIBS.

H4: Communication (COM) is positively correlated to the organization performance level in AHIBS.

H5: Training (TRA) is positively correlated to the organization performance level in AHIBS.

H6: Employee reward and recognition (ERR) is positively correlated to the organization performance level in AHIBS.

Figure 1. Research framework and hypotheses

3. RESEARCH METHOD

This research was quantitative based. The research adopted questionnaire developed by Ali, Choong, and Jayaraman [14] as research instrument. Data was analyzed via descriptive analysis and Pearson correlation test.

3.1. Population and sampling

The targeted respondents for this research were lecturers in a Business School in Malaysia, with population size of 108. Sample size was estimated based on sampling table proposed by Krejcie and Morgan, with targeted sampling size of 80 respondents.

3.2. Research instrument

Research instrument in the form of questionnaire was used to collect feedback from the targeted respondents. The questionnaire consists of three sections. Section A aims to collect the demographic information of respondents. Section B adopted 30 questions developed by previous reserachers [14] with the objective to assess the important LSS CSFs perceived by respondents. Section C made up of eight questions adopted from Sahney, Banwet, and Karunes [6] with the purpose to gather the respondents' perception on organization performance. Respondents are asked to rate the important level and performance level based on five-points scale from 1 (the lowest) to 5 (the highest).

3.3. Analysis tool

3.3.1. Normality and reliability test

Data collected from section B and C of questionnaire are analyzed to validate the data normality and reliability via Skewness and Kurtosis value and Cronbach alpha respectively. Skewness and Kurtosis value of +/-3 suggested that data is normally distributed. Meantime, Cronbach alpha reliability value should be at the minimum 0.70 in order to proceed for further analysis.

3.3.2. Descriptive analysis

In addition, to identify the LSS CSF for a business school in Malaysia (research objective 2). The mean score of data collected from section B of the questionnaire (important level of LSS CSF) is calculated to assess the important level of the LSS CSF.

3.3.3. Pearson correlation test

Research objective 2 (to explore the relationship between LSS CSF and the perceived organization performance within the business school in Malaysia). The six hypotheses shown in Figure 1 are assessed via Pearson correlation test. Hypothesis are tested at significant level of 5%, while the strength of correlation is evaluated via level of correlation coefficient with the reference as shown in Table 3.

Table 3. Correlation coefficient scale

Strength of relationship	r
Very weak	0.00-0.19
Weak	0.20-0.39
Moderate	0.40-0.59
Strong	0.60-0.79
Very strong	0.80-1.00

4. RESULTS AND DISCUSSION

The questionnaire was transformed into Google Form. It distributed to the targeted respondents via email. There were 69 lecturers responded, with the respond rate of 86.25%.

4.1. Normality and reliability test

Normality and reliability of data collected from sections B and C of questionnaire are assessed via Skewness and Kurtosis value and Cronbach's alpha value respectively. Analysis result reveals that Skewness value is ranged from -1.267 to -0.457, while Kurtosis value is between -0.334 to 2.895, which are within the acceptance range of +/-3, hence, data is normally distributed. In addition, result of reliability test revealed that Cronbach's alpha value for each variable is ranged from 0.959 to 0.981, which is higher the acceptance level of 0.70. This suggested that the internal consistency of data is accepted and could be proceed for further analysis.

4.2. Address research objective 1

To address research objective 1 (to identify the LSS CSF for a business school in Malaysia), descriptive analysis is performed on the data collected from section B of questionnaire (important level of LSS CSF). It aimed to generate the mean score for each CSF. The means score represents the important level of each critical success factor. Result of descriptive analysis and the important ranking of the six CSF is summarized in Table 4.

Table 4. Descriptive analysis result of LSS CFSs

LSS CSFs	Mean	Rank
Top management commitment (TMC)	4.2898	1
Communication (COM)	4.2449	2
Continuous improvement culture (CUL)	4.2143	3
Training (TRA)	4.1293	4
Employee reward and recognition (ERR)	4.0578	5
Project selection and prioritization (PSP)	3.8857	6

As referred in Table 4, the six CSF are rated by the respondents between mean score of 3.8857 to 4.2898, this suggested that all the six LSS CSF are viewed by the respondents as important factors for the business schools' performance. LSS CSF top management commitment (TMC) is perceived by the respondents as the most important CSF with the mean score of 4.2898, follows by LSS CSF communication (COM), continuous improvement culture (CUL).

The analysis result of this research is in line with finding from prior research. Ali, Choong, and Jayaraman [14] in service industry suggested that engagement of top management toward LSS initiatives and commitment toward promoting "continuous improve culture" are the key drivers for organizational performance. In addition, research done by prior scholars [3] in manufacturing setting also reveals that commitment shown by top management team members as well as how it is communicated across the organization are the two important elements to ensure the success of LSS. Moreover, study done by Lande, Shrivastava, and Seth [20] in small and medium entreprise (SME) also recommended that effective training on LSS principle, framework, tools, and technique is the key mechanism for LSS success. Finding from this research also enchoes view of prior scholars [3], [20], which regard manufacturing, services and education sectors shared the commonality in term of process improvement management, hence factors that LSS success factors for manufacturing and service setting could be bring across to education setting.

4.3. Address research objective 2

Data collected from section B (important level of LSS CSF) and section C (perceived organizational performance) are analyzed via Pearson correlation test to assess the relationship between the important level of LSS CSFs and the organizational performance perceived by the respondents. The analysis result is used to address both research objective 2 (to explore the relationship between LSS CSF and the perceived organization performance within the business school in Malaysia) and hypotheses H1 to H6. The analysis of Pearson correlation test is summarized in Table 5.

Table 5. Result of Pearson correlation analysis (LSS CSFs versus perceived organizational performance)

	LSS CSFs	Coefficient of correleation (r)	Sig (2-tailed)	Hypothesis
H1	Top management commitment (TMC)	0.831	0.000	Accepted
H2	Continuous improvement culture (CUL)	0.823	0.000	Accepted
H3	Employee reward and recognition (ERR)	0.823	0.000	Accepted
H4	Communication (COM)	0.803	0.000	Accepted
H5	Training (TRA)	0.801	0.000	Accepted
H6	Project selection and prioritization (PSP)	0.283	0.031	Accepted

As refers to Table 5, the significant value for all correlation test is less than 0.05 suggested that the relationship between all the six LSS CSF and the perceived organization performance are positive and significant. Based on the coefficient of correlation (r) and the coefficient correlation scale of Table 1, the strength of relationship for five of the CSF (top management commitment, continuous improvement, employee reward and recognition, communication, training) are "very strongly". Hence, LSS CSF "project selection and prioritization" is suggested by respondents has a "weak" relationship with the perceived organization performance.

In general, finding from this study is in parallel with study done by prior scholars in manufacturing and service industry setting [3], [20]. They revealed that commitment and involvement of top management team in LSS process improvement projects initiates a positive and significant impact toward performance of the organization. Prior scholars also tends to agreed that the culture of continuous process improvement the organization and the reward and recognition system for successful LSS implementation are the factors that impel the advancement of organization performance [31]. Hence, finding from this research suggested that LSS CSFs that significantly correlated with organizations are generally common among manufacturing, service and education sectors.

However, one of the remarkable findings from this research is LSS CSF "project selection and prioritization" is suggested by respondents as "weakly" correlated with the perceived organization performance. It is not in line with the study done by prior scholars in manufacturing setting. From the perspective of LSS in manufacturing, "project selection and prioritization" is commonly view by prior researches as important factors as well as factor that strongly correlated with organization performance [13], [20]. Finding from this research suggested that project selection is important, however it is weakly correlated with the perceived organization performance. Perhaps, within the setting or nature of the population for this research (the lecturers of the business school), there is no direct involvement by the lectures in the process of project selection because this is done at the top management level.

Project selection process involves three main steps, which are project proposal, project screening, and project selection [32]. The sources of project proposal could be from the top management team or from the employees. Projects proposed at top management level are initiates that raised based on the organization's vision, mission and strategy. Whereby projects proposed by employees are projects that related to improvement on processes that deal by the employees or to resolve process related problem that faced by the employees. Perhaps, the nature of education institution improvement focus tends to be driven by projects proposed from the top management team. Hence, perhaps within the population in this research, the business school should look into project proposal from the employee's perspective as an alternate source of process improvement opportunity.

5. CONCLUSION

The research confirmed that all the six LSS CSFs are viewed by lecturers in the business school as important factors toward success implementation of LSS. In addition, at significant level of 0.05, the six LSS CSFs are also significantly correlated with the performance of the business schools that perceived by the lecturers. Hence, the first implication of this research is manufacturing, services, and education sectors share a commonality in term of factors that drive the success of LSS implementation toward operational process improvement.

However, the remarkable finding from this research is LSS CSF "project selection and prioritization" is viewed by the lecturers as the least important and weakly correlated with the business performance perceived by the lecturers. The business schools shall explore the potential process improvement opportunity for LSS via gathering and grasping the process improvement ideas and proposal from the lecturer as well as the rest of the staffs.

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