Continual Improvement (CI) Lean Culture Continuous Quality and Cost Saving in Malaysia Manufacturing & Engineering (M&E) Companies

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ABSTRACT

Lean sustainability is often perceived to only be possible to be maintained via small group application of lean culture that carry out improvement activities. The purpose of this case study is thus to examine the success factors of inculcating lean culture framework by lean practitioners in Malaysian Manufacturing and Engineering (ME) companies that faced inconsistencies in implementing and sustaining lean. The impact of lean culture framework practiced by Small Group Improvement Activities (SGIA) was analysed via productivity improvement methodologies comprises of semi-structured interviews and analysis of 633 Small Group Improvement Activities (SGIA) project reports in establishing a final lean culture framework that can contribute to the longevity of a lean company. The improved lean culture framework that had been extended to other strategic business units (SBU) in ME companies are found to be the positive factor contributing to the sustainability of lean culture and achieving tangible and intangible benefits via small group improvement activities, enhancement standard which include companies' policy, as well as providing a guideline in problem solving methodology. The findings revealed that enhancement of inculcating lean framework is crucially in need especially in expanding the initiatives across ME companies via a systematic and standardised problem-solving methodology. This study intends to aid organisations, practitioners, academicians, and respective industries in benchmarking the best practises and at the same time further reduce the gap and continually improve the lean culture framework in other compass industries.

Keywords: Lean Culture; continual improvement; small group improvement activity; problem-solving; lean manufacturing

INTRODUCTION

Malaysia Productivity Corporation (MPC), which is an agency under the Ministry of International Trade and Industry (MITI), has been mandated to drive the nation's productivity growth by creating a strong ecology to revitalize the business climate (Malaysia Productivity Corporation 2020) based on four productivity drivers which are talent, technology, business environment, and subsidies. Talent, which is one facet of the productivity drivers refers to building a future-ready workforce, where talent performance calls for proper improvement initiatives in talent development. Work-based learning programs that comprise skills upgrading, retraining, upskilling and/or reskilling courses, are fundamental approaches to building a country's skilled workforce and talent, emphasizing lifelong learning (Malaysia Productivity Corporation

2022). In 2019, MITI spokesmen asserted that arduous and expeditious efforts must be in place, the productivity drivers shall be deployed, and industry must play a critical role in rebuilding the economy with the right policies and assistance in place, forming a conducive canvas for businesses to sustain (Malaysia Productivity Corporation 2020).

Few authors remark that national culture lenses a few key points between manufacturing competitiveness and talent management. Stronger deployment of lean practices in the organisation is a need, but it is of upmost importance that deeper understanding, refinement, and customization to the organization's needs will aid and prove useful in managing the organizational culture change process (Dorval et al. 2019).

The baseline focus of skill development and soft techniques are employee involvement, group problem-solving, and supplier and customer relationships (Matharu et al. 2019). In addition, Matharu et al. (2019) stated organisations shall support the scheme and alignment between organizational culture and lean management for performance improvement and sustainability efforts. Iranmanesh et al. (2019) on the other hand opinionated for special attention to lean culture development is required to enhance the sustainable performance of the organisation. Various factors that affect the development of lean culture have been identified, such as the lack of understanding, the fact that the manual of lean implementation only covers the operation area, and the inability to align with the organisation's common goals (Matharu et al. 2019). In addition, Mamoojee-Khatib et al. (2023) found that 70% to 90% of lean implementation in the industry failed due to shortcomings in different lean implementation approaches as well as a shortage of lean implementation models.

Thus, this case-based study is conducted to answer the Minister of Ministry of International Trade and Industry Malaysia (MITI)'s call and to share the enhancement framework strategy to inculcate lean culture in Malaysian manufacturing and engineering companies, focusing on a future-ready workforce as well as enhancing the work-based learning programme. This case study uses qualitative methodologies involving 633 small group improvement activities (SGIA) from year 2019 to year 2022 in three business segments namely automotive, lubricants and aerospace industries as well as questionnaire survey targeted towards lean practitioners' manufacturers. The main objectives are to enhance efficiency and inculcate a lean culture in the organisation through an enhanced and standardised framework, policy as well as provide guidelines for problem solving.

LITERATURE REVIEW

In Table 1, the definition of lean manufacturing (LM), and Toyota Production System (TPS), scope of application, philosophical approach, tools and techniques as well as cultural impact which are analysed and used in this study are tabulated. Lean manufacturing (LM) and TPS focuses on elimination of waste in improving efficiency and ensuring smooth Just-In-Time (JIT) production, minimizing defects and enabling quick problem identification and resolution through continuous improvement via employee and people involvement. The outcome of overall operational excellence by LM and TPS are based on the usage of tools and techniques such as value stream mapping (Bugvi et al. 2021), 5S methodology, Total Productive Maintenance (TPM), Kanban, Andon, Poka-Yoke (error free) and Jidoka (automation with human touch).

The definition of lean culture (LC) and small group improvement activities (SGIA) adapted from Kaizen principles that are used in this study are tabulated in Table 2. Lean culture (LC) is practiced through employee-driven enhancements initiatives via small group improvement activities (SGIA) that focus on minimizing waste, reducing non-value adding activities and maximizing customer value at all levels and processes which may influence improving the lean culture and the financial health of the business, both of which contribute to profitability. However, lean culture requires more top-down approach rather than bottom-up approach especially if the improvements are present throughout the entire value chain. For SGIA, the PDCA (Plan-Do-Check-Act) is an additional methodology used in the improvement activities together with other LM and TPS tools and techniques such as Value Stream Mapping (VSM), 5S methodology, Total Productive Maintenance (TPM), Kanban, Andon, Poka-Yoke (error free) and Jidoka (automation with human).

Table 3 shows the benefits and challenges of inculcating LC. It is discovered that employee involvement, soft practices principles that comprises of people management and performance orientation which relates to Key Performance Indicators (KPI) leads to tangible benefits are the most significant benefits and challenges obtained from LC. Surprisingly however, the benefits and challenges in inculcating LC are less mentioned in the reviews in term of visual and project management.

TABLE 1. Lean manufacturing (LM), and Toyota Production System (TPS) (This Study)

Differences	Lean Manufacturing	TPS	Citation
1.Origin and focus	Broader concept that incorporates TPS methodologies and tools, aiming to improve efficiency, minimize waste, and maximize value across various industries.	Developed by Toyota, TPS is a comprehensive management philosophy that focuses on the elimination of waste, quality improvement, and efficient production	Dorval et al. 2018 Tortorella et al. 2018 Liker 2004
2.Scope of Application	Adapted and applied in various manufacturing and service industries beyond Toyota, focusing on waste reduction, continuous improvement, and customer value maximization.	Primarily applied within the manufacturing processes of Toyota, emphasizing the principles of just-in-time (JIT) production, Jidoka (automation with a human touch), and continuous improvement.	Dorval et al. 2018 Bortolotti et al. 2014 Salleh et al. 2015 Iranmanesh et al. 2019 Liker 2004 Salleh et al.2012
3.Philosophical approach	Integrates TPS principles with other methodologies, emphasizing the importance of customer value, waste reduction, and employee involvement to achieve operational excellence.	Emphasizes the philosophy of respect for people and continuous improvement as core values within the organization.	Dorval et al. 2018 Tortorella et al. 2018 Alhuraish et al. 2017 Matharu et al. 2019 Malaysia Productivity Corporation 2020 Liker 2004 Shook 2007 Matsuzaki 2005
4.Tools and techniques	Incorporates a broader range of tools, including value stream mapping, 5S methodology, and Total Productive Maintenance (TPM), to optimize processes and improve overall operational efficiency.	Utilizes tools such as Kanban, Andon, and Poka-Yoke to ensure smooth production processes, minimize defects, and enable quick problem identification and resolution.	Bortolotti et al. 2014 Alhuraish et al. 2017 Matharu et al.2019 Deif et al. 2019 Malaysia Productivity Corporation 2020 Liker 2004 Shook 2007 Matsuzaki 2005
5.Cultural Impact	Encourages a culture of continuous learning, innovation, and waste reduction, fostering employee empowerment and a customer-centric approach to operations.	Cultivates a strong organizational culture that promotes employee engagement, teamwork, and a commitment to continuous improvement at all levels of the organization.	Dorval et al. 2018 Taherimashhadi et al. 2018 Alhuraish et al. 2017 Iranmanesh et al. 2019 Malaysia Productivity Corporation 2020 Liker 2004

TABLE 2. Definition of Lean Culture (LC) and Kaizen through small group improvement activities (SGIA) (This Study)

Comparison	Kaizen Philosophy	Lean Culture	Citation
1.Focus	Primarily centres on the concept of continuous improvement through small, incremental changes.	Focuses on minimizing waste, reducing non-value-adding activities, and maximizing customer value.	Dorval et al. 2018 Taherimashhadi et al. 2018 Alhuraish et al. 2017 Iranmanesh et al. 2019 Malaysia Productivity Corporation 2020 Liker 2004
2.Scope	Emphasizes improvement at all levels, including individual processes and employee-driven enhancements.	Encompasses a broader approach, incorporating various methodologies such as Just-in-Time (JIT) production, value stream mapping, and continuous flow to optimize entire value streams.	Bortolotti et al. 2015 Liker 2004 Bugvi 2021

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3.Methodology	Primarily involves a bottom-up approach, encouraging every employee to contribute to the improvement process.	Can be implemented through a top-down or bottom-up approach, focusing on systematic methodologies and tools to identify and eliminate waste throughout the entire value chain.	Bortolotti et al. 2015 Taherimashhadi et al. 2018 Badgujar et al. 2016 Alhuraish et al. 2017 Matharu et al. 2019 Dorva et al. 2019 Malaysia Productivity Corporation 2020 Liker 2004 Shook et al. 2009 Matsuzaki 2005
4. Application	Originally applied to manufacturing, it has since been adopted in various sectors, including healthcare, services, and administration.	Initially focused on manufacturing, it has expanded to different industries, including healthcare, construction, and software development.	Salleh et al. 2015 Liker 2004 Matsuzaki 2005
5.Waste reduction	Aims to reduce waste through continuous incremental improvements driven by employees.	Targets waste reduction through a comprehensive approach that involves the elimination of all forms of waste, such as overproduction, waiting time, defects, and excess inventory.	Alhuraish et al.2017 Salleh et al. 2015 Badgujar et al. 2016 Malaysia Productivity Corporation 2020 Liker 2004 Shook et al. 2009 Matsuzaki 2005
6. Integration of tools	Utilizes various tools such as PDCA (Plan-Do-Check-Act) cycles, 5S methodology, and value stream mapping.	Incorporates a broader range of tools and techniques, including JIT, Kanban, and Total Productive Maintenance (TPM), to streamline processes and eliminate inefficiencies.	Bortolotti et al. 2015 Alhuraish et al. 2017 Matharu et al. 2019 Deif et al. 2019 Malaysia Productivity Corporation 2020 Liker 2004 Shook et al. 2009 Matsuzaki 2005

TABLE 3. Benefits and challenges in inculcating lean culture (This Study)

No	Key factors	Deif et al. 2019	Tortorella et al. 2018	Alhuraish et al. 2017	Liker 2004	Liker et al. 2007	Malaysia Productivity Corporation 2016-2020	Dorval et al. 2018	Iranmanesh et al. 2018	Matahru et al. 2019	Taherimashhadi et al. 2018.	Salleh et al. 2015	Badgujar et al. 2016	Bortolotti et al. 2015	Shook et al. 2009	Total
1	Leadership / top management	√	√	√	√	√	√	√		√						9
2	Employee involvement	√	√	√	√		√				√	√	√	√		10
3	Communication channels			√			√	√								3
4	Continuous Improvement (CI) learning			√	√			√	√		√					5
5	Shop floor involvement			√	√		√	√				√		√	√	8
6	Visual Management				√			√								2
7	Standardised Process and workflows				√		√	√								4

... cont.

#		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
8	Waste Elimination			√	√		√	√					√	√		7
9	Cross function Collaboration	√	√	√			√			√		√				7
10	Recognition and celebration achievements			√	√		√									3
11	HR Management -people engagement	√			√	√		√	√			√		√	√	8
12	Cultural Gap/ change			√	√			√	√	√		√				6
13	Soft practices – principles, people and relations, managerial	√			√	√	√	√			√	√		√	√	10
14	Hard practices – technical, analytical tools	√		√	√	√	√	√			√			√		9
15	Performance orientation, benefits	√		√	√	√		√		√	√	√		√		10
16	Project management skills			√	√											2
17	Others (ie : software, technology)				√								√			3

METHODOLOGY

One of the solutions taken to enhance the current continual improvement lean culture framework in ME companies is to grasp current condition and integrate all the best practices of successful initiatives benchmarked from current ME companies and the establishment of lean culture enhancement framework will be used across ME companies. Details phases explained in Figure 1.

PHASE 1 – SELECTION OF REFERENCES

24 references have been selected include academic journals, books, reports, and reputable websites which relate to lean manufacturing, lean culture and lean tools used and practised in lean journey.

PHASE 2 – ANALYSE AND SUMMARISE FINDINGS

Next, the references have been analysed and summarised as follows in Table 1, Table 2 and Table 3.

PHASE 3 – SELECTION OF ME COMPANIES

To accomplish this, three business segments of ME companies had been selected to gauge and grasp the current lean culture conditions. The details result summarised in Table 4 in this case study.

PHASE 4 – SEMI STRUCTURED INTERVIEWS

Several past studies recommended a survey approach to study lean expert experience on how lean can be successfully implemented and sustained in the organization (Dorval et al. 2019). To support this research, one semi-structured interview was conducted where four operational head in ME companies selected as the respondents.

Selection is based on their knowledge and experience in inculcating lean cultures in the companies.

PHASE 5 – SUMMARIZE THE FINDINGS

Interviews with a structured questionnaire were conducted to get a better understanding of the continual improvement (CI) lean culture in ME companies. The interviews commenced with sharing their experience and knowledge about the company. Structured questions have been prepared in advance to help focus on getting the actual data that will link to the research objectives. The first question to understand the history of continual improvement journey from respective Strategic Business Units (SBU's). The second question aims to understand how the continual improvement activities were embedded in each of the SBU, where it is important to thoroughly analysed the strategy and approaches used.

The third question was to understand the types of platforms used in executing the lean culture and to understand what the best platform is to be used and enhanced so that the initiatives can be applied to other SBUs.

The fourth question was focused on identifying programs and initiatives to enhance the lean culture in the organization and to collect data in the form of the number of small group improvement activities (SGIA) registered across ME companies which resulted in an enhanced problem-solving methodology and benefits gain from the SGIA.

While the fifth question helps to understand upcoming ideas to be generated, jotted down and further analysed for the betterment of the enhancement process throughout this research.

The last question focuses on measurement criteria that currently used in the organization intending to understand the impact and influences on putting continual improvement as part of the Key Performance Index (KPI) for each staff. Results shows in Table 5, Table 6, Figure 2 to Figure 3.

PHASE 6 – ENHANCEMENT OF LEAN CULTURE
FRAMEWORKS

The interview transcripts have been analysed using qualitative data to identify recurring initiatives, patterns, or insights relevant to the research objectives. Details are as per Figure 4.

PHASE 7 – SELECTION OF 633 SGIA PROJECTS

Following steps from the timeline is the selection of actual improvement projects executed from respective ME companies. Data shows in Table 6.

PHASE 8 - ANALYSE AND SUMMARISE 27 TOPS SGIA

Furthermore, from this case study lean tools and techniques have been summarised to customise problem-solving methodology as summarised in Table 7.

PHASE 9 - VALIDATION OF 27 TOP SGIA

Continuous quality and cost savings gain from this case study has been details up in Table 9.

PHASE 10 - ESTABLISH ENHANCEMENT OF SGIA FRAMEWORK TECHNIQUE IN PROBLEM SOLVING FROM LEAN CULTURE ENHANCEMENT FRAMEWORK

Finally, the enhancement of lean culture framework has been established and illustrated in Table 8.
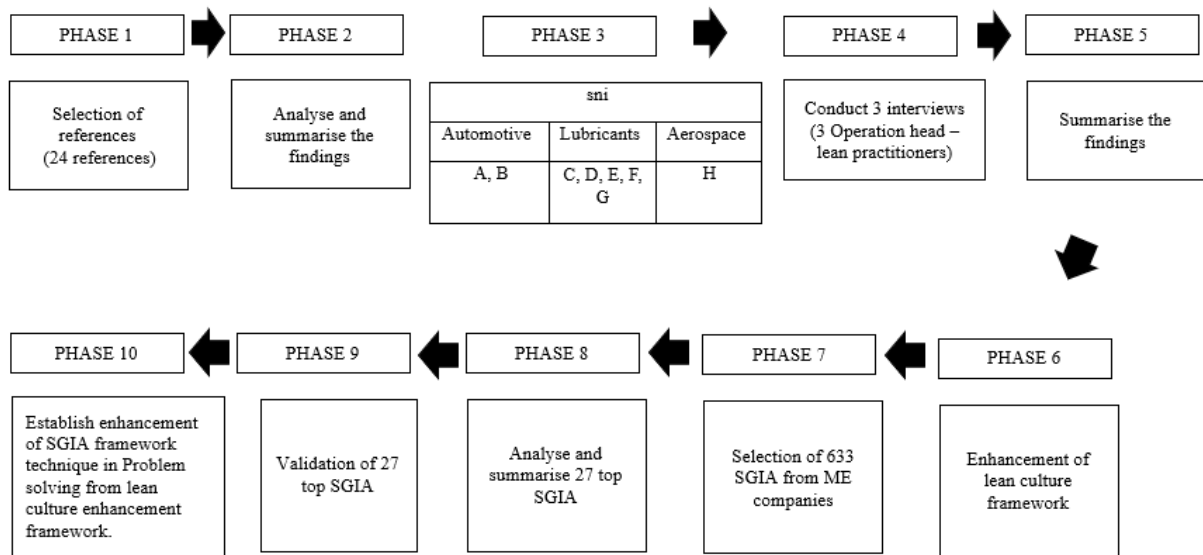

FIGURE 1. Research methodology – timeline to integrate lean culture and problem-solving framework (This study)

RESULTS AND DISCUSSION

For this multiple case study, several ME companies have been chosen. It has three primary businesses consisting of manufacturing products in the automotive and aerospace industries, as well as the manufacturing and distribution of lubricants. The holding companies, namely Strategic Business Unit (SBU), consist of Company A, Company B, Company C, Company D, Company E, Company F, Company G, and Company H. The total number of employees reported was 1,716 and a turnover rate of 5% was reported as of December 2019. Total revenue as of December 2019 was reported at RM1,062.5 million, and the profit before tax was RM 126.4 million. Details of the three business segments are explained in Table 4.

TABLE 4. Three Business segments breakdown in the ME companies (This Study)

ME Companies nature of business		
Automotive	Lubricants	Aerospace
Company A: specializes in the manufacturing of shock absorbers, and supplies products to original equipment manufacturers (OEM) and replacement markets (REM) such as shock absorbers, motorcycle suspension units, hydraulic power steering pumps, and system. Company B: specializes in manufacturing filters, engineered plastic parts, and specialty fluids in Malaysia	Company C: supplies motor oils for passenger vehicles, and diesel engines Company D: supplies motor oil to automotive and industrial sectors Company E: supplies lubricants, and transmission oil for the race car, and industrial clients Company F: manufacturing, selling, marketing, and distributing motor oils passenger vehicles, motorcycles, and diesel engines. Company G: Manufacturing, distributing in China offer a full range of research and development, blending, storage, and distribution services to our customers.	Company H: supplies fan case to Rolls Royce. It is tier 1 aerospace engine component manufacturer. These products are being manufactured in a highly equipped plant, in Malaysia to complement its counterpart RR plant in Singapore.

Company A and Company B are two companies from automotive sector. Company A specialises in shock absorbers and provides goods to both the OEM and replacement markets (REM). Items produced include shock absorbers, suspension systems for motorcycles, and hydraulic power steering pumps and systems. Company B, the second SBU from ME businesses, is focused on producing fluids, engineered plastic parts, and filters in Malaysia.

Companies that are involved in the lubricants sector are Company C, D, E, F and G and only Company H from aerospace sector participated in this case study.

In every fiscal year, the management of ME divisions has periodically reviewed their business performance. Top management leadership support and commitment are crucial in the lean manufacturing implementation (Salleh et al. 2020). During the session, all the improvement activities that have been conducted were presented and reviewed by each SBU. This initiative has taken placed as an important part of continuously improving company profitability and, at the same time, as a strategic business enhancement to be competitive with market players. To enhance and optimise customer needs from upstream and downstream, ME Division has come up with a strategy to inculcate lean culture across ME companies. This is aligned with (Dorval et al. 2019), who indicated lean culture needs to be understood and implemented in the organisation as part of the lean transformation journey. According to Bortolotti et al. (2014), soft practises are fundamental to become a successful lean plant and have important implications for lean practises.

As reported in the yearly management review in the ME Division, Small Group Improvement Activities (SGIA) is one of the continual improvement initiatives to inculcate lean culture in the organisation. From the data bank that ME Division has; the current status of implementation is explained in Table 5. As shown, only Company A. has matured and installed the SGIA programme. The maturity defines in term of working culture, no of process improvement done, practicing lean tools and techniques, key performance indicators (KPI) monitoring, employee engagements, supplier and customer relationship. This company has been involved with the SGIA since 2000. The maturity of the installation has been benchmarked for other SBUs. While in Company B, it started the SGIA programme in 2002 and has continued the exercise to date. There are six remaining SBUs that have not yet implemented the SGIA in their companies. The companies namely are Company C, Company D, Company E, Company F, Company G and Company H.

TABLE 5. Eight ME companies' status on SGIA lean culture implementation (This Study)

No.	ME Company	Initiatives to inculcate lean culture	Status
1.	Company A (Automotive)	Matured SGIA Program	Yes
2.	Company B (Automotive)	Started SGIA	Yes
3.	Company C, D, E, F and G (Lubricants)	Yet to implement SGIA	No
4.	Company H (Aerospace)	Yet to implement SGIA	No

Company A started implementing SGIA way back in 1990, and now has a matured SGIA program. Thus, Company A's framework is used as the benchmark company. Figure 2 shows Company A framework which comprises of 5 steps in maturing the lean culture.
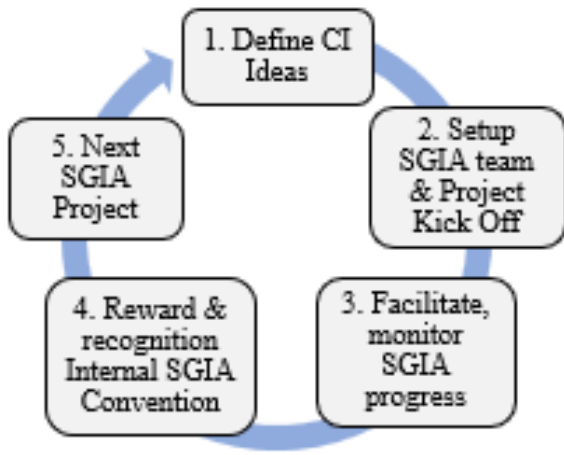

FIGURE 2. Company A framework (This Study)

Company A's framework starts with identifying improvement ideas, usually, comes from top-down or down-to-top approaches. The ideas may also come from other sources such as efficiency improvement, customer complaints, management review output, internal or external audit noncompliance, quality, cost, delivery, safety, and others that help the company to improve the way they do things to be more effective.

The next step is to set up SGIA team. The SGIA formation may come from the individual department or cross-function team depending on the theme projects that need to be improved. The goal of this process is to allow the SGIA to buy off their proposal and seek management approval before executing the project. During the initial setup, the responsibility matrix of each member will be identified to ensure each member understands their responsibilities whether as a leader, assistant, and the level of involvement of each member. Each member will experience different responsibilities to ensure the given task is completed according to the given timeline.

To ensure the SGIA team is working and able to be completed within the specific timeline, the SGIA progress has to be monitored and reported. In this stage, the SGIA team works along with their appointed supervisor or name as a mentor. The frequency of progress updates is usually weekly with all team members and reported on a monthly basis by the leader to the management. The objective of this step is to ensure any hiccup or stumbling block is addressed and at the same time support the SGIA team's needs to pursue their next step to complete the project in a timely manner.

Another company that has implemented the SGIA program is Company B. The company has started the SGIA in the year 2020 and have been implementing unstructured SGIA for almost 20 years. Figure 3 shows their implementation framework that consists of 4 main steps in inculcating lean in the organization.
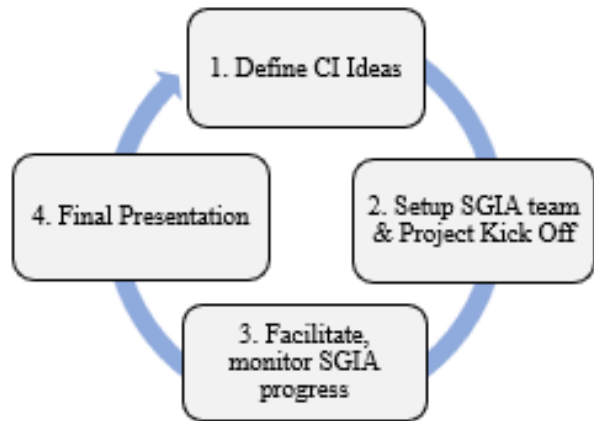

FIGURE 3. Company B framework (This Study)

Step 1 is to define continual improvement ideas. The input of the ideas may come from top- to- bottom directions or bottom-to-top approaches. Once the decision has been made, the team will continue to step 2 which is to set up the SGIA team and kick off the project. After that is mentorship in step 3, with the main aims are to facilitating and monitoring the SGIA progress and the last step is the final presentation.

Generally, this framework is similar to Figure 2 since Company B has benchmarked the framework of Company A in order to inculcate lean in their organization. However, the next SGIA ideas projects were not introduced in Company B as in Company A and this is one of the potential improvements that can be added to improve and strengthen the lean framework in all ME operating companies.

An annual sharing session event platform is organized for presentation sessions of the completed SGIA projects. Outcomes from this event platform are to recognize SGIA teams by having them presenting their successful project and to motivate and encourage sharing of best practices across the department in order to inculcate the lean culture by sharing the right methodology in improving the way their doing things. At the end of the event, the best team is rewarded by the top management.

Continual improvement is a must in the company whether the business is in good or bad condition. By having this mindset, the team is encouraged to propose new SGIA ideas at the end of their SGIA presentation and this continuity process helps Company A sustain and maintain the effort of continual improvement and making the lean

culture live. Many companies have found it difficult to successfully implement and sustain lean manufacturing. Not many companies are willing to share their success story in inculcating a lean culture in their organisation (Bortolotti et al. 2015) and (Ibrahim et al. 2017) mentioned that the organization needs to custom-make, identified, and understand the critical success factors and significance in ensuring the lean manufacturing installation and being the organizational culture.

In this case study, the ME top management understands the need to inculcate the lean culture in the organization. To start the enhancement program across companies, ME companies has established a Continuous Improvement (CI) policy and deployed to all companies. These deployment processes were cascaded down with a proper program in order to ensure the understanding and basic CI needs were explained from all levels of stakeholders. The purpose of the policy is to set expectations and clear guidelines in setting CI objectives, scope or area of implementation, standard form used, responsibility and steps taken in executing the CI through a structures problem-solving process in an activity called SGIA.

This policy contains a complete kaizen/ CI procedure as the main guideline for others to follow. Salleh et al. (2015) stated the importance of having lean policy and lean objectives to promote the lean manufacturing activities is to ensure the lean policy and objectives can be accomplished in promoting the lean culture in the organization.

In this case study, the first enhancement framework is to setup a lean office consists of committee members come from ME companies appointed person. Enhancement framework to strengthen the installation process of lean culture in ME companies has been illustrated in Figure 4. (Bortolotti et al. 2015) recommends managing people first before implementing lean transformation framework.

FIGURE 4. Enhancement framework to strengthen the installation process of lean culture in ME companies

LEAN CULTURE INSTALLATION

STEP 1 SETUP LEAN OFFICE

The setup committee is chosen from a cross-functional department within the organisation and is led by a corporate function. The role of lean office is to facilitate, coordinate and promote the lean culture in the organisation. Roles and responsibilities of the committee is to ensure the policy, standard and guidelines been deployed from corporate to all ME companies' members. Few standards have been established in aligning the problem-solving methodology across ME companies. Division SGIA convention guidelines are established and cascaded down to all ME companies. Shook et al. (2009) proposed that to reduce the ineffective of CI installation, the stakeholder in the organization comprises of management, middle management and workers have their roles and responsibilities in ensuring the culture embedded in the organization. Firstly, other than the change of needs, establishing activity to install the CI culture, setting up lean office to observe and monitor the CI installation program as well as to reward and recognize the CI success story that can promote the effectiveness of continuous improvement activities. Table 6 shows this step as the first step in the enhancement lean culture framework.

STEP 2 TRAINING/WORKSHOP ON SGIA

The second step of the framework are to understand the training or workshop needed by committee members in respective ME companies. From the input, trainings or workshop programs are planned. The training varies to each companies needs and may come from basic lean understanding such as waste elimination, quality control tools, project management, 5S and many other tools which can help the SGIA understanding and skills in executing the SGIA projects. The most training or workshop that had been conducted in this case study is the problem-solving methodology. Once the training or workshop being given to the staff, they will be part of SGIA team and will continuously enhance their ability through practical and repetitive of CI activities. Table 6 shows this step as the second step in the enhancement lean culture framework.

STEP 3 PROJECT BUY OFF & ROLL OFF

The third step of the enhancement framework shows the SGIA project buy off and roll out. To initiate this, the SGIA selection of members are depending on the selection of project theme. The SGIA team need to justify why the theme is being selected. Theme may vary from operational

figures which are quality, cost, delivery, safety and morale as well as from waste elimination activities that comes from the 7 types of wastes which are transportation, inventory, motion, waiting time, overproduce, overprocessing and defect (Alhuraish et al. 2017 and Salleh et al. 2015). The difference in this step is the ability of SGIA to find what is the gap and improvement scope at their areas during the brainstorming session. Once identified, the SGIA team will share their ideas and buy off with management team. One of the most significant findings from this research is the buy-off session, which will assist the SGIA team in balancing the project's requirements with management's concerns in enhancing the company's finances, including income and profitability from operations as well as advantages for employee wellbeing. These criteria can be ranked against the criticalness of the problem-solving steps in ensuring all SGIA understand the importance key points in solving any problems. At the end of the SGIA projects, the outcomes shall help the company to improve their profitability and way of doing things become better. Once the SGIA buyoff been made, the SGIA projects will be rolled off and monitored.

People or workers are flexible and have great abilities. Once they obtain the way of thinking and train themselves in the basic art of CI, most of the workers are willing to contribute towards CI implementation for the betterment and sustainability of the company (Shook et al. 2009). Table 6 shows this step as the third step in the enhancement lean culture framework.

STEP 4 MENTOR & MANTEE PROGRAM

This enhancement framework continues with step four which is the mentor and mentee program. From this case study, Company A pioneers in benchmarking the mentor and mentee program. The selection of mentor for the SGIA is based on knowledge, skills, and experience in solving problems with right methodologies. He/she must have the ability to train and coach the new SGIA team. This approach has been extended to Company B, C, D, E, F, G and H which resulted a total of 633 SGIA across ME companies. This study has identified that any new or enhancement culture can be accepted and well-practiced with the support and directions from the top management. Table 6 shows this step as the fourth step in the enhancement lean culture framework.

STEP 5 MONTHLY UPDATES

Step five involves monthly SGIA updates. Like any project management process, SGIA projects need to be monitored to ensure the project is on track. The progress update content has been guided following the problem-solving methodology. The monthly SGIA updates are required to be reported to corporate office and showing commitment to the policy deployment and execution at all companies. In this case study, committee members have conducted monthly discussions to update the progress of SGIA in all companies and address any new ideas or issue that needs corporate office attention and assistant. All progress updates are then compiled and blasted in ME companies email known as the Lean bulletin and are shared every month in order to give awareness and status updates to all stake holders in the companies.

One of the important points observed in this case study is during proposal of implementation plan which are shared during monthly updates with top management or scheduled upon urgent request from SGIA team. All SGIA leaders were given a chance to share their proposed ideas and budget required in materialising the solutions. During this stage, top management has to assist in approving the ideas, budget approval and at the same time aligning the needs towards company direction and goal for those consecutive years. The approval is very important to help the SGIA team focus the action plan within the stipulated timeline to complete the SGIA project.

Table 6 shows this step as the fifth step in the enhancement lean culture framework.

PROBLEM-SOLVING METHODOLOGY ENHANCEMENT:

STEP 6 THEME SELECTION / PROBLEM STATEMENT AND EXPLANATION

To start the SGIA activities, all project leaders shall be able to propose CI ideas in their respective areas. Theme selection represents how employees have to identify types of problems found in their working areas. Problems are defined as the gap found between actual and standard. The problems can be categories as sudden deviation, change in standard, one time deviation or day one deviation. There are few potential areas to look for which comes from quality, cost delivery, safety, and morale. Team may use few techniques to do this such as workflow with pictures, brainstorming, matrix table, ranking system and mapping process. Table 6 shows this as the sixth step in the enhancement lean culture framework.

STEP 7 GRASPING CURRENT SITUATION

This step explains how the staff members must obtain real data from the source of the issues. The data collection process should yield numerical data that reflects both

historical and present information. Then, the degree and priority of impotencies were evaluated to identify the gap that has to be filled. The condition can be visualised with the aid of seven quality control (QC) instruments. A few other strategies, such mapping flow and the 5Ws (What, When, Where, Who, Why) and 1H (How), are advised to be used as well. Table 6 shows this step as the seventh step in the enhancement lean culture framework.

STEP 8 TARGET SETTING AND EXPLANATION

This step provides a detailed explanation on how to establish the target setting. The team is encouraged to use the remove, increase, create and eliminate (RICE) approaches to identify the goal. The target must be quantifiable, i.e., expressed in RM, Quantity, %, hour, and so on, to support the goal. Table 6 shows this step as the eighth step in the enhancement lean culture framework.

STEP 9 ROOT CAUSE ANALYSIS

One of the crucial elements in the problem-solving process is the root cause analysis. Repeating the "why" of the cause and looking into as many variables as possible will help to locate the fundamental cause of the issue or the root cause of the problems clearly. To accomplish this, the process owner or subject matter expert must participate in the brainstorming session, which will further streamline the workflow. A few tools are suggested, including fault tree analysis, decision matrix tables, and fishbone/cause effect/Ishikawa diagrams. Table 6 shows this step as the nineth step in the enhancement lean culture framework.

STEP 10 GENERATE SOLUTION AND IMPLEMENTATION

The tenth step exhibits how to generate solution and implementation of proposed solutions. All potential solutions shall be listed and evaluated using the systematic tree diagram which comprises few points which are degree of effectiveness, cost and productivity. The details of the plan shall be listed by answering the 5W and 1H questions such as "What - clarify orders of the solutions, who – function allocated to each member, Where – area to be implemented, When – date of action and How – to do list of the item taken. To minimize error, the proposed solutions have to be reviewed and bought off at management level in order to seek budget and approval. A few tools were suggested based on SCAMPER method which is substitute, combine, adapt, modify, put to other use, eliminate and rearrange. Table 6 shows this step as the tenth step in the enhancement lean culture framework.

STEP 11 RESULT AND ACHIEVEMENT

The eleventh step is generally seen as the outcome of a process or action as well as data comparison before and after against step 3. Every solution that prioritised needs are to be confirmed and verified. A few tools such as 7-Quality Control tools were used to visualize the result and achievement. Table 6 shows this step as the eleventh step in the enhancement lean culture framework.

STEP 12 EVALUATE AND REFLECTION

The twelfth step is a process to support step 6. The outcomes will be verified and classified into tangible and intangible benefits. Tangible benefits are measurable and typically quantifiable advantages that are based on results from a particular action, decision, or investment. Intangible benefits, on the other hand, are non-monetary, associated with qualities that are not easily seen or touched such as enhanced reputation, improved employee morale, better customer satisfaction, and increased brand loyalty. A few tools that are suitable is shown in the table and spider chart. Table 6 shows this step as the twelfth step in the enhancement lean culture framework.

STEP 13 COST SAVINGS AND AVOIDANCE

The thirteenth step is a process on how to measure the cost savings or cost avoidance gained from the SGIA projects. Cost savings refers to the amount of money saved in expenses or expenditures as a result of specific actions or measures. While cost avoidance refers to the prevention or proactive action to avoid unnecessary expenses, rather than realizing direct reductions in existing costs, often associated with risk management and strategic decision-making. Both concepts contribute to effective cost management and financial health within an organization. Then, the project savings shall be verified by the accountant or head of department (HOD). Table 6 shows this step as the thirteen steps in the enhancement lean culture framework.

STEP 14 STANDARDIZATION/ CONCEPT DUPLICATION

Step fourteenth is a process of developing and implementing standards or guidelines to ensure consistency, compatibility, and quality in respective SGIA areas. A small number of new continuing activities improving on existing ones, such as document registration, coaching, training, monitoring, and horizontal deployment throughout the organisation. Table 6 shows this step as the fourteen steps in the enhancement lean culture framework.

STEP 15 NEXT PROJECT

Step fifteenth illustrates new ideas and timeline for upcoming SGIA projects. There are several possibilities to be explored, including fresh concepts and enhanced approaches from earlier targets. Gantt chart and other suitable project management and monitoring tools can be used. Table 6 shows this step as the fifteenth steps in the enhancement lean culture framework.

STEP 16 INTERNAL SGIA CONVENTION

For step sixteenth, to recognise the success stories of each SGIA projects, an internal SGIA convention has been held in respective ME companies to showcase the success story as well as to be a platform to share CI ideas and best practices across departments in the companies. The team will share the projects using problem-solving methodologies that have been standardized across ME companies. The presentation has been guided structurally from its theme, grasping current condition, searching for the root causes, targeting, and eliminating them, developing the implementation plan, results gained, standardisation and future project proposals.

From the case studies, it was found that the internal SGIA convention has been another good promotion platform for the companies to inculcate lean culture. This continual internal SGIA program can be an invaluable opportunity to understand CI and develop staff ability to improve their practices. Table 6 shows this step as the sixteenth steps in the enhancement lean culture framework.

STEP 17 DIVISION SGIA CONVENTION

Step seventeenth involves executing the division of SGIA convention as part of ME Division strategy and a yearly event to sustain lean culture in the organization. The winning SGIA teams from ME companies have to compete in the division SGIA convention. The objectives of this division of SGIA convention are to recognise SGIA teams by having them to present their successful project, to motivate and encourage sharing of best practices across SBU companies, customization ideas across SBU and to establish platform for lean networking among the companies.

The Lean committee will plan and propose the Division SGIA convention event from agenda, judges, judging criteria, venue, logistics, food and beverage, prizes and so on. This event will be joined by the top management consisting of the President and all ME General Managers, senior managers, SGIA team, judges and working committee. At the end of the event, the winning team will be announced, and the e-Lean bulletin will be published to recognise the Champion with the best CI ideas and solution, second runner up, first runner up and best presenter. Table 6 shows this step as the seventeenth steps in the enhancement lean culture framework.

TABLE 6. Establish enhancement of SGIA framework technique in Problem Solving from lean culture enhancement framework

SGIA framework technique in Problem solving from lean culture enhancement framework (This study)			
No. of Step	Step Description	Key point description	Tools/ techniques used
	Lean culture		
Step 1	Setup Lean office	General Manager of companies to appoint person in charge come with clear job function.	Designation person
Step 2	Training / Workshop on SGIA	To plan lean training/ workshop to equip team knowledge and skill.	Classroom
Step 3	Project Buy off & Roll Off	To prioritise projects that benefits to company revenue and operational cost or etc	Face to face session with management
Step 4	Mentor & Mantee program	Management and non-management engagement activities	Face to face or online
Step 5	Monthly updates (All steps required in problem-solving)	Team leader to share the progress update status and project concern	Respective areas
	Problem-solving		
Step 6	Theme selection/ Problem statement and explanation	Potential areas come from Quality- Cost – Delivery – Safety – Morale (QCDMS) In sequence 4W1H (What is wrong? Where it happens? When it happens? Who found? and how it affect/ to what extent?)	Mapping, pictures, brainstorming, matrix table, ranking system

... cont.

Step 7	Grasping Current Situation	Go to the source of problem. Collect and record data ie: current information, past information, and numerical data.	7 Quality Control (QC) tools, Material Information Flow Chart (MIFC), Value Stream Mapping (VSM) and etc
Step 8	Target Setting and explanation	Identify and clarify Target (Reduce, Increase, Create and Eliminate) Express target in quantitative (RM, Quantity, %, Hour, etc)	7 QC Tools, SMART and RICE – Reduce, Increase, create and eliminate. RICE Element and etc
Step 9	Root Cause Analysis	Identify problems, repeat "Why" until end. Find root causes. Root cause table after verification Involvement of subject matter expert during brainstorming.	Fishbone diagram, Affinity diagram, Fault tree analysis, Decision matrix table
Step 10	Generate solution and implementation	Propose solution against respective root causes, evaluate from various viewpoints to select solution (effect, practicability, cost, etc) Create and plan based on 5W2H, clarify order solutions, clarify function allocated to each member, review, and buy-off proposal with top management. Improvement monitoring as per Gantt chart	Gantt Chart, Systematic Tree diagram, RICE – Reduce, Increase, create and eliminate. SMART – Specific, measurable, achievable, realistic, and timely. SCAMPER – substitute, combine, adapt, modify, put in other use, eliminate, and rearrange.
Step 11	Result and achievement	Result evaluation. Verify the effect of the solution execution. Check the effect of the solutions against the target setting at STEP 3	7 QC tools
Step 12	Evaluate and reflection	Identify and validate benefits in tangible/intangible. Lesson learned and challenges. Evaluate team performance in web chart	Table, Spider/Web chart
Step 13	Cost Savings and avoidance	Calculate cost savings/cost avoidance. Cost saving – budgeted cost and strategies that lower existing spending. Cost avoidance – unbudgeted cost and preventing spending unnecessary money.	Calculation Verify by Head of Department (HOD) / accountant
Step 14	Standardization/ concept duplication	Establish/enhance standard, training, and horizontal deployment	Standard
Step 15	Next project	Propose new ideas and project timeline.	Gantt Chart
Step 16	Internal SGIA Convention	Team leader to share the success story to management and cross sharing to other SGIA teams within department in the companies.	Platform to share the event.
Step 17	Division SGIA Convention	Winning SGIA team from respective companies to share lean success story and share across ME companies.	Platform to share the event.

Finally, the repetitive step is a yearly review conducted to revise and improve the framework as well as to recommend initiatives. The Lean committee will conduct e-lean survey to all stakeholders. The outcomes of the survey will be aligned to the upcoming SGIA annual schedule. The survey was conducted in few areas such as the effectiveness of problem-solving methodology that have been used, SGIA convention events, lean guidelines as well as soft and hard lean skills. Worker's enhancement practical programs that are needed by the improvement teams such as CI workshop, CI training, CI activities, benchmarking CI visit and any suggested ideas which comes from the workers need will be considered by the top management.

In addition to being a success story for ME organization, this repeating process of the SGIA division platform has been extended to other divisions within the company. It allows ME companies to inspire all team members to maintain and improve the lean culture inside the organisation.

Lean culture is about fostering a mindset that fosters the creation of added values to the organization. This case study emphasizes the involvement of all employees from management and non-management, empowering them to take ownership on their way of working and continually improve through SGIA by playing the role of problem solver. Table 6 reported the success status of lean implementation at eight ME

TABLE 7. Eight ME companies' status on SGIA lean culture - After implementation (This Study)

No.	ME Company	Initiatives to inculcate lean culture	Status
1	Company A (Automotive)	Matured SGIA Program	Yes
2	Company B (Automotive)	Matured SGIA Program	Yes
3	Company C (Lubricants)	Implement SGIA	Yes
4	Company D (Lubricants)		Yes
5	Company E (Lubricants)		Yes
6	Company F (Lubricants)		Yes
7	Company G (Lubricants)		Yes
8	Company H (Aerospace)		Yes

companies from the lean culture enhancement framework and active SGIA participation with strengthened problem-solving guidelines used across the ME companies.

Companies A and B that have matured in SGIA implementation are considered as benchmarked companies that have started the lean culture framework. By aligning the process to respective six ME companies namely company C, company D, Company E, Company F, Company G and Company H,it has resulted in full lean implementation across eight ME companies.

The semi structured interviews and an analysis of 633 Small Group Improvement Activities (SGIA) project reports were done in this case study company. Since, the problem-solving methodologies in Company A portrays 10 steps; Company B seems to have different steps which include 8 steps and Company C, D, E, F, G, and H exhibits 6 steps.

According to the findings, improving problem-solving techniques is essential in spreading initiatives among ME companies and establishing systematic and uniform problem-solving techniques. Therefore, steps from three companies were grouped and integrated into one enhancement framework. The proposed enhancements of problem-solving methodologies involving 10 steps are illustrated in Table 7.

The tangible and intangible benefits gained from year 1 to year 4 are listed in Table 9. For tangible benefit, the installation, strengthening, and sustainability program helps ME Division to further improve their margin improvement plan. It will be beneficial to the company survival, management, staff, customers, suppliers, academicians, administrators, students and for the national government for policy settings.

While for the intangible benefit, the strengthen framework helps ME companies, enhance the continual improvement culture installation by upskilling and reskilling the current resources in becoming problem solver and keep doing improvement to achieve best practices in their way of doing things. The output of the case study will give added value for lean practitioners, company owners, managers, administrators, and suppliers to aggressively adapt and customize lean cultures to their needs. In addition, this case study may advance knowledge for students to equip themselves with the knowledge and ready the students for the industry upon completing their studies.

Many companies reported that CI has started based on a top-down process which resulted in ineffective lean installation. In this case study, results show any new or enhancement culture cannot run well by only ordering from top, and it can be effectively installed with an involvement of CI stakeholder which involves management, middle management, and workers. Firstly, in this case study, it starts from policy making and deployment of CI policy to all ME companies. Secondly, lean office shall be established to help in facilitating, coordinating, and promoting the lean culture in the organization in order to foster the program's

implementation. Then, a practical CI training program shall be planned to assist all SGIA team members in order to understand the basic needs of CI and lean tools that they can learn and apply in the CI projects. Lastly, reward and recognition platform shall be established to sustain lean culture in the organization. Defining the CI as part of individual Key Performance Indicator (KPI) will help top down and bottom-up alignment in meeting the division goal as well.

TABLE 8. Problem Solving methodology use across in ME companies (This Study)

No of STEP	Company A	Company B	Company C, D, E, F, G and H	Enhancement standard
1	Theme selection & standard theme	KAIZEN ideas	Discover potential improvement	Theme selection & explanation
2	Identify problem	Understand current situation	Grasping present situation & target setting	Grasping current situation
3	Target setting	Target setting	Root cause analysis	Target setting & explanation
4	Root cause analysis	Root cause analysis	Develop implementation plan	Root cause analysis
5	Develop implementation plan	KAIZEN action plan	Evaluate and reflection	Develop implementation plan
6	KAIZEN results	KAIZEN execution	Concept duplication	Result and achievement
7	Evaluation & explanation	Result, evaluation & validation		Evaluate and reflection
8	Cost savings	Standardization		Savings
9	Standardization			Standardization / concept duplication
10	Next project			Next project

Most of the workers possess the ability and ideas and willingness to contribute to the CI activities. At the end of year 4, the total SGIA registered reported improvement are 633 SGIA across different business scopes in ME companies comprising automotive industries, lubricant, and aerospace industries. Table 10 illustrates the cost saving/year achieved by the top SGIA based on departments.

TABLE 9. Tangible and Intangible Benefits gained from year 1 to year 4 (This Study)

Tangible / intangible benefits	Year 1	Year 2	Year 3	Year 4
No of staff invoves	974	958	922	879
No of SGIA Project	166	108	184	175
No of LEAN training classes	11	12	23	40
Cost savings	1.6M	1.4M	1.3M	1.6M
Number of SGIA Internal and Division Convention	2	3	3	3

TABLE 10. 27/633 of SGIA projects resulted in cost savings in year 1 to year 4 (This Study)

No	Year	Company	SGIA team name	Department	SGIA Title	Type of defect	Lean tools	Results	Cost savings/Year
1		C	Magnificient	Quality	Quality abnormal reporting improvement by establishing mobile application	Info lead time	MIFC,7QC,RCA, 5Why, PDCA	Reduce waiting time	RM 15K
2		H	Polyseal A	Production	Production flow improvement on assembly line	Defect	SW,7QC, RCA,5Why,PDCA	Material,labor cost,waiting time	RM 17K
3		B	Tip top	Production	Work load improvement for contract workers	Process time	YC, RCA,5Why,PDCA	22 pax to 20 pax Relocate access staff	RM 48K
4		C	Ramadhan	Maintenance	Review and enhance spare part management system	Waiting time	MIFC, 7QC, RCA,5Why, PDCA	Reduce spare part cost	RM 16K
5		A	Double line team 1	Production	Upper seam welding leaking	Inprocess reject	SW, 7QC,RCA,5Why, WR, PDCA	Reduce reject	Rm 2.3K
6		H	The vane fillers	Production	Right first time – 100% in vane filling process	Inprocess reject	SW,7QC, RCA,5Why,PDCA	Reduce reject	RM 10K
7		B	Besi waja	Maintenance	Maintenance cost reduction at injection plant	Inprocess reject	WB,SW,WR, 5Why, PDCA	Reduce mold cost	RM 7.7K
8		A	New generationw	R&D	Valving part improvement activity	Material optimization	MO,7QC,RCA,WR, 5Why,PDCA	Reduce material cost	RM 17K
9		A	New generation	R&D	Valving part improvement activity	Material optimization	MO,7QC,RCA,WR, 5Why,PDCA	Reduce material cost	RM 17K
10		H	Thunder Bird	Production	Cycle time improvement at dressing process	Inprocess reject	5Why,7QC,RCA,PDCA, SW,WR	Reduce cycle time	RM 15K
11		A	Inspira	Procurement	High import duty cost	Material cost	7QC,RCA,WR, 5Why,PDCA	Reduce duty cost	RM 37K
12		B	Top Speed team	Maintenance	Change over improvement process at charcoal line	Process time	7QC,RCA,WR, PY, 5Why,PDCA	Reduce operation cost	RM 42K
13		H	Aero e-DIS	IT	Dimension Inspection sheet enhancement	Waiting time	5Why,7QC,RCA,PDCA, SW	Real time data	RM 100K
14		A	Intelligent	QAQC	Eliminate particle chip at production line	Inprocess defect	7QC,5Why,SW, WR,PDCA	Reduce defect	RM 56K
15		A	Sepakat	Production	Reduce reject cost to zero defect	Inprocess defect	5Why,7QC,RCA,PDCA, WR	Zero defect	RM 19K
16		A	Sepakat	Production	Inrocess defect improvement at production line	Inprocess defect	5Why,SW,7QC, WR,PDCA	Zero defect	RM 3.9K

... *cont.*

17	H	A Frontliner	Safety	Infection risk improvement in physical distance checking COVID 19	environment	5Why,MIFC,7QC, SW,PDCA	Reduce covid19 case and cost	RM165K
18	C	NO OR	Procurement	Process improvement at pail labelling process at supplier	Material cost	5Why,MIFC,7QC,WR, SW,PDCA	Increase production output	RM 50K
19	A	Sepakat	Production	Tightening defect improvement at production line	Inprocess defect	5Why,MIFC,7QC,WR, SW,PDCA	Reduce reject	RM 3.1K
20	A	Toxic Buster	Safety	High concentration chrome waste at production line	Production waste	5Why, 7QC, SW, WR,RCA,PDCA	Reduce schedule waste	RM 5K
21	H	Q-MIT	QAQC	Data management improvement at QAQC	Data error	5Why, 7QC, WR,RCA,PDCA	Real time data	RM 12K
22	H	Kesatria	Production	Inspection improvement on self-locking plate rivet tail	Inprocess defect	5Why, 7QC, WR,RCA,PDCA,PY	Reduce Inspection time	RM 2.6K
23	H	Wings	QAQC	Rework process at production line	Inprocess defect	5Why, 7QC, WR,RCA,SW, PDCA	Reduce rework cost	RM 42K
24	E	EmEmTee	Production	Low efficiencies at membrane production line	Inprocess defect	5Why, 7QC, WR,RCA,SW, PDCA	Improve efficiency	RM 1K
25	E	The Abdul	Warehouse	Longer lead time at battery subcon process	Inprocess defect	5Why, 7QC, WR,RCA,SW, PDCA	Imrove efficiency	RM 10.2K
26	E	Engineus	Engineering	Lead time improvement at project management flow	Waiting time	5Why,MIFC,7QC,WR,SW, RCA,PDCA	Reduce waiting time	RM 4K
27	A	Evolution	R&D	Damper valving commonization improvement	Material	5Why,MIFC,7QC,SW, RCA,PDCA	Commonization material to respective part	RM 11.8K

* Lean tools (MIFC - Material information flow chart, 7QC - Quality Control, RCA - Root cause analysis, PDCA - Plan, Do, Check and Action, YC - Yamazumi chart, SW -standardize work, WR - waste reduction, WB - Work balancing, MO -Material optimization, PY - Poka Yoke)

Table 10 portrays a total of 27 top SGIA projects that were accomplished and shared during ME division convention level. The objectives of these events are to recognize CI and SGIA teams by having them present their successful projects using constructive problem-solving methodologies, to motivate and encourage sharing of best practices using right presentation skills in PowerPoint, videos, audios, actual samples and so on across SBU as well as to establish a platform for lean networking among SBU members. The study shows that SGIA originates from three primary departments: supply chain management (SCM) accounts for 10%, others (Research and Development, Safety, and Information Technology) for 20%, and operation for 70%. The SGIA documented the use of a few lean tools and techniques in achieving cost and lead time reduction (Suhaimi et al. 2018), including the fishbone diagram or cause and effect diagram, the Material Information flow chart (MIFC) (Tehrim et al. 2023), Value Stream Making (VSM) (Salman, 2021 #98} the Plan, Do, Check, and Action (PDCA), the standardised work (SW), the 5S, the root cause analysis (RCA), the 5Why, work balancing, waste reduction (Ruizhe et al 2023) and the mistake proofing or error proofing (Poka-Yoke) method. Through cost reductions that are assessed at the conclusion of each project, this SGIA initiative assists organisations in increasing profitability of RM848K from these 27 top SGIA projects.

The case study in Table 10 reveals that CI through SGIA projects can be done across operation and non-operation areas. From this SGIA division records samples, area of operations can be classified as quality department, production department and maintenance department. In the other hand, supply chain management comes from procurement department, logistics and warehouse department. For non-operation areas, few departments identified were safety, IT, Research and Development and engineering department. From Table 10, the important findings in the sample shows the commonly used lean tools are the Deming Cycle or known as Plan, Do, Check Action (PDCA) Cycle, Waste Reduction (WR), Root cause analysis (RCA), 5 Why, and 7 QC tools. These results show how important it is for individuals, academics, businesses, and the government to incorporate these skills, competencies and information into their frameworks and plans as it has proven to be able to achieve cost reduction and waste reduction (Bugvi, et al. 2021).

The study demonstrates the less common tools that were used, such as workload balance, mistake proof tools (PY), and material optimisation, despite the active tools being employed. This is the outcome of certain ME companies' maturing processes and improvements.

CONCLUSION

Enhancing comprehension, streamlining, and personalisation is a challenging undertaking for any kind of business. Nonetheless, whether the organisation is doing well or not, it is imperative that it continue its efforts at improvement. The customize lean culture framework and standardised problem-solving methodology guidelines has proven to enhance efficiency (quality, cost, delivery, safety and morale) and inculcate lean culture in ME organisation with a repetitive activity such as small group improvement activities (SGIA) as one of the strategies to stay relevant and sustainable in the ME companies which resulted in efficiency improvements, cost savings and company survival. Through people, technology, business climate, and subsidies, these efforts are then able to support the national productivity drivers. The study's findings can be compared, and more research will be conducted to reward noteworthy achievements in a person's knowledge and experience of upskilling as well as enhance industry profitability and sustainability.

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None

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