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A SURVEY ON LEAN MANUFACTURING IMPLEMENTATION: A CASE STUDY IN AN INDONESIAN AEROSPACE COMPANY

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Abstract: Lean manufacturing is well-known worldwide, and many businesses today use it as a production method. However, many companies seem failed in the implementation. Therefore, the purpose of this paper is to assess lean performance in an Indonesian Aerospace Company and explore any factors that could drive and hinder the lean implementation from a holistic perspective. In essence, this research is rarely conducted in Indonesia, especially in the aerospace industry. LESAT (Lean Enterprise Self-Assessment Tools) V.2 questionnaire and methodology are adopted to assess lean implementation. The respondents were chosen with purposive sampling. The results showed that most of the evaluation activities related to the performance were done with an informal approach deployed in a few areas with varying degrees of effectiveness and sustainment. Furthermore, several factors are considered driving and hindering successful lean implementation. It was found that the driving factors for successful deployments are a good change agent, continuous improvement, involvement of suppliers in the supply chain, considerations of customer value, and evaluation of roles/programs for lean implementation. In comparison, the primary hinder factors are a lack of shared understanding of the company's condition among the managers and supervisor and between the other managers and directors, and culture.

Keywords: *Aerospace industry, lean enterprise, lean manufacturing, LESAT*

1. Introduction

In business, every company has high competition to gain high profit with minimum resources. Every company has its strategy to achieve it. One of the common strategies is lean manufacturing. That strategy was pioneered by a vast Japanese automotive company, Toyota, in the 1950s. Lean manufacturing is a continuous effort to eliminate waste and improve value from a product or service to achieve customer value (Gasper, 2011). There are seven kinds of waste: delay time, inventory, defect, overprocessing, overproduction, movement, and transportation (Wilson, 2010). By eliminating waste, it will be undirectly to minimize the production cost as low as possible.

Enormous companies that implement lean manufacturing are Toyota, Intel, John Deere, and Nike. Implementation of lean manufacturing brings in a significant effect. In Intel, lean implementation reduces production time to produce microchips from 3 months reduced to less than ten days, while on Nike impact to reduce poor works activity by 50% (Lombardi, 2018). Based on that, the result of lean manufacturing implementation is quite promising.

However, only about 10 percent of companies have successfully implemented lean manufacturing practices (Bhasin & Burcher, 2006). According to Pay (2008), it is found that only 2 percent of companies which has been successfully achieved the desired result from implementing lean manufacturing. XYZ Company is one of those companies; after eight years of implementing lean manufacturing, the result is unsatisfactory. This indicated by the Key Performance Index achievement on Directorate of Production in January-May 2019 is only 59,62%. XYZ Company is one of the manufacturing companies located in Indonesia, especially in the aerospace industry. This company produces various kinds of planes such as rotary wings and fixed wings. Furthermore, XYZ Company is an Airbus subcontractor to make parts of their aircraft.

Few studies have been done in Indonesia based on lean manufacturing. The study conducted by Widiasih et al. (2015) shows that commitment, participation, and support from senior management are essential in lean implementation. Furthermore, according to a study conducted by Nawanir et al. (2016), if firms want to achieve the intended result, all lean manufacturing methods should be adopted holistically due to the mutually beneficial nature of such activities. However, in Indonesia, a rare holistic study examines lean even from the management level. Although, according to the Massachusetts Institute of Technology (2001) the benefits of lean manufacturing only could be felt if considered and involved in all of the company's elements.

This study aims to examine lean manufacturing implementation with a holistic perspective. This study analyzes a company in the aerospace industry in Indonesia as a case study. In addition, factors that drive and hinder the implementation were also identified. To the best of our knowledge, this is the first study to use a holistic view in assessing lean manufacturing implementation, particularly in the aerospace industry in Indonesia.

2. Literature Review

2.1. Lean Manufacturing

Lean manufacturing was established in 1991 in The Machine That Changed the World, written by James P. Womack, Daniel T (Dekier, 2012). According to John Shook in Earley (2016) in the book The Lean Book of Lean, lean manufacturing is a manufacturing philosophy that reduces the time between customer order and the final goods by disposing of any source of muda/waste. In the same book, Taiichi Ohno, the father of Toyota Production System (TPS), defines lean as an idea of thinking to adapt to change, reduce waste, and continuously improve. Nash, Poling, and Ward (2006) describe lean as a systematic approach to determine and minimize waste through continuous improvement.

Lean manufacturing has five core principles: value, value stream, flow, pull, and perfection (Womack & Jones, 1996). Besides the principle, lean manufacturing also has tons of tools and techniques such as VSM (Value Stream Mapping), 5S, Kanban, SMED (Single Digit Minute Exchange of Die), takt time, TPM (Total Productive Maintenance), Kaizen, Ishikawa Diagram, Heijunka, OEE (Overall Equipment Effectiveness) (Arlbjørn et al., 2008).

2.2. Implementation of Lean Manufacturing

The concept of lean implementation is very challenging because lean is in a multi-dimensional structure (Denton & Hodgson, 1997). It calls for much experience and time to advance in a complete implementation. Many countries still struggle in the implementation

stage (Dilanthi, 2015). In most companies, the primary focus implementation of lean manufacturing is still on the production line, and their research for competitive gain has not relied on the latest lean integrative approaches (Hines et al., 2004). Nevertheless, lean manufacturing implementation has a more favorable result than other practices such as flexible and computer-integrated manufacturing systems (Rahman et al., 2010). Those facts have been supported by a survey study in the Malaysian Electrical and Electronics Industry, which obtained many prosperities such as diminished cost and improved productivity because of lean manufacturing implementation (Wong et al., 2009).

According to a study conducted by Kovacheva & Araujo (2010), six factors are considered as the most significant in lean implementation according to the literature:

1. The commitment of the management in the improvement program, especially in the improvement process and communicating the vision
2. Fundamental changes in the organizational culture
3. Employee's engagement
4. Network relationship
5. Holistic strategy
6. Eagerness to learn

However, the failure of the implementation could be a cause of the impoverished focus on the lean philosophy. Achanga et al., (2006) implied that the success of the lean manufacturing implementation relies on four crucial factors: leadership and management, finance, skills and expertise, and the organization's supportive culture. Furthermore, intensive communications also have a critical role in lean implementation success (Duque & Cadavid, 2007). The study conducted by James (2006) and Herron & Braiden (2007) also implied that applying the complete set of lean principles and tools also led to the successful transformation of Lean Manufacturing.

According to Nordin et al. (2010)'s survey study in the Malaysian Automotive Industry, there are barriers to lean implementation. The most significant challenges for in-transition organizations include a lack of understanding of lean manufacturing ideas, the attitude of shop floor workers, a lack of communication, and company cultures and firms that have been using lean for years.

2.3. Lean Enterprise Self-Assessment Tool (LESAT)

The term lean enterprise means the integrated entity that efficiently and effectively creates value to various stakeholders by implementing lean practices and principles (C. D. Nightingale et al., 2020). The distinction between lean organization and lean manufacturing is that lean enterprise considers the entire business, whereas lean manufacturing just finds a portion of the firm (Earley, 2016). Lean Enterprise Self-Assessment Tools (LESAT) was first introduced by Lean Advancement Initiatives (LAI) at MIT in 2001. The purpose of this tool is to appraise an enterprise's current 'lean' status and also determine the 'lean' target for the future (desired future state) (Karvonen et al., 2012).

LESAT also has its methodology, which is included in LESAT Facilitator's Guide V2. This methodology consists of 5 stages: preliminary, planning, execution, evaluation, and action stages. In the first stage (preliminary stage), the objective is to develop an environment that convinces the organization if they benefit from this assessment. This step contains six

steps: obtain organizational commitment, define enterprise and its boundaries, define time horizon for the future enterprise state, and define the timing of assessment.

In the second stage (planning stage), the objective is to prepare the assessment and ensure the assessment process runs efficiently and effectively. This stage consists of 3 steps: identify participants, determine a timeline for evaluation, Introduce the tool, the assessment process, and the intended utilization of a result.

The third stage is the execution stage to conduct the assessment. The fourth stage is the evaluation stage to determine the improvement area. Those improvement areas were determined by three methods such as SWOT Analysis (Current State vs Gap), Alignment Analysis (Variance vs Gap), and 3D Analysis (Current State vs Variance vs Gap).

The last stage is to develop an action plan and prioritize resources. The objectives are to develop an improvement plan based on the previous stage's results and list the resources necessary for improvement. Those five stages are a cycle, and every stage has feedback for other stages.

In the beginning, LESAT was designed for the aerospace industry. However, the implementation is becoming broad in other sectors. There is also LESAT for the government, which MIT introduced in 2005 (LAI-MIT, 2005). The study conducted by Hernandez (2010) adapting LESAT for healthcare. Furthermore, LESAT was also adapted in the software domain (Karvonen et al., 2012).

3. Research Method

In conduct, this research adapts LESAT methodology from the Facilitator's Guide V.2.This methodology consists of 5 stages: preliminary, planning, execution, evaluation, and action stages. Nevertheless, this research only adapts the methods until the evaluation stage due to the limitation.

In the first stage (preliminary stage), several things need to be prepared: discussion to determine the boundaries of assessment, determine time horizon for future state assessment, and define participants and its roles. Review only focuses on the Directorate of Production, and the other parties are boundaries. The time horizon for future state assessment is set to next three years. There are four participants: enterprise leadership (Director of Production), facilitator (researcher), respondents (Head of Division and Manager in Directorate of Production), and assessment users (Industrial Development Manager & Director of Production).

In the second stage (planning stage), the questioners are divided into the first and second types. The first type is the desired state assessed by the Director of Production and the second type is the current state evaluated by a manager and head of a division. In the recent state questioner, the respondent is chosen using purposive sampling with criteria: management has balance understanding from technic and corporation aspects. The company decides respondents. Before establishing the questioner, a pre-test is conducted on several respondents. From this pre-test, that could be any suggestion/comment to the questioner, and based on this feedback, the actual questioner could be improved. The questioner is written in Indonesian with three main sections, 15 subsections, and a total of 68-point statements (enterprise practices) that should be answered. The refine questioner then distributed in May 2020 then collected on June 12, 2020. This questioner distributed with the help of XYZ

Company via Google Forms. At the beginning of the questioner, an introduction about LESAT was explain briefly.

In the third stage (execution stage), the objective is to conduct the assessment; as explained in the previous paragraph, the two types of questioners were distributed to the respondents. Every evaluation consists of 3 significant parts, i.e., enterprise transformation/leadership, lifecycle processes, and enabling infrastructure. The total numbers of the assessment are 68. The evaluation was translated from English to Indonesian. In the last stage (evaluation stage), the objective is to find the area for improvement by using three parameters: current state average, current state variance, and gap.

4. Results and Discussion

4.1. Respondent Profile

The collected respondent is 15 people, with an average answering time of 45-60 minutes. The entire of the respondents are male. The respondent has several characteristics, such as work position, age, length of work in the XYZ Company, and the division's origin. Those characteristics can be seen in Table 1.

Table 1: Characteristics of Respondents

Characteristics	n	%
Respondent's Position		
Managers	13	86,7%
Head of Division	2	13,13%
Respondent's Age		
28-37 years old	6	40%
38-47 years old	1	6,7%
48-57 years old	8	53,3%
Years of Service (Length of Work)		
0-5 years	0	0%
6-10 years	4	26,7%
11-15 years	2	13,3%
16-20 years	0	0%
21-25 years	4	26,7%
>25 years	5	33,3%
Origin of Division		
Quality Assurance	2	13,3%
Production Planning & Control	2	13,3%
Manufacturing Engineering	4	26,7%
Component & Assembly	2	13,3%
Detail part Manufacturing	4	26,7%
Final Assembly & Delivery Centre	1	6,7%

4.2. Lean Manufacturing Implementation Result

There are two types of questioners results, i.e., the desired state questioner and the current state questioner. The result will be shown per subsection as Table 2 below.

Table 2: Overall LESAT Result

Subsection	Current State Average	Current State Variance	Desire State Score	Gap
SECTION I: *ENTERPRISE TRANSFORMATION / LEADERSHIP*				
I.A Determine Strategic Imperative	2,93	1,56	4,33	1,40
I.B Engaged Leadership in Transformation	2,69	1,13	4,33	1,64

Table 2: Overall LESAT Result (Continue)

Subsection	Current State Average	Current State Variance	Desired State Score	Gap
I.C Understand Current State	2,53	1,29	5,00	2,47
I.D Envision and Design Future Enterprise	2,60	1,28	3,50	0,90
I.E Align Enterprise Structure and Behaviors	2,31	1,04	3,75	1,44
I.F Create Transformation Plan	2,40	1,08	3,50	1,10
I.G Implement and Coordinate Transformation Plan	2,37	1,05	3,75	1,38
I.H Nurture Transformation and Embed Enterprise Thinking	2,52	1,26	4,17	1,64
Section I Average	**2,54**	**1,21**	**4,04**	**1,50**
SECTION II: *LIFE CYCLE PROCESSES*				
II.A Align, Develop and Leverage Enterprise Capabilities	2,27	1,37	4,00	1,73
II.B Optimize Network-Wide Performance	2,43	0,99	4,83	2,40
II.C Incorporate Downstream Customer value into the Enterprise Value Chain	2,30	1,11	4,00	1,70
II.D Actively Engage Upstream Stakeholders to Maximize Value Creation	2,26	1,07	3,17	0,91
II.E Provide Capability to Monitor and Manage Risk and Performance	2,44	0,95	5,00	2,56
Section II Average	**2,34**	**1,10**	**4,20**	**1,86**
SECTION III: *ENABLING INFRASTRUCTURE*				
III.A Organizational Enablers	2,36	1,15	4,00	1,64
III.B Process Enablers	2,44	1,03	4,00	1,56
Section III Average	**2,40**	**1,09**	**4,00**	**1,60**
Overall Average	**2,46**	**1,16**	**4,09**	**1,63**

LESAT assessment used a five-scale score which is every definition of the score usually different for every enterprise practice (statement). However, there is a standard definition for those scale scores (Hallam & Keating, 2014):

Level 1: Some consciousness of the practices; desultory improvement may be ongoing in a few areas

Level 2: General awareness; informal approach deployed in a few areas with fluctuating degrees of effectiveness and sustainment

Level 3: A methodical approach deployed in varying stages across most areas; supported with metrics; good sustainment
Level 4: Ongoing refinement and continuous improvement across the enterprise; improvement growth are maintained
Level 5: Marvelous, distinct, innovative approach is fully deployed across the extended enterprise (across internal and external value streams); identified as most acceptable practices

Based on the LESAT overall score, the current state score is 2,46 out of 5. Table 3 shown the result from every section, both for the desired state or current state. For the desired state, the development for Section II (Life Cycle Processes) is higher than Section I (Enterprise Leadership/Transformation) and Section III (Enabling Infrastructure). However, Hallam (2003) states that if Section I could be the primary prompt to Section III (Enabling Infrastructure) and Section II (Life Cycle Processes). Furthermore, it is stated that Section III could prompt Section II. Based on those statements, the desired state should prioritize Section I (Enterprise Leadership) to make a change, and it should be started from the leadership team commitment (D. J. Nightingale & Srinivasan, 2011).

Nevertheless, according to the current state result, shows Section I (Enterprise Leadership/Transformation) has a higher score than Section II (Life Cycle Processes) and Section III (Enabling Infrastructure). Moreover, Section III (Enabling Infrastructure) score is higher than Section II (Life Cycle Processes). According to Hallam (2003) the higher lean maturity score in Section I will impact a high maturity score in Section II and III. Moreover, Hallam (2003) also states that if Section III has a high result on lean maturity level will also impact a higher score on Section II.

4.3. Evaluation of the Areas of Lean implementation

When evaluating areas, 3D Analysis is being used to consider the current state average, current state variance, and gap (Lean Advancement Initiative, 2012). Those three considerations are determined using the relative distribution from the result score (Lean Advancement Initiative, 2012). Based on the LESAT result, the relative distribution for the current state average is 2,42, the current state variance is 1,14, and the gap is 1,67.

This research focused on the area that has an average score and variance of the current state below the parameter's standard score (average score <2,42; variance <1,14) and the gap score above the standard score (>1,67). From those criteria, it could be indicated that there is an agreement between the respondent if the score is relatively low. Also, the gap scores determined from deduction from the current state and the desired state score have a score above the standard. Based on this, the area for improvement could be determined, as shown in Table 3.

Table 3: Improvement Areas

Improvement Areas	Enterprise Practice
Structure deploys and company behavior	I.E.4. Empower change agents
	I.E.2. Align performance measurement system
Process Enablers	III.B.3. Process variation reduction
Embed Enterprise Thinking	I.H.6. Institutionalize continuous improvement
Company Capabilities	II.A.3. Product development - Enterprise Capabilities
	II.A.4. Supply chain management - Enterprise Capabilities

Network Performance	II.B.1. Program management - Network-Wide Performance
	II.B.2. Requirements definition - Network-Wide Performance
	II.B.4. Supply chain management - Network-Wide Performance
Incorporation of Customer Value	II.C.2 Product Development - Customer Value
	II.C.4. Supply chain management - Customer Value
Participation of Upstream Stakeholder	II.D.3. Product development - Upstream Stakeholders

Table 3: Improvement Areas (Continue)

Improvement Areas	Enterprise Practice
Supervision and Risk Management	II.E.2. Requirements definition - Monitoring and Risk Management
	II.E.3. Product development - Monitoring and Risk Management
	II.E.6. Distribution and sales - Monitoring and Risk Management

The description of the problems arises from each enterprise practice. This problem description refers to the resulting current state results. This description can be seen in Table 4.

Table 4: Problem Description

Enterprise Practice	Problem
I.E.4. Empower change agents	Change agents do not have any authority, not following the expected role
I.E.2. Align performance measurement system	Measurement system inadequate to assess toward the strategic objective, and lack of objective integration between area
III.B.3. Process variation reduction	Non-uniformity between respondent
I.H.6. Institutionalize continuous improvement	The formal methodology does not yet exist
II.A.3. Product development - Enterprise Capabilities	There is low conformity toward the capability
II.A.4. Supply chain management - Enterprise Capabilities	
II.B.1. Program management - Network-Wide Performance	Optimization enablers are still local and do not concern interdependency relationship between one another elements
II.B.2. Requirements definition - Network-Wide Performance	
II.B.4. Supply chain management - Network-Wide Performance	
II.C.2 Product Development - Customer Value	Non-uniformity between respondents about consumer engagement
II.C.4. Supply chain management - Customer Value	

II.D.3. Product development - Upstream Stakeholders	Product development does not consider the capability
II.E.2. Requirements definition - Monitoring and Risk Management	Metric has not been established and distributed yet to the whole company. The action plan does not entirely solve the problem
II.E.3. Product development - Monitoring and Risk Management	
II.E.6. Distribution and sales - Monitoring and Risk Management	

After discovering the problem, we next determined the root cause from every enterprise practice. The root cause is found by interviewing the authorities in the Directorate of Production.

For the changes agent, the recruitment for this position does not consider requirement characteristics. Moreover, the change agents are primarily fresh graduates who do not have the authority to make changes. Based on the interview, it is known that the company never evaluates the change agent.

The second improvement area is the performance system, the company has just developed a balanced scorecard in early 2020, and the implementation started from the manager level in April 2020. Nevertheless, based on the interview, some managers still do not entirely understand the balanced scorecard. This poor understanding could impact the managers unable to appraise the congruity of the performance system and the strategic objective.

The third improvement area is variance reduction, and the respondents are divided into two groups. The first group appraises if the variance reduction is not going well because of the limited use of the variance reduction method. The second group appraises if the variance reduction has been implemented in the whole company. However, based on the interview, the company still has not decided which method to reduce the variance.

The fourth improvement area is about continuous improvement. This continuous improvement has not used any method yet—the company focuses on innovation competition. The next improvement area is about the company's capabilities. The company now uses Visual Management, such as television that is located in the production area. However, this television only shows the performance of their site.

The sixth improvement area is the optimization of the extended enterprise. Based on the interview is known that the company culture is still in silos with blaming culture. The company still makes an effort to build and implement enterprise thinking in the company.

The next improvement area is about the participation of the consumer. XYZ Company has two types of consumers, the first type is for the aircraft, and the second type is for the aerostructure. For aircraft types, the consumer is not involved in product development because the culture only participated at the beginning and the end of the product. Nevertheless, for the aerostructure type, consumers participate actively. The respondent group who works in the aerostructure chooses the consumer who is already actively engaged when answering the assessment. By engaging consumers, the company will have feedback that could be used in product and process improvement.

The seventh improvement area is upstream stakeholder engagement. In this improvement area, there is a contradiction between the company and the respondent. Based on the interview with the company's authority, it is known that the upstream stakeholder already

engages in product development. However, most respondents answered that the upstream stakeholder does not engage in product development based on the assessment result.

The last improvement area is supervision and risk management. XYZ Company has a risk officer to identify risk. Nevertheless, the problem occurs frequently said that the action plan does not entirely solve the problem. These could happen because of the problem identification process. Moreover, the company has never evaluated the risk officer yet.

After further investigating improvement areas, the problem and the root causes then could be determined which area could be seen as driving or the hinder for the successful lean implementation. Those topics will be discussed later.

4.4. Factors driving the success of lean implementation

Earlier, the root causes have been identified. Then from the root causes, it could be known which root causes that need to be improved. The things that already exist and only need to be improved to gain the success of lean then categorize as factors driving the success of lean implementation. There are several factors included in those types, and those factors will be explained in succession.

The first driving factor is the change agent. This factor is following a study conducted by Sadrina (2020). Moreover, a study conducted by Nordin & Belal (2017) shows that incorporating change agents in lean implementation will accomplish continuality and support to lean. According to Pathak (2010), a good change agent should have several characteristics such as empathy, linkage, structure, synergy, energy, proximity, and openness.

The second factor is continuous improvement. This second driving factor follows a study conducted by Rose et al. (2014) to discover the critical success factors for implementing Lean Manufacturing in the Malaysian Automotive Industry. Based on the root cause, XYZ Company put more attention on innovation rather than continuous improvement. Imai (2005) states that creation could give a drastic result but is commonly only one-shot and problematic. Nevertheless, it is different with constant improvement; progress is incremental but could have an impactful future.

The third factor is transparency through Visual Management. Transparency is a crucial component of a lean workplace (Charles et al., 2012). However, a scarce study discovers transparency through Visual Management as a driving factor for lean implementation success. According to Tezel et al. (2009), one of the Visual Management functions is unification. This function states that Visual Management should eliminate horizontal (between area) and vertical (between management layer). Moreover, integrated Visual Management could give a big picture to the workers from any department to see the direct impact and interdependency relationship between the department/area (Greif, 1991; Liff & Possey, 2004).

The next factor is the involvement of suppliers in the supply chain. These driving factors follow a study conducted by Almanei et al. (2017) to discover SMEs' lean manufacturing implementation challenges. According to Bhamu & Sangwan (2014), concurrent adoption of lean practices in the supply chain is one of the crucial factors of lean implementation. By engaging the supplier, there are some prosperities as follows (De Toni & Nassimbeni, 2000):

- Minimize total development time, and these benefits could be gained because there is the identification of technical issues of the supplier at the starting point.
- Possibility of the emergence of the innovations proposed by the supplier.

- Enhanced quality of the products
- Minimize the development expenditure

The fifth factor is customer value. This factor is associated with the first principle of lean, discussed in the literature view. Moreover, this driving factor is following a study conducted by Almanei et al. (2017). According to Kajdan (2008), the fundamental approach of lean is exaggerating customer value. Moreover, the main result of successful lean manufacturing implementation is fulfilling the customer demand/needs and expectations (Shah & Ward, 2003; Shah et al., 2008; Singh et al., 2009).

The last factor is the evaluation of roles/programs for lean implementation. A scarce study considers this factor as one of the driving factors for lean implementation success. According to (NHS England Institute for Innovation, 2015), evaluation means systematic assessment of the implementation and the impact of a project, program, or initiative, such as investigating whether everything is doing things right and everyone is doing the right things. Usually, the result of the evaluation can be helpful to the person who is considering making changes. Evaluation could have a role as the leading indicator to raise performance and identify the program's strengths and weaknesses (Hallam, 2003).

4.5. Factors that hinder the success of lean implementation

To determine the hinder factors, the root cause about something that needs to be reconstruction, not just improves. Those root causes are then categorized as hinder factors.
The first hinder factor is a lack of shared understanding of the company's condition among the respondent. Those conditions also happen between the respondent and the Industrial Development Manager and Director of Production. Those situations could happen because of poor communication. A study conducted by Puvanasvaran et al. (2009) shows that communication has a role to lean implementation success. Hamid (2011) also indicates that communication is one of the international organizational factors critical for lean implementation success. Therefore, in this study case, poor communication is considered as one of the hinder factors.

The second factor that hinders the successful lean implementation is culture, mainly if silos and blaming culture still exist. This hinder factor is following a study conducted by Almanei et al. (2017). Sarhan & Fox (2013), in their research to explore barriers to implementing lean construction in the UK construction industry, also shows culture (i.e., silos culture) as a barrier. However, these studies included culture in a workforce hinders category. Moreover, a study conducted by Devaki & Jayanthi (2014) in the construction industry shows culture as one of the hinders to lean manufacturing success. Lean manufacturing builds upon Japanese culture, so the implementation of it should require organizational culture change. According to Badurdeen et al. (2009), the predicament for lean implementation is not in the techniques but the culture changes. Culture is the fundamental pillar for lean manufacturing implementation. According to Little & McKinna (2005), to take the initiative prosperous, a supportive culture that leads the employee to work, communicate and grow jointly is crucial.

5. Conclusion

Based on the research, the overall score for lean implementation from LESAT measurement is 2,46 out of 5. This score indicates that the enterprise leadership (Section I Enterprise Leadership/Transformation), production process until operational support (Section II Life

Cycle Process), and infrastructure element (Section III Enabling Infrastructure) are still in an informal approach in lean implementation. Moreover, performance often has various values of effectiveness and efficiency. This could lead to insignificant results in lean implementation. Factors driving the success of lean implementations are good to change agent, continuous improvement, involvement of supplier in the supply chain, considerations of customer value, and evaluation of roles/programs for lean implementation. Also, some factors hinder lean performance. Those factors are a lack of shared understanding of the company's condition among the respondent and between the respondent and the Industrial Development Manager, Director of Production, and culture.

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