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Readiness assessment of lean six sigma implementation in the manufacturing industry as a way to ensure sustainability

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Abstract. Lean Six Sigma (LSS) is a strategy to overcome the problems that occur to improve the efficiency and effectiveness of the company through the elimination of variation and waste. efficiency and effectiveness will ensure the sustainability of the company. Several factors affect the success of LSS implementation in the company. Therefore, to be successful in LSS implementation, an assessment is needed to measure the level of LSS readiness (Lean Six Sigma Readiness/LESIRE). This article discusses the measurement of the readiness level of the plastic industry in Indonesia in the implementation of LSS. In addition to measuring the level of readiness, this article also discusses what important factors must be prepared in advance to be ready for LSS implementation. Data was collected by distributing questionnaires and processed using the fuzzy method. Factors that influence success consist of 5 enablers, 19 criteria, and 55 attributes. The results showed that the industry studied was categorized as Almost Ready. Attributes that need to be improved to increase LSS readiness are company initiatives in development, learning processes in development, improving workforce skills, customer-focused organizations or companies, strategic and visionary leadership, responsibility, authority and communication, planning, feedback loop design, eliminating waste, high impact of customer satisfaction, and technology improvement.

1 Introduction

The manufacturing industry must prioritize product quality and excellence. In addition, manufacturing companies must also improve efficiency and efficiency to reduce waste. Waste is any activity contained in a process flow that does not provide added value to the final product which can affect the aspect of customer satisfaction. Hines & Taylor [1] explain that there are seven types of waste, and it has even grown to eight types of waste. Höfer et al. [2] explained that the eight wastes are defects and rework, overproduction, waiting, non-utilized talent, transportation, inventory, motion, and extra processing. Waste has an impact and results in losses, so the company needs the right strategy to reduce waste. Lean Six Sigma

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is a strategy that can be used in business and industry improvement. Lean started from Toyota's production system with the main emphasis on waste in the process, and Six Sigma originated from Motorola with a focus on reducing variation in the process to improve efficiency. According to Albliwi et al. [3] LSS is a widely accepted technique used for continuous improvement in quality-related issues in fields such as manufacturing and service sectors by combining both lean thinking (LT) and six sigma. LSS is widely used because it has been widely recognized and has proven to be the most successful to improve a company with operational efficiency, increasing productivity, and reducing costs [4].

The manufacturing sectors' principal concern in recent years has been to lessen their ecological imprint. With the help of developing technology, businesses are becoming more resource-efficient and shifting their focus to sustainability [5]. Meanwhile, Maria, et.al [6] stated that the LSS technique, in particular for firms using it as a methodology to accomplish and manage results and seek competitive advantage, contributes to the performance of organizations as it highlights environmental aspects. Furthermore, approaches like LSS would be more successful in meeting the rising demand while maximizing resource use and taking environmental concerns into account [5]. By using the LSS approach, it can reduce waste, which in turn will improve environmental and economic sustainability.

Organizational readiness is essential in developing LSS. The readiness to develop LSS will determine its success. By knowing the level of readiness to develop Lean Six Sigma, organizations can identify barriers to implementing LSS. Many factors affect the success of LSS implementation, so it is necessary to evaluate LSS readiness so that improvements or preparations for LSS implementation can be made. Identifying the level of readiness in an organization or company will help determine the company's potential to make the change process effective [7]. Several researchers have measured Lean Readiness in manufacturing and healthcare as well as in Higher Education Institution (HEI).

Fuzzy logic was used by Bayou & de Korvin [8] to measure the leanness of two automotive industries using fuzzy logic and determine how lean two car industries were. Fuzzy logic was also used by certain academics to measure leanness [9–11]. The leanness index and score can be used to identify areas that need to be improved. Furthermore, Wong et al. [12] used the Analytic Network Process (ANP) to quantify the leanness level (index) in a comprehensive method that took into account three factors (quality, cost, and on-time delivery). Other researchers have evaluated leanness using Interval-Valued Fuzzy Sets (IVFS) [13] and Data envelopment analysis (DEA), Fuzzy DEA (FDEA), Fuzzy Cognitive Map (FCM), DEMATEL, and AHP [14]. While working in the healthcare industry, Vaishnavi & Suresh [7] used fuzzy logic to assess a hospital. Mulyana, IJ et al. [15] used fuzzy method to measure lean readiness of Higher Education Institution.

This article discusses the assessment of the readiness level of the plastic industry for LSS implementation. Fuzzy logic is used to assess the readiness level.

2 Methods

The performance level and importance weight of each aspect makes up the two components of the assessment. The readiness level of each factor is assessed based on the evaluation of the performance level and importance weight of each factor. using the fuzzy approach to assess. The following are the steps to determine the readiness level:

2.1 Enabler, criteria, and attribute of readiness

LSS implementation enabler, criteria, and attribute. The enablers consist of organization culture, management and leadership commitment, LSS planning, linking LSS to business, and the external environment [7,11].

2.2 Determination of Likert Scale, Linguistic Scale, and Fuzzy Number of performance levels and importance weights of factors used in the assessment of LSS readiness

Assessment of performance level and importance weight by experts using the Likert Scale. Each expert's answer is converted to a fuzzy number according to Table 1.

Table 1. Linguistic Scale, Likert Scale, and Fuzzy Number.

	Performance Level			**Importance Weight**	
Linguistic Scale	**Likert Scale**	**Fuzzy Number (l,m,u)**	**Linguistic Scale**	**Likert Scale**	**Fuzzy Number (l,m,u)**
Worst	1	(1, 1, 2)	Very Low	1	(0.1, 0.1, 0.2)
Very Poor	2	(1, 2, 3)	Low	2	(0.1, 0.2, 0.3)
Poor	3	(2, 3, 4)	Fairly Low	3	(0.2, 0.3, 0.4)
Fair	4	(3, 4, 5)	Medium	4	(0.3, 0.4, 0.5)
Fairer	5	(4, 5, 6)	Fairly High	5	(0.4, 0.5, 0.6)
Almost Good	6	(5, 6, 7)	More Fairly High	6	(0.5, 0.6, 0.7)
Good	7	(6, 7, 8)	Almost High	7	(0.6, 0.7, 0.8)
Very Good	8	(7, 8, 9)	High	8	(0.7, 0.8, 0.9)
Almost Excellent	9	(8, 9, 10)	Almost Very High	9	(0.8, 0.9, 1)
Excellent	10	(9, 10, 10)	Very High	10	(0.9, 1, 1)

2.3 Aggregating fuzzy performance levels and importance weights

Calculation of fuzzy performance level and importance level of each criterion using equations (1) and (2) respectively,

$$H_{ij} = \frac{\sum_{k=1}^{n} G_{ijk} \otimes H_{ijk}}{\sum_{k=1}^{n} G_{ijk}} \quad (1)$$

$$G_{ij} = \frac{\sum_{k=1}^{n} G_{ijk} \otimes H_{ijk}}{\sum_{k=1}^{n} H_{ijk}} \quad (2)$$

Meanwhile to find the fuzzy performance level and importance level of each enabler using equation (3) and (4) respectively,

$$H_i = \frac{\sum_{k=1}^{n} G_{ij} \otimes H_{ij}}{\sum_{k=1}^{n} G_{ij}} \quad (3)$$

$$G_i = \frac{\sum_{k=1}^{n} G_{ij} \otimes H_{ij}}{\sum_{k=1}^{n} H_{ij}} \quad (4)$$

Where,

H_i = Fuzzy importance rating for readiness for the implementation of LSS of i-th enabler

H_{ij} = Fuzzy importance rating for readiness for the implementation of LSS of j-th criterion in the i-th enabler

H_{ijk} = Fuzzy importance rating for readiness for the implementation of LSS of k-th attribute of j-th criterion in the i-th enabler

G_i = Fuzzy importance weight for readiness for the implementation of LSS of i-th enabler

G_{ij} = Fuzzy importance weight for readiness for the implementation of LSS of j-th criterion in the i-th enabler

G_{ijk} = Fuzzy importance weight for readiness for the implementation of LSS of k-th attribute of j-th criterion in the i-th enabler

Then, calculate the fuzzy readiness index using equation (5).

$$\text{FRLSSI} = \frac{\sum_{i=1}^{i}(G_i \otimes H_i)}{\sum_{i=1}^{i} G_i} \quad (5)$$

2.4 Match the FRLSSI with an appropriate level

The Euclidean Distance technique is then used to compare the FRLSSI value to the term readiness level. Five language terms from Naranayamurthy [16] readiness level are used in this strategy consisting of Not Ready (NR), Low Ready (LR), Average Ready(AR), Close to Ready (CR), and Ready (R). Table 2 shows terms of readiness level and related fuzzy numbers

Table 2. Fuzzy number term readiness level.

Term Readiness Level	Fuzzy Number
Not Ready (NR)	(0, 1.5, 3)
Low Ready (LR)	(1.5, 3, 4.5)
Average Ready(AR)	(3.5, 5, 6.5)
Close to Ready (CR)	(5.5, 7, 8.5)
Ready (R)	(7, 8.5, 10)

Calculate Euclidean Distance using equation (6)

$$\text{D}(\text{FRLSSI}, \text{RLSSLi}) = \sqrt{\sum(\text{fFRLSSI}(\text{x}) - \text{fRLSSLi}(\text{x}))^2} \quad (6)$$

2.5 Determine the attribute must be improved

Variables that have a low level of readiness will become obstacles to making improvements. For this reason, the value of the Fuzzy Performance Importance Index (FPII) is calculated using equation (7)

$$\text{FPII} = \text{W}_{\text{ijk}} \otimes \text{H}_{\text{ijk}} \quad (7)$$

where Wijk = (1,1,1) – Gijk

Furthermore, calculate a rank score for each variable using equation (8)

$$\text{Rank Score} = \frac{\text{a}+4\text{b}+\text{c}}{6} \quad (8)$$

3 Result and discussion

In this study, enabler, criteria, and attributes of readiness Lean Six Sigma are adopted from Sreedharan, et. al [11] and Vaishnavi & Suresh [7] displayed in Appendix 1. The performance level and importance weight assessment of attributes LSS readiness was conducted by ten (10) middle managers. Each answer is converted to a fuzzy number according to Table 2. The conversion results are averaged using equation (7). Table 3 displays the average performance level and importance weight of attributes.

Average fuzzy number =

$$\left[\frac{l_1+l_2+\cdots l_n}{n}, \frac{m_1+m_2+\cdots m_3}{n}, \frac{u_1+u_2+\cdots u_3}{n}\right] \quad (9)$$

Table 3. Average performance level and importance weight.

Enabler	Criteria	Attribute	G_{ijk}	H_{ijk}
LC1	LC11	LC111	(0.72, 0.89, 0.94)	(6.5, 7.69, 8.69)
		LC112	(0.75, 0.85, 0.92)	(6.31, 7.31, 8.25)
		LC113	(0.58, 0.68, 0.78)	(5.69, 6.69, 7.69)
		LC114	(0.65, 0.75, 0.85)	(5.56, 6.56, 7.56)
	LC12	LC121	(0.79, 0.89, 0.96)	(5.93, 6.93, 7.93)
		LC122	(0.8, 0.9, 0.95)	(6.06, 7.06, 8.06)
		LC123	(0.81, 0.91, 0.97)	(5.87, 6.87, 7.87)
	LC13	LC131	(0.64, 0.74, 0.84)	(4.81, 5.81, 6.81)
	LC14	LC141	(0.77, 0.87, 0.94)	(5.81, 6.81, 7.81)
		LC142	(0.76, 0.86, 0.93)	(6.43, 7.43, 8.43)
	LC15	LC151	(0.7, 0.8, 0.89)	(6.25, 7.25, 8.25)
		LC152	(0.75, 0.85, 0.92)	(6, 7, 8)
		LC153	(0.75, 0.85, 0.93)	(5.93, 6.93, 7.93)
LC2	LC21	LC211	(0.82, 0.92, 0.97)	(6.81, 7.81, 8.81)
		LC212	(0.77, 0.87, 0.94)	(6.43, 7.43, 8.43)
		LC213	(0.8, 0.9, 0.95)	(6.31, 7.31, 8.31)
	LC22	LC221	(0.66, 0.76, 0.86)	(5.75, 6.75, 7.75)
	LC23	LC231	(0.77, 0.87, 0.93)	(5.75, 6.75, 7.75)
		LC232	(0.8, 0.9, 0.96)	(6.43, 7.43, 8.43)
		LC233	(0.79, 0.89, 0.95)	(6.18, 7.18, 8.18)
	LC24	LC241	(0.79, 0.89, 0.95)	(6.25, 7.25, 8.25)

Enabler	Criteria	Attribute	G_{ijk}	H_{ijk}
		LC242	(0.77, 0.87, 0.93)	(6.37, 7.37 8.375)
		LC243	(0.79, 0.89, 0.95)	(6.37, 7.37, 8.37)
		LC244	(0.79, 0.89, 0.95)	(6.31, 7.31, 8.31)
	LC25	LC251	(0.78, 0.88, 0.94)	(6.5, 7.5, 8.5)
		LC252	(0.8, 0.9, 0.95)	(6.5, 7.5, 8.5)
		LC253	(0.77, 0.87, 0.93)	(6.25, 7.25, 8.25)
		LC254	(0.78, 0.88, 0.95)	(6.25, 7.25, 8.25)
LC3	LC31	LC311	(0.71, 0.81, 0.91)	(6.25, 7.25, 8.18)
		LC312	(0.69, 0.79, 0.89)	(4.93, 5.93, 6.93)
		LC313	(0.75, 0.85, 0.93)	(5.62, 6.62, 7.62)
	LC32	LC321	(0.78, 0.88, 0.94)	(6.06, 7.06, 8.06)
		LC322	(0.74, 0.84, 0.92)	(5.68, 6.68, 7.68)
		LC323	(0.74, 0.84, 0.91)	(6.06, 7.06, 8.06)
	LC33	LC331	(0.76, 0.86, 0.94)	(6.06, 7.06, 8.06)
		LC332	(0.77, 0.87, 0.93)	(6.06, 7.06, 8.06)
		LC333	(0.8, 0.9, 0.97)	(6.12, 7.12, 8.12)
LC4	LC41	LC411	(0.75, 0.85, 0.93)	(6, 7, 8)
	LC42	LC421	(0.74, 0.84, 0.92)	(5.93, 6.68, 7.68)
		LC422	(0.76, 0.86, 0.95)	(6.06, 7.06, 8.06)
		LC423	(0.73, 0.83, 0.92)	(6.12, 7.12, 8.12)
		LC424	(0.73, 0.83, 0.92)	(6.37, 7.37, 8.37)
		LC425	(0.74, 0.84, 0.93)	(5.81, 6.81, 7.81)
	LC43	LC431	(0.72, 0.82, 0.91)	(6.75, 7.75, 8.68)
		LC432	(0.72, 0.82, 0.91)	(6.37, 7.37, 8.37)
		LC433	(0.73, 0.83, 0.92)	(6.31, 7.31, 8.31)
		LC434	(0.79, 0.89, 0.96)	(6.75, 7.75, 8.68)
LC5	LC51	LC511	(0.78, 0.88, 0.95)	(6.31, 7.31, 8.31)
		LC512	(0.79, 0.89, 0.96)	(6.25, 7.25, 8.25)

Enabler	Criteria	Attribute	G_{ijk}	H_{ijk}
		LC513	(0.78, 0.88, 0.94)	(6.75, 7.75, 8.68)
	LC52	LC521	(0.76, 0.86, 0.94)	(6.5, 7.5, 8.5)
		LC522	(0.76, 0.86, 0.94)	(6.5, 7.5, 8.5)
		LC523	(0.73, 0.83, 0.93)	(6.25, 7.25, 8.25)
	LC53	LC531	(0.77, 0.87, 0.94)	(6.06, 7.06, 8.06)
		LC532	(0.79, 0.89, 0.95)	(6.12, 7.12, 8.06

Furthermore, the calculation of fuzzy performance level and importance weight of each criterion (1) and (2), respectively. For example, the calculation of fuzzy performance level and importance weight of LC11 criteria is as follows:

$$H_{LC11} = \frac{\begin{matrix}[\big((0.72,0.89,0.94)\otimes(6.5,7.69,8.69)\big)\oplus \\ \big((0.75,0.85,0.92)\otimes(6.31,7.31,8.25)\big)\oplus \\ \big((0.58,0.68,0.78)\otimes(5.69,6.69,7.69)\big)\oplus \\ ((0.65,0.75,0.85)\otimes(5.56,6.56,7.56))]\end{matrix}}{\begin{matrix}[(0.72,0.89,0.94)\oplus(0.75,0.85,0.92)\oplus \\ (0.58,0.68,0.78)\oplus(0.65,0.75,0.85)\end{matrix}}$$
$$= (6.05, 7.11, 8.07)$$

$$G_{LC11} = \frac{\begin{matrix}[\big((0.72,0.89,0.94)\otimes(6.5,7.69,8.69)\big)\oplus \\ \big((0.75,0.85,0.92)\otimes(6.31,7.31,8.25)\big)\oplus \\ \big((0.58,0.68,0.78)\otimes(5.69,6.69,7.69)\big)\oplus \\ ((0.65,0.75,0.85)\otimes(5.56,6.56,7.56))]\end{matrix}}{\begin{matrix}[(6.5,7.69,8.69)\oplus(6.31,7.31,8.25)\oplus \\ (5.69,6.69,7.69)\oplus(5.56,6.56,7.56)]\end{matrix}}$$
$$= (0.68, 0.80, 0.88)$$

The complete calculation results for all criteria can be seen in Table 4

Table 4. Fuzzy performance level and importance weight of criteria.

Criteria	G_{ij}	H_{ij}
LC11	(0.68,0.80,0.88)	(6.05, 7.11, 8.07)
LC12	(0.79, 0.89, 0.95)	(5.96, 6.96, 7.96)
LC13	(0.64, 0.74, 0.84)	(4.81, 5.81, 6.81)
LC14	(0.76, 0.86, 0.93)	(6.12, 7.12, 8.12)
LC15	(0.73, 0.83, 0.91)	(6.05, 7.05, 8.05)
LC21	(0.79, 0.89, 0.95)	(6.52, 7.52, 8.52)
LC22	(0.66, 0.76, 0.86)	(5.75, 6.75, 7.75)
LC23	(0.78, 0.88, 0.94)	(6.12, 7.12, 8.12)

LC24	(0.78, 0.88, 0.94)	(6.32, 7.32, 8.32)
LC25	(0.78, 0.88, 0.94)	(6.37, 7.37, 8.37)
LC31	(0.71, 0.81, 0.91)	(5.61, 6.60, 7.58)
LC32	(0.75, 0.85, 0.92)	(5.93, 6.93, 7.93)
LC33	(0.77, 0.87, 0.94)	(6.08, 7.08, 8.08)
LC41	(0.75, 0.85, 0.93)	(6.01, 7.02, 8.04)
LC42	(0.73, 0.83, 0.92)	(6.06, 7.01, 8.01)
LC43	(0.74, 0.84, 0.92)	(6.55, 7.55, 8.51)
LC51	(0.78, 0.88, 0.94)	(6.43, 7.43, 8.41)
LC52	(0.75, 0.85, 0.93)	(6.41, 7.41, 8.41)
LC53	(0.78, 0.88, 0.94)	(6.09, 7.094, 8.06)

Calculate the fuzzy performance level and importance weight of each enabler using equations (3) and (4) and the results can be seen in Table 5.

Table 5. Fuzzy performance level and importance weight of enabler.

Enabler	G_i	H_i
LC1	(0.72, 0.83, 0.90)	(5.82, 6.83, 7.82)
LC2	(0.76, 0.86, 0.93)	(6.23, 7.23, 8.23)
LC3	(0.75, 0.84, 0.92)	(5.88, 6.88, 7.87)
LC4	(0.74, 0.84, 0.92)	(6.20, 7.18, 8.17)
LC5	(0.77, 0.87, 0.94)	(6.31, 7.31, 8.29)

The next step is to calculate the fuzzy readiness index (FRLSSI) using equation (5)

$$FRLSSI = \frac{\begin{array}{c}[((0.72,0.83,0.90)\otimes(5.82,6.83,7.82))\oplus \\ \big((0.76,0.86,0.93)\otimes(6.23,7.23,8.23)\big)\oplus \\ \big((0.75,0.84,0.92)\otimes(5.88,6.88,7.87)\big)\oplus \\ \big((0.74,0.84,0.92)\otimes(6.20,7.18,8.17)\big)\oplus \\ ((0.77,0.87,0.94)\otimes(6.31,7.31,8.29))]\end{array}}{\begin{array}{c}[(0.72,0.83,0.90)\oplus(0.76,0.86,0.93)\oplus \\ (0.75,0.84,0.92)\oplus \\ (0.74,0.84,0.92)\oplus(0.77,0.87,0.94)]\end{array}}$$

$$= (6.09, 7.09, 8.08)$$

The Euclidean Distance technique as equation (6) is then used to compare the FRLSSI value to the term level of readiness as in Table 3. As an example of calculating the Euclidean Distance level of readiness Not Ready:

$$D(FRLSSI, NR) = \sqrt{[(6.09-0)^2 + (7.09-1.5)^2 + (8.08-3)^2]} = 9.71$$

Similarly, other readiness levels can be determined from Euclidean distance, including:

$$D(FRLSSI, LR) = 7.12$$
$$D(FRLSSI, AR) = 3.69$$
$$\boldsymbol{D(FRLSSI, CR) = 0.73}$$
$$D(FRLSSI, R) = 2.54$$

In this case, the readiness level of this company is **Close to Ready (CR)** based on the term readiness level and the minimal grade of D.

To be successful in implementing LSS, improvements must be made to the LSS readiness attributes so that the readiness level becomes **Ready**. To determine the priority of attributes that must be improved, the Fuzzy Performance Importance Index (FPII) is calculated using equation (7) and the ranking value (rank score) using equation (8). Attributes with low-rank scores are prioritized for improvement. Rank score and priority improvement of attributes are displayed in Table 6.

Table 6. Rank score and priority improvement order.

Attribute	W_{ijk} = (1,1,1) – Gijk	H_{ijk}	FPII = $W_{ijk} \otimes H_{ijk}$	Rank Score	Priority Improvement Order
LC111	(0.06, 0.11, 0.28)	(6.5, 7.69, 8.69)	(0.39, 0.85, 2.43)	1.037	29
LC112	(0.08, 0.15, 0.25)	(6.31, 7.31, 8.25)	(0.51, 1.10, 2.06)	1.162	41
LC113	(0.22, 0.32, 0.42)	(5.69, 6.69, 7.69)	(1.25, 2.14, 3.23)	2.173	55
LC114	(0.15, 0.25, 0.35)	(5.56, 6.56, 7.56)	(0.83, 1.64, 2.65)	1.673	54
LC121	(0.04, 0.11, 0.21)	(5.93, 6.93, 7.93)	(0.24, 0.76, 1.67)	0.825	7*
LC122	(0.05, 0.1, 0.2)	(6.06, 7.06, 8.06)	(0.30, 0.71, 1.61)	0.792	4*
LC123	(0.03, 0.09, 0.19)	(5.87, 6.87, 7.87)	(0.18, 0.62, 1.50)	0.693	1*
LC131	(0.16, 0.26, 0.36)	(4.81, 5.81, 6.81)	(0.77, 1.51, 2.45)	1.543	52
LC141	(0.06, 0.13, 0.23)	(5.81, 6.81, 7.81)	(0.35, 0.89, 1.80)	0.952	20
LC142	(0.07, 0.14, 0.24)	(6.43, 7.43, 8.43)	(0.45, 1.04, 2.03)	1.107	36
LC151	(0.11, 0.2, 0.3)	(6.25, 7.25, 8.25)	(0.69, 1.45, 2.48)	1.495	51
LC152	(0.08, 0.15, 0.25)	(6, 7, 8)	(0.48, 1.05, 2)	1.113	37
LC153	(0.07, 0.15, 0.25)	(5.93, 6.93, 7.93)	(0.42, 1.04, 1.98)	1.093	32
LC211	(0.03, 0.08, 0.18)	(6.81, 7.81, 8.81)	(0.20, 0.63, 1.59)	0.718	2*
LC212	(0.06, 0.13, 0.23)	(6.43, 7.43, 8.43)	(0.39, 0.97, 1.94)	1.035	27
LC213	(0.05, 0.1, 0.2)	(6.31, 7.31, 8.31)	(0.32, 0.73, 1.66)	0.817	5*

Attribute	W_{ijk} = (1,1,1) – Gijk	H_{ijk}	FPII = $W_{ijk} \otimes H_{ijk}$	Rank Score	Priority Improvement Order
LC221	(0.14, 0.24, 0.34)	(5.75, 6.75, 7.75)	(0.81, 1.62, 2.64)	1.655	53
LC231	(0.07, 0.13, 0.23)	(5.75, 6.75, 7.75)	(0.40, 0.88, 1.78)	0.950	19
LC232	(0.04, 0.1, 0.2)	(6.43, 7.43, 8.43)	(0.26, 0.74, 1.69)	0.818	6*
LC233	(0.05, 0.11, 0.21)	(6.18, 7.18, 8.18)	(0.31, 0.79, 1.72)	0.865	11
LC241	(0.05, 0.11, 0.21)	(6.25, 7.25, 8.25)	(0.31, 0.80, 1.73)	0.873	12
LC242	(0.07, 0.13, 0.23)	(6.37, 7.37 8.375)	(0.45, 0.96, 1.93)	1.037	28
LC243	(0.05, 0.11, 0.21)	(6.37, 7.37, 8.37)	(0.32, 0.81, 1.76)	0.887	14
LC244	(0.05, 0.11, 0.21)	(6.31, 7.31, 8.31)	(0.32, 0.80, 1.75)	0.878	13
LC251	(0.06, 0.12, 0.22)	(6.5, 7.5, 8.5)	(0.39, 0.9, 1.87)	0.977	21
LC252	(0.05, 0.1, 0.2)	(6.5, 7.5, 8.5)	(0.33, 0.75, 1.7)	0.838	8*
LC253	(0.07, 0.13, 0.23)	(6.25, 7.25, 8.25)	(0.44, 0.94, 1.90)	1.017	25
LC254	(0.05, 0.12, 0.22)	(6.25, 7.25, 8.25)	(0.31, 0.87, 1.82)	0.935	17
LC311	(0.09, 0.19, 0.29)	(6.25, 7.25, 8.18)	(0.56, 1.38, 2.37)	1.408	49
LC312	(0.11, 0.21, 0.31)	(4.93, 5.93, 6.93)	(0.54, 1.25, 2.15)	1.282	45
LC313	(0.07, 0.15, 0.25)	(5.62, 6.62, 7.62)	(0.39, 0.99, 1.91)	1.043	30
LC321	(0.06, 0.12, 0.22)	(6.06, 7.06, 8.06)	(0.36, 0.85, 1.77)	0.922	16
LC322	(0.08, 0.16, 0.26)	(5.68, 6.68, 7.68)	(0.46, 1.07, 2.00)	1.123	38
LC323	(0.09, 0.16, 0.26)	(6.06, 7.06, 8.06)	(0.55, 1.13, 2.10)	1.195	42
LC331	(0.06, 0.14, 0.24)	(6.06, 7.06, 8.06)	(0.36, 0.99, 1.94)	1.043	31
LC332	(0.07, 0.13, 0.23)	(6.06, 7.06, 8.06)	(0.42, 0.92, 1.85)	0.992	23
LC333	(0.03, 0.1, 0.2)	(6.12, 7.12, 8.12)	(0.18, 0.71, 1.63)	0.775	3*
LC411	(0.07, 0.15, 0.25)	(6, 7, 8)	(0.42, 1.05, 2)	1.103	33
LC421	(0.08, 0.16, 0.26)	(5.93, 6.68, 7.68)	(0.48, 1.07, 2.00)	1.127	39
LC422	(0.05, 0.14, 0.24)	(6.06, 7.06, 8.06)	(0.30, 0.99, 1.94)	1.033	26
LC423	(0.08, 0.17, 0.27)	(6.12, 7.12, 8.12)	(0.49, 1.21, 2.19)	1.253	43
LC424	(0.08, 0.17, 0.27)	(6.37, 7.37, 8.37)	(0.51, 1.25, 2.26)	1.295	47

Attribute	W_{ijk} = (1,1,1) – Gijk	H_{ijk}	FPII = $W_{ijk} \otimes H_{ijk}$	Rank Score	Priority Improvement Order
LC425	(0.07, 0.16, 0.26)	(5.81, 6.81, 7.81)	(0.41, 1.09, 2.03)	1.133	40
LC431	(0.09, 0.18, 0.28)	(6.75, 7.75, 8.68)	(0.61, 1.40, 2.43)	1.440	50
LC432	(0.09, 0.18, 0.28)	(6.37, 7.37, 8.37)	(0.57, 1.33, 2.35)	1.373	48
LC433	(0.08, 0.17, 0.27)	(6.31, 7.31, 8.31)	(0.51, 1.24, 2.24)	1.285	46
LC434	(0.04, 0.11, 0.21)	(6.75, 7.75, 8.68)	(0.27, 0.85, 1.82)	0.915	15
LC511	(0.05, 0.12, 0.22)	(6.31, 7.31, 8.31)	(0.32, 0.88, 1.83)	0.945	18
LC512	(0.04, 0.11, 0.21)	(6.25, 7.25, 8.25)	(0.25, 0.80, 1.73)	0.863	10*
LC513	(0.06, 0.12, 0.22)	(6.75, 7.75, 8.68)	(0.41, 0.93, 1.91)	1.007	24
LC521	(0.06, 0.14, 0.24)	(6.5, 7.5, 8.5)	(0.39, 1.05, 2.04)	1.105	34
LC522	(0.06, 0.14, 0.24)	(6.5, 7.5, 8.5)	(0.39, 1.05, 2.04)	1.105	35
LC523	(0.07, 0.17, 0.27)	(6.25, 7.25, 8.25)	(0.44, 1.23, 2.23)	1.265	44
LC531	(0.06, 0.13, 0.23)	(6.06, 7.06, 8.06)	(0.36, 0.92, 1.85)	0.982	22
LC532	(0.05, 0.11, 0.21)	(6.12, 7.12, 8.06	(0.31, 0.78, 1.70)	0.855	9*

Table 6 shows the top 10 attributes that have the highest rank score and are prioritized for improvement, namely (1). Workforce skill upgrade (LC123) (2). Customer-focused organization (LC211) (3). Eliminating waste (LC333) (4). Learning in the organization (LC122) (5). Strategic and visionary leadership (LC213) (6). Responsibility, authority, and communication (LC232), (7). Development initiatives (LC121) (8). Design of feedback loops (LC252) (9). Technology upgradation (LC532), and (10) High impact of customer satisfaction (LC512). Based on the 10 (ten) weaker attributes, some suggestions to improve readiness in implementing LSS as in Table **7**.

Table 7. Weaker and related suggestions.

Weaker	Suggestion(s)
Workforce skill upgrade	Upgrading workforce skills by appropriate continuous training Job analysis and recruiting a skilled workforce
Customer focused organization	Development of customer survey and feedback system Product design based on customer requirements.
Eliminating waste	Identification and classification of wastes both in shopfloor and office Uses appropriate Six Sigma methodology to reduce waste
Learning in the organization	Development sharing forum between departments. Competition for interdepartmental improvement projects Regular seminars or workshops

Weaker	Suggestion(s)
Strategic and visionary leadership	Improve managerial skills, planning and control, and teamwork development of all level leaders
Responsibility, authority, and communication	Distribute duties, responsibilities and rights equally among employees Giving power and responsibility for decisions made Encourage employee participation in achieving goals Plan and schedule regular meetings or discussions to maintain communication.
Development initiatives	Encourage all workforce to improve their work Provide reward system
Design of feedback loops	Improve feedback system at all levels of management
Technology upgradation	Update equipment, tools, and methods in production Replace the old equipment and machines. Proper training in handling machines and equipment Periodic review and analysis of all equipment
High impact on customer satisfaction	Accessibility of service and information of the company Simplicity in handling customer suggestions and complaints

Sustainability is a timely and important issue. Achieving sustainability has become important for organisations as they face increasing pressure from customers, regulators, and other stakeholders to become greener. In this context, moving towards greener operations can help organisations develop products and processes that are in line with stakeholder expectations [17]. LSS is one of the most effective initiatives for improving process performance. LSS approach to minimize different types of waste [18]. By minimizing waste sustainability of the environment and economy can be achieved. Environmental sustainability can be achieved by minimizing product defects. Otherwise, economic sustainability through effective and efficient resource utilization.

4 Conclusion

This article has discussed the readiness level of the plastic industry. The result shows that the readiness level of LSS this company is Close to Ready. It means that there are some opportunities to improve some attributes to Ready in implementing LSS. Some ideas have been suggested to improve the readiness level of the company. Implementing LSS will improve the environmental and economic sustainability of the company.

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