Development lean assessment indicator: A case study

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Abstract. The manufacturing industry is always faced with global challenges such as cost effectiveness, lead time, quality, and safety. Lean as a concept of continuous improvement can be a solution in solving the challenge. PT. Compotec International is one of the companies faced with the problem. Basically, the company has implemented lean concept in its production process, but the lack of understanding and commitment of the company in its implementation still leads to the emergence of waste in the production process. Therefore a comprehensive measurement is needed to assess company performance from several dimensions such as time effectiveness, quality, process, cost, human resources, delivery, customer, and inventory. In the previous lean assessment tools research, safety issues that became the basis of production considerations before making improvements have not been taken yet into account. Therefore it is necessary to integrate waste based indicators related to poor safety. Measurements are done qualitatively and quantitatively using aggregate scoring and fuzzy approaches. From the measurement result and then weighted with Brown-Gibson method to get the value of leanness. then the results of these calculations are combined to be visualized in the form of lean radar chart. In this research, it is hoped that the development of new lean assessment can measure lean performance more comprehensively.

1 Introduction

Lean assessment is the first step in the implementation of lean manufacturing. According to Feld (2001), there are four stages in the application of lean manufacturing, namely lean manufacturing assessment, current state gap, future state design, and implementation. The objective of the lean assessment is to define leanness's current level of lean implementation by companies or organizations (Almomani, Abdelhadi and Mumani, 2014). Leanness creates a sustainable competitive advantage (Womack, J. P., & Jones, 1996). However, a lack of clear understanding of lean's performance and its measurement is the cause of the implementation failure of lean itself, making it impossible to implement lean without measuring its performance (Behrouzi and Wong, 2011).

According to Pakdil and Leonard (2014), the use of a single approach to the lean assessment process allows for bias. Pakdil and Leonard (2014) developed a lean assessment

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model using two approaches, namely quantitative assessment and qualitative assessment. Quantitative assessment can measure the application of lean in accordance with the results and objectives that have been implemented, while the qualitative assessment can reflect the perceptions of stakeholders or in the context of companies that can generate different perceptions of assessment. Both lean assessment tools (LAT) provide an overall picture of the company's lean performance.

Improving safety in the workplace has always been a topic discussed during continuous improvement. Statistics show that an accident incident occurs when a person or an individual does something out of the ordinary, in an unorganized place, or when the individual is required to perform a difficult, risky job without sufficient tool support. So that the work environment should be strived for as safe as possible, and how safety should not be sacrificed in the name of productivity.

2 Literatur Review

2.1 Lean Assessment Tool (LAT)

Some of the key pillars of lean assessment are size and can align with company strategy, then allow for performance control and evaluation (Taylor, Pakdil and Leonard, 2014). In some ways it is also able to help identify space to make improvements and be realistic on the application. Assessment becomes important in determining the initial step of performance measurement so that further does not lead to incorrect improvement policy. Implementation of lean assessment is also dynamic in accordance with the needs and availability required in case studies and applications.

2.2 Fuzzy Logic

Fuzzy logic is an approach method used to optimize uncertainty by using fuzzy numbers or fuzzy sets (Behrouzi and Wong, 2011) in their research to develop lean dynamic evaluation models using fuzzy methodology.

2.3 Lean Radar Chart

Lean radar chart is a graph that can describe or visualize the performance or results of calculations from the assessment that has been carried out. The company management can use the lean radar chart to see the internal effort of the company to be compared with the reference performance (Taylor, Pakdil and Leonard, 2014).

3 Development of Lean Assessment Indicator

This research begins with a reference search related theories that can assist researchers in deepening the problem and determine the direction of correct improvement. The purpose of this study is the development and modification of the framework based on previous studies to identify the critical dimensions and waste of the lean assessment results that have been developed, to know the root cause of problems to the performance of lean and waste critical implementation, and to recommend improvement on the production process in the company's production line that showed at Table 1.

Table 1. Quantitative and qualitative assessment studies.

	Quality	Cost	Time	JIT delivery	Inventory	Process	Set up time	Safety	Waste elimination	Continuous Improvement	Culture	Supplier issues	Customer issues	Scheduling system	Pull system	Multifunction worker	Visual Management	Movement materials	Flow system
Wan and Chen (2008)		√	√																
Maskell (2000)		√																	
Shields (2006)					√														
Almomani (2014)	√		√		√	√													
Sanjay Bhasin (2011)	√			√		√		√		√							√		
Behrouzi and Wong (2011)	√	√	√	√															
Goodson (2002)	√			√	√			√					√			√		√	
Shah and Ward (2007)				√		√	√					√	√			√			√
Pettersen (2009)												√		√					
Singh (2010)												√	√						
Isabela Nahmens (2009)								√											
Pakdil and Leonard (2014)	√	√	√	√	√	√	√		√	√		√	√	√	√			√	√
Development LAT (2018)	√	√	√	√	√	√	√	√	√	√		√	√	√	√			√	√

3.1 Integrating Lean Assessment Indicator

In the quantitative lean assessment indicator shown in Table 2 then the calculation phase of leannes value is done to determine the level of lean implementation in the company's production line. At this stage of collection is collected data to obtain the data needed to carry out research. The data collected at this stage is the company's performance data. Data taken at this stage can be primary data and secondary data. Primary data is data taken directly from the part of the object observation with discussion and interviews to the company. Secondary data is data obtained from recaps company report.

Table 2. Dimension of Quantitative Indicator

Dimension	Indicator of measurement
Time Effectiveness	Setup times : Time spent in setups / total productives time
	Ratio takt time / cycle time
	Machine downtime : Hours machine lost due to malfunction / Total machines hour scheduled (percentage)
	Total time of emergency repairs / total maintenance
Quality	Defect rate
	Rework % of the units that need to be sent to rework
	Scrap % of the products that need to be scrapped
Process	Overall Equipment Effectiveness (OEE)
	Capacity utilization rate (idle capacity / total capacity)
Human resources	Absentecism rate
	Total of suggestions / total employees
	Total of employees working in teams / total employees
	Total of hierarchical levels
	Total indirect employees / total direct employees
Delivery	Order lead time : Average time from the placement of an order (by a customer) to its delivery
	Ratio total delivery late per year / total delivery per year
	Ratio order processing time / total orders
Customer	Customer complaint rate
	Customer retention rate
	Total products returned by customer / total sales
Inventory	Raw material inventory / total inventory
	Finished goods inventory / total inventory
Safety	Incident rate
	Lost time case rate
	Dart rate
	Severity rate

3.2 Calculation

Calculation is done by using secondary data from indicators that have been modified and quantitative lean assessment done using fuzzy approach, while the qualitative lean assessment is done by using aggregate scoring approach in Lean Assessment combined. The results of quantitative lean assessment and qualitative lean assessment will be weighted by using Brown-Gibson method to get the value of leannes every dimension. The Table 3 show the result from qualitative assessment and the Table 4 show the result from quantitative assessment.

Table 3. Qualitative Leannes Score

Dimension	Agregat Scores	Total Question	Maximum Total scores	Leannes
Quality	44	11	55	0.800
Customer	9	2	10	0.900
Process	54	14	70	0.771
Human Resources	37	8	40	0.925
Delivery	52	14	75	0.693

Table 4. Quantitative Leannes Score

Dimension	Quantitative Scores
Quality	0.998
Customer	0.865
Process	0.933
Human Resources	0.556
Delivery	0.719
Safety	0.536

then the results of these calculations are combined to be visualized in the form of lean radar charts as in Figure 1.

Fig. 1. Lean Radar Chart

4 Conclusions

In this study it can be concluded that the qualitative and quantitative measurements on the determination of indicators determine how much accuracy in doing assessment on each dimension. Then from the results of the assessment can be found the value of leannes each

dimension which can then be identified critical waste so that can be searched the root cause of the problem and continue on the recommendation of correct improvement.

References

1. Feld, W. M., *Lean Manufacturing: Tools, Techniques, and How to Use Them.*, Alexandria VA: St. Lucie Press,(2001)
2. Almomani, M. A., Abdelhadi, A., Mumani, A., Momani, A. dan Aladeemy, M., A. *International Journal of Advanced Manufacturing Technology*, **72**(1–4), (2014)
3. Womack, J. P., & Jones, D. T., *Review Literature And Arts Of The Americas*, (1996)
4. Behrouzi, F., and K. Y. Wong., *Procedia Computer Science*, **3** (388– 395),(2011)
5. Pakdil, F. dan Leonard, K. M., *International Journal of Production Research*, **52**(15), hal. 4587– 4607.,(2014)
6. Gaspersz, V., *Lean Six Sigma for Manufacturing and Service Industries*, **3**(20-21),(2007)