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AN INVESTIGATION ON LEAN PRACTICES AND SUSTAINABLE DEVELOPMENT

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***ABSTRACT**--This paper seeks to reflect on Lean manufacturing's significance in achieving an organization's sustainable development. Customer satisfaction through improved quality, reduced costs, shortened delivery lead times and good communication is the secret to achieving sustainable development. Lean Manufacturing philosophies help managers recognize and eliminate waste at all organizational levels. Lean concepts are well established across waste disposal with recorded savings and productivity improvements. Most companies have found that "clean" or ecological quality is improved by a by-product of lean concepts, even if lean practices have not been implemented for environmental reasons. This paper analyzes the relationship between lean and sustainable development practices. Data were collected and analyzed using SPSS through a survey of 53 manufacturing firms in Chennai. Eighteen lean facilities have been reduced to four factors: 1 Lean-Agile Leadership.2Environmental factor 3)Economic and 4)Social factor. The results indicate that lean activities influence sustainable output positively and significantly. Such findings have significant implications for improving manufacturing firms ' sustainable efficiency through lean manufacturing practices.*

***Keywords**--Lean Practices, Sustainable development, Lean-Agile and Environmental factors*

I. INTRODUCTION

These days, business is carried out in a global economy, putting tremendous pressure on manufacturers to adopt advanced manufacturing practices in order to achieve the organization's sustainable competitive advantage. Customer satisfaction through improved quality, reduced costs, reduced delivery lead times and proper communication is the key to achieving sustainable development. While there is broad consensus on terminology, managers still seem to disagree on the sustainability motivation, which differs from a moral mandate to a legal requirement, and the cost of the right to operate.

The Lowell Center for Sustainable Production described sustainable production as ' the manufacture of goods and services using non-polluting processes and systems, energy and natural resources conservation, economically viable, safe and healthy for employees, communities and customers, and socially and creatively satisfying for all workers. 'Increasingly, Lean goals need to recognize more than just eliminating activities that add non-value. Lean targets need to be extended to consider the ability to reduce resource or capability needs through recycling and

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reclamation projects and the ability to capture assets at a price below the recovered value. One major change in the corporate environment over the last few years has been the increasing demand for social responsibility as a result of global warming, resource depletion and other environmental issues. Environmental concerns are attracting increasing attention around the world and as a result, corporate environmental stewardship is becoming a more important issue.

II. OBJECTIVES OF THE STUDY

1. To analyze the items that influence lean practices in manufacturing industries.
2. To find the relationship between factors of lean practices and sustainable development..

III. REVIEW OF LITERATURE

Lean manufacturing offers manufacturers a competitive edge by reducing costs and the performance and enabling the producer to be more receptive to customer demands by removing seven forms of waste that occur in the manufacturing process (Womack et al 1990, Hines and Rich 1997).

Lewis (2000) presented a lean production model and a sustainable competitive advantage using the company's input resources (raw material, WIP, skilled personnel, market information, technology data). Environmental waste disposal using lean practices allows business values to be acquired (Kaebernick et al. 2003).

Lean and sustainability are quite similar as they need more leadership than financial investment, and only work when management ' walks the conversation. ' Both are rather a journey than separate ventures, although they have different criteria for decision-making (Langenwalter 2006; SME 2008).

Piercy and Rich (2014) used the theatrical stage template to determine the wider feasibility of lean operations. The model serves as a guide for future managers to understand the change and process in organizations as they lean to sustainable practices.

Thanki et al. (2016) made a comparison between lean and green manufacturing as follows: "The purpose of Lean is to reduce operational waste through non-value-added activities, while the objective of green manufacturing is to condense environmental waste "Experts agree, however, that while lean and green paradigms contribute to corporations ' environmental performance, there are some differences between them, raising the question of whether there are synergistic benefits in applying both. In response to this synergistic question, Dues et al. (2013) described this synergy with "the formula 1 + 1 = 3," implying that "the combined activities have greater results than the sum of the individual performances."

IV. METHODOLOGY

This is a work that is concise. To collect data from respondents, a standardized questionnaire was used. The research build objects were adapted from previous studies and measured using five-point Likert scales ranging from "strong disagreement" to "strong agreement." Items from previous studies have been adapted to ensure validity of the content. Researcher has adopted convenient random sampling for data collection The data were collected from

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managers in Chennai's manufacturing firms.Managers have been chosen from various departments of the company as lean is a multidimensional approach. Sixty respondents received the questionnaire. It was incomplete with seven questionnaires. So the researcher rejects that and has selected the study's fifty-three questionnaire.

V. RESULT AND DISCUSSION

A factor analysis was performed to verify groupings of lean practices items from the survey data. Factors were extracted and followed by a varimax rotation. Aptness for factor analysis is checked using two analyze particularly Kaiser-Meyer-Olkin (KMO) and Bartlett's test of Sphericity. The proportion of variance within the constructs or items which could be caused by new factors is specified by KMO Measure of Sampling Adequacy. Generally high values indicate that a factor analysis could also be useful with the data. If the value is smaller than 0.50, the results of the factor analysis probably won't be very helpful.

Table 1:KMO and Bartlett's Test for lean practices

Kaiser-Meyer-Olkin Measure...	0.792
Bartlett's Test of Sphericity	
Approx. Chi-Square	89.525
Df	15
Sig.Bartlett	.000

Source: Primary Data

It was revealed from the table that, KMO and Bartlett's Test that, the Kaiser-Meyer-Olkin Measure value is 0.792 which was adequately high to conclude that it was appropriate to use factor analysis with the data to reach meaningful conclusion of 67.483percent common variance explained by the underlying factors as shown in table 2, which indicates that the factor analysis is useful with the data. For Bartlett's test of Sphericity, the chi-square value is 89.525 and the significant value is 0.000 which is significant at more than 1% percent level of confidence. Since the p-value (0.00) is less than the 0.05 level of significance, hence, it can be concluded that the items are suitable for factor analysis and the items or constructs form factors. The Kaiser criterion (eigenvalues > 1) was employed. Initial eigen value test suggested the presence of four significant factors for lean practices items that were retained for rotation.

Table 2: Total Variance explained for lean practices

Component Total	**Initial Eigen values**			**Rotation Sums of Squared Loadings**		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	1.552	24.526	22.526	1.896	21.598	21.598

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2	1.011	27.845	37.491	1.666	27.773	37.521
3	1.563	21.309	49.722	1.508	20.529	49.732
4	1.353	17.392	67.483	1.432	19.374	67.483

Source: Primary Data

As far as first factor is concerned table 2 shows that the eigen value of the first factor is 1.552 which gives 21.598 percent of total variance. The items included in this factor are Continuous improvements, Increased productivity, Innovation, Employees engagement, and Predictable delivery of value .Among these Continuous improvements has scored highest factor loading i.e. 0.894 shown in table 3. Since the items are related to the agile, the first factor was named as Lean-Agile Leadership.

The eigen value for the second factor was 1.011 which gives 37.521 percent of total variance. The construct; Defects, inventory, overproduction, over processing, transportation and waiting were loaded under factor 2. Among these items defects has the highest factor loading i.e. 0.869 shown in table 3. Since all these items are related to environmental performance, the second factor was named as environmental factor.

Table 3: Rotated Component Matrix for Lean performance

Constructs	**Factor1**	**Factor2**	**Factor3**	**Factor4**
Continuous improvements	0.894			
Increased productivity	0.831			
Innovation	0.785			
Employees engagement	0.769			
Predictable delivery of value	0.694			
Defects		0.869		
Inventory		0.746		
Transportation and Motion		0.731		
Overproduction		0.695		
Over processing		0.682		
Waiting				
Reduce errors			0.759	
Reduce the cost			0.753	
Profitability			0.564	
Reduce the accident				0.732
Reduce the stress				0.672
Same rules for all actors in the project				0.557

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Source: Primary Data

The eigen value for the third factor was 1.563 which gives 49.732 percent of total variance. The construct; reduced errors, reduced cost and profitability were loaded under factor 3. Among these items reduced errors has the highest factor loading i.e. 0.759 shown in table 3. Since all these items are related to economic performance, the third factor was named as economic factor.

The eigen value for the fourt factor was 1.353 which gives 67.483 percent of total variance. The construct; reduced accidents, reduced stress and Same rules for all actors in the project were loaded under factor 4. Among these items reduced accidents has the highest factor loading i.e. 0.732 shown in table 3. Since all these items are related to social performance, the fourth factor was named as social factor.

So, after data reduction the eighteen items were reduced to four factors namely; 1 Lean-Agile Leadership.2Environmental factor 3)Economic factor and 4)Social factor. In fact, large environmental gains can be made by implementing lean, because environmental wastes are related to lean's seven deadly wastes.

Table 4 : Relationship between Lean Practices and Sustainable Development

Lean Practices Competencies	**Pearsons Correlation**	**Sustainable Development**
Lean-Agile Leadership	Correlation coefficient	0.818**
	Sig. (2 tailed)	0.000
	N	53
Environment Factors	Correlation coefficient	0.792**
	Sig. (2 tailed)	0.000
	N	53
Economic Factors	Correlation coefficient	0.731**
	Sig. (2 tailed)	0.000
	N	53
Social Factors	Correlation coefficient	0.519**
	Sig. (2 tailed)	0.000
	N	53

Source: primary Data.

H0: There is no significant relationship between Lean practices and sustainable development.

H1: There is a significant relationship between Lean practices and sustainable development.

From Table 1, the correlation (r) value of 0.818 shows that there is a strong relationship between lean-agile leadership and sustainable development. Also, since the p-value (0.000) is less than the level of significance (α =

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0.05) indicates there is a significant relationship between lean-agile leadership and sustainable development. The correlation (r) value of environment factors is 0.792. since the p-value (0.000) is less than the level of significance ($\alpha = 0.05$) indicates there is a shows that there is a relationship between environment factors and sustainable development. The correlation (r) value of econmoic factors is 0.731. since the p-value (0.000) is less than the level of significance ($\alpha = 0.05$) indicates there is a shows that there is a relationship between economic factors and sustainable development. The correlation (r) value of social factors is 0.519. since the p-value (0.000) is less than the level of significance ($\alpha = 0.05$) indicates there is a shows that there is a relationship between social factors and sustainable development. In view of the fact that the p-value of all constructs in emotional competencies were found to be less than 0.05. we therefore, reject the null hypothesis and accept the alternate hypothesis that there is significant relationship between lean practices and sustainable development in Chennai manufacturing industries.

VI. CONCLUSION

This research was to investigate the extent that lean practices can ensure more sustainable development, The constructs chosen in this research are appropriate to demonstrate the relationship in the manufacturing industries between lean practices and sustainable development. Results revealed that there is the strong positive relationship between environmental factors and sustainable development. Sustainability is the world's most important challenge today. Material and resource costs are driving the need for sustainable products.

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