

## **Analysis of factors affecting the Lean and Green Manufacturing Systems by ISM approach**

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### **Abstract**

Lean system consists of best common sense practices for optimum resource utilization. Green manufacturing focuses on practices which reduce negative impacts on the environment. Global market conditions forced organizations to adopt Green-Lean (GL) concepts in the last few years. This paper focuses on factors affecting the implementing of lean and Green manufacturing systems.

**Keywords:** ISM (Interpretive Structural Modelling), Structural Self-Interaction Matrix (SSIM), Reachability Matrix, Level partitions, ISM Model.

### **1. INTRODUCTION:**

Lean Production, also called the Toyota Production System (TPS), is defined as “an integrated manufacturing system that is intended to maximize the capacity utilization and minimize the bufferinventories of a given operation through minimizing system variability[1]. Lean production rests on bundles of practices aimed at reducing and eliminating all forms of waste from firms’ manufacturing operations [2] and the Interpretive structural modeling (ISM) is a technique for identifying relationships among specific items. For any complex problem under consideration, a number of factors may be related to an issue or problem.[3] However, the direct and indirect relationships between the factors describe the situation far more accurately than the



**Table 1.** Structural Self Interaction Matrix

**Step 2: Development of Reachability Matrix**

Variables	1	2	3	4	5	6	7	8	9	10	Driver Power
1	1	1	1	0	1	1	0	1	1	0	7
2	0	1	0	0	1	1	0	1	1	1	6
3	1	1	1	0	1	0	0	1	0	0	5
4	0	1	1	1	0	0	1	1	0	1	6
5	1	0	0	0	1	0	1	1	0	1	5
6	1	0	0	1	1	1	1	1	0	1	6
7	0	1	0	0	0	0	1	1	0	1	4
8	0	0	0	0	0	1	0	1	0	0	2
9	1	0	1	1	1	1	1	1	1	0	8
10	1	0	1	0	0	0	0	1	1	1	5
<b>Dependence</b>	6	5	5	3	6	5	5	9	4	6	

**Table 2.** Reachability Matrix

**Step 3: Level partitions**

Variables	Reachability Set	Antecedent Set	Intersection Set	Level
1	1,2,3,5,6,8,9	1,3,5,6,9,10	1,3,5,6,9	
2	2,5,6,8,9,10	1,2,3,4,7	2	
3	1,2,3,5,8	1,3,4,9,10	1,3	
4	2,3,4,7,8,10	4,6,9	4	
5	1,5,7,8,10	1,2,3,5,6,9	1,5	
6	1,4,5,6,7,10	1,2,6,8,9	1,6	
7	2,7,8,10	4,5,6,7,9	7	
8	6,8	1,2,3,4,5,6,7,8,9,10	6,8	1 <sup>ST</sup>
9	1,3,4,5,6,7,8,9	1,2,9,10	1,9	
10	1,3,8,9,10	2,4,5,6,7,10	10	

**Table 3.** Partitioning of Variables-Iteration 1

Variables	Reachability Set	Antecedent Set	Intersection Set	Level
1	1,2,3,5,6,8,9	1,3,5,6,9,10	1,3,5,6,9	2 <sup>th</sup>
2	2,5,6,8,9,10	1,2,3,4,7	2	7 <sup>th</sup>
3	1,2,3,5,8	1,3,4,9,10	1,3	6 <sup>th</sup>
4	2,3,4,7,8,10	4,6,9	4	5 <sup>th</sup>
5	1,5,7,8,10	1,2,3,5,6,9	1,5	4 <sup>th</sup>
6	1,4,5,6,7,10	1,2,6,8,9	1,6	9 <sup>th</sup>
7	2,7,8,10	4,,5,6,7,9	7	3 <sup>rd</sup>
8	6,8	1,2,3,4,5,6,7,8,9,10	6,8	1 <sup>ST</sup>
9	1,3,4,5,6,7,8,9	1,2,9,10	1,9	8 <sup>th</sup>
10	1,3,8,9,10	2,4,5,6,7,10	10	10 <sup>th</sup>

**Table4.** Final Partitioning of Variables-Iteration 1

Level	No.	Variables
1	8	Relative cost benefit.
2	1	Waste elimination practice.
3	7	Quality of human resources.
4	5	Proper utilization of floor space.
5	4	Reduction in unnecessary inventory.
6	3	Minimizing the defect.
7	2	Green quality practice.
8	9	Creativity and Innovation.
9	6	Value addition.
10	10	Health and safety practice.

**Table 5:** Final list of Level Partitions**CONCLUSION**

Waste minimization, improving efficiency without effecting environment is the main objectives of lean green manufacturing system implementation.(Health and safety practice) has been ranked the most important factor as a result of survey analysis and (Relative cost benefit)has been identified as the most important bottom level factor in ISM hierarchy.

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