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Detection and Prioritization of Significant Issues in Green Lean System in Small and Medium Scale Manufacturing Industries

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Abstract

The purpose of this research is to investigate of significant supply chain menace factors exist in small scale manufacturing industries (SSI) in India. The small scale segment is a manifestation of India's socio-economic development model and has met with the country's long term expectations in terms of contribution to GDP, industrial base, employment and exports. This segment forms a major part of Indian industrial base. Small scale industries contribute about 10% of total GDP. The small scale industries are supported by the government and financial institutions like MSME, TIIC, SBI etc. in terms of technical and financial assistance. Even then MSE's are lagging in infrastructure, skilled labour. In order to analyse the various menace factors in SSI, the survey was conducted in 20 small scale industries who are supplying their product to many Tier 1 companies and leading automobile companies (OEM) in India. Lean philosophy of manufacturing focuses on waste reduction. Lean identifies some wastes namely over production, equipment breakdown, material shortages, yield loss, rework and scrap, non-optimal performance, changeover, material transport, material storage, inspection, delays, walking, idle time or waiting and excess inventory. Green manufacturing is an emerging philosophy of manufacturing aims to reduce the impact on environment. By using materials that are eco-friendly and by avoiding or reducing pollution to the maximum extent green manufacturing can be ensured and wherever possible the electric power can be produced with this renewable energy sources. Sustainable practices combine Lean Green methodologies. Green lean practices are successfully applied in large scale industries in India compared to small and medium scale industries. In this article the significant issues for green lean system execution in Small and Medium Scale Enterprises (SMEs) in India were studied using Customized Interpretive Structural Modeling and the necessary suggestions were made.

Keywords: GDP (Gross Domestic Product), SSI (Small scale industries), OEM (Original Equipment Manufacturer), Small and Medium Enterprises (SME) Environment Issues, Lean and Green Manufacturing, ISM.

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1. Introduction

Supply chain menace management (SCRM) is a field of escalating importance and is aimed at developing approaches to the detection, assessment, analysis and treatment of areas of Vulnerability and menace in supply chains. Vincent et.al (2012). Menace Management is an ongoing process that can help improve operations, prioritize resources, ensure regulatory compliance achieve performance targets, improve financial stability and ultimately, prevent loss/damage to the entity. Ragavan, R. (2005). In manufacturing lean philosophy is mainly focuses on waste reduction. Nowadays, several manufacturing companies must follow the all new technology and tools for efficiently and effectively to present themselves a good competitor in the global economy. Lean manufacturing is the basic techniques for improve the production rate with the minimum available resources. Toyota Production System is the inventor of

lean production techniques. Lean identifies some wastes namely Excess Inventory, Over Production, Equipment breakdown, Material shortages, Yield loss, Rework, and Scrap, Non-optimal performance, Changeover, Material transport, Material storage, Inspection, Delays, Walking and Idle time. Green manufacturing is an up-and-coming philosophy of manufacturing aims to reduce the impact on environment. By using materials that are eco-friendly and by avoiding or reducing pollution to the maximum extent Green Manufacturing can be ensured and wherever possible the electric power can be produced with this renewable energy sources. Sustainable practices combine Lean Green (LG) methodologies. LG practices are successfully applied in large industries. In India small scale industries are more compared to the medium and large scale industries. Now a days due to increase in cost of energy, increase in pollution, global warming, rules and regulation regarding green manufacturing, cheaper prize of competitors, so to sustain in this environment company should adopt lean and green concept. Hence the possibility of application of lean green techniques in small scale industries is to be studied and identified. It has provided employment to many and

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has stamped itself as a major revenue source for India. The generation of employment in SSI is five times that of large scale sector. But still the SSI face the supply chain issues from medium and large scale industries. The bullwhip effect is the major disruptions to SSI and has to be countered by the suppliers. Vincent et.al (2012).

2.Literature Review

Lean manufacturing is nothing but lean and manufacturing. Simply we can say that it is the lean value for industry and customer [1]. Subha [2] and Zhu, Q.H [3] aims to evolve sector-specific Lean Manufacturing Practices (LMP) with special reference to engineering goods manufacturing industries. They are duly validated to show how they would lead to higher volumes of production through minimum use of resources and thus achieve competitive advantage through operational benefits. Manoj Ade [4] suggests that Productivity improvement through Lean manufacturing means optimization and co-ordination of the input resources to minimize the wastes to reduce total production cost. Ramamoorthy [5] suggests implementing the lean manufacturing tools and techniques in the pump manufacturing premises for taking necessary steps to fulfill the customer demand and expectations. Hudli Mohd [6] describes the development of key areas which will be used to assess the adoption and execution of lean manufacturing practices. Ramesh V [7] discusses the simulation study carried out for proposing one-piece lean line layout with features of Lean Manufacturing. The lean initiatives that can be addressed are, introducing Kanban replenishment system, better work-in-process, changing the layout, visual management techniques, standardized work for the reduction of cycle time, number of workers and number of setups. Indian manufacturing industries are facing problem with less resources and this can be overcome by implementing lean manufacturing [8]. Now a day due to increasing pollution levels, energy consumption rate and waste generation, the pressure from government to become green is increasing and also there are some strict international rules and regulations regarding green supply chain management so rather than option it is mandatory to implement green technology in industries [9]. This analysis starts with the finding the important issues for lean and green execution in small and medium scale enterprises. From the pointed out issues, the new idea of Customized Interpretive Structural Modeling will be used for find out the significance of issues and stages of issues.

Issues in Lean and Green Execution

By means of the existing study and specialist recommendation significant issues for green lean execution have been finalised. The major ten significant issues has been finalised for this study on green lean execution in small and medium scale enterprises.

Healthy Management (HM): In successful execution

of green lean in industries the stability in management assurance is very vital element. Correct resolutions at the right time must be taken by management which is essential for green lean manufacturing.

Development of Thoughts (DT): Development of thoughts is necessity for motivation of the industry to execute green lean concept in the premises. It needs long term move towards as ecological impact created by industries has been for many years.

Expectation of Customer (EC): In order to increase the market share and to sustain long term connection with consumers, industries are to meet the consumer anticipation. Consumer is very vital for industries since lack of consumer demand regarding eco-friendly product will resist the producer to execute green lean technology.

Talent and Knowledge (TK): Higher level of execution of green lean manufacturing lead by elevated talent and knowledge. Talent and knowledge is one of the fences for small and medium scale enterprises for execution of new idea in industry.

Monetary Abilities (MA): One of the significant issues for successful execution of green lean is the monetary abilities of the industries. The most important problem for applying new idea is economic insufficiency which is desirable for worker training programs, outside consultancies charges, etc.

Teaching and Guidance (TG): To study the recent technology teaching and guidance helps the employees to develop their efficiency of the process. To execute green lean production concept teaching the people is always better.

Illumination Effectiveness (IE): Lightening in organizations use to take around sixty percent of electricity, for using day light changing normal and fluorescent bulbs with recent energy saver bulbs then around seventy five percent of electricity can be saved.

Choice of Material (CM): The very important footstep for green lean design is chosen of material since a product consists of numerous materials which have various level of impact on environment.

Participation of Dealer (PD): Participation of dealer is very necessary for green lean execution because dealer alliance will give better prizes to consumer and maintaining long term liaison with an industry and also it is more important for high-quality with timely deliverance.

Assistance by Government (AG): To defeat lack of news and major speculation government can assist by educating the people for minimizing the barriers in execution of green lean manufacturing.

3. Supply Chain menace factors in SSI:

3.1 Supplier menace

Suppliers are the backbone of any industries. The quality and on-time delivery is the order of the day. The frequent supplier visits enable to access supplier facilities such as capacity, machinery, processes, product lines, Quality management systems, etc. Chris Ellegaard (2008). Supply side menaces happening mainly due to suppliers, supplier relationships, and supply networks. These include supplier business menaces, production capacity constraints on the supply market, quality problems, and changes in technology and product design was among the first who emphasized that firms should proactively involve and manage the uncertainties in their supplier portfolio in order to guard against costly supply. Another type of disruption occurs when a supplier is vertically integrated by a direct competitor of the customer. The inability of suppliers to adapt to technological or product design changes may have harmful effects on the customer's costs and competitiveness. Wagner et.al (2008). Supplier development, for instance, involves upgrading of suppliers' process capabilities, educating supplier personnel, investing in supplier processes, and placing buying company personnel for extended time periods at supplier facilities Chris Ellegaard (2008). Supplier dependence has been viewed as the one of the major uncertainty and shall be avoided by multisourcing. Wagner et.al (2008).

3.2 Production Menace

Majority of the small scale units use old techniques of production and outdated machinery and equipment. They cannot afford new machines and equipments and are therefore not in the position use latest techniques of production. Therefore productivity and quality in SSI tends to be low while unit cost of production is generally high. Lack of communication problem between the owner and worker affects the rate of production to a large extent. Vincent et.al (2012). There is often a fluctuation of demand for any manufacturing products. In some cases, the OEM may give bulk orders to SSI. But the SSI could not keep up with the demand as there is a shortage of labourers. In sometimes there may be shortage of orders from the OEM or Tier 1 Company which results in less amount of work to the SSI. Moreover, the SSI uses old form of production techniques which is generally not encouraged in this competitive scenario and it will not increase the production rate. Lack of professionals in production area, leads to irregular monitoring of work schedule and line area Jorn-Henrik et.al (2011) The SSI is not updated with modern technological machines like CNC, EDM, etc. Lack of preventive maintenance frequently affects production of SSI. SMEs give less attention to planning and control methods mainly in the absence of expertise and knowledge on latest concepts in manufacturing. Jitesh Thakkar et.al (2013). World class manufacturing includes the best practices, inter alia, in the fields of lean

manufacturing, quality improvement and supply chain management. Many researchers have noted the growing number of World class Manufacturing tools under the lean manufacturing and quality improvement umbrellas, as well as the supply chain management (SCM) and enterprise resource planning (ERP) tools for enterprise-wide co-ordination and improvement.

3.3 Labour Menace

The fluctuation of demand forces the SSI to have only a limited number of permanent labours, thus employing casual labour. The SSI are not able to meet out the demands of the labourers as they expect high salary which cannot be met out by the SSI. Most of the SSI have to give allowances like rent, food etc. which affects their profit very badly. SSI should satisfy the bonus demands made by the workers. The workers prefer MNC because they find it better for their Self-esteem and also they are provided with good food, transport and a better work environment. Vincent et.al (2012), moreover, their timings are fixed but in SSI the work pressure is more and hectic. Supervisor of Y Company explained, "We are not able to hold a labour for more than 2 years even we provide additional allowances and it goes in vain. As growth prospects are very limited in SME sector, it is prone to high degree of employee turnover and this may involve lot of wastage of manpower and additional cost in the form of training and knowledge updation, affecting continuity besides lowering the productivity. Qualified and experienced personnel may not stay long as they may gain some experience and change employment. Ragavan, R.(2005). As labour being the major problem faced by the MSEs in India, they can be solved by giving good salary, bonus, providing medical facilities etc. This will help in improving the percentage of retention and also makes the worker to have a mind set to work in a SSI or a long period. The government should provide flexible policies for repayment of loans to SSI. Vincent et.al (2012)

4. Methodology

Based on literature survey and discussion with few SSI owners, the questionnaire was prepared with 5 point likert scale having options of 1-Poor, 2-Low, 3-Medium, 4-High, 5-Very high. Totally, 200 numbers of questionnaires were circulated to 20 manufacturing SSI companies in the level of owners, Managers, Quality Inspectors and supervisors in each company. The 35 responses were received with response rate of 17.5%. Then questionnaire was coded by likert scale and analysed using SPSS (Statistical package for social science). The supply chain menace factors and its items are analysed by descriptive statistics using SPSS.

4.1. Revised Interpretive Structural Modeling

Revised Interpretive Structural Modeling method by initiating two more new constraints E and F were suggested earlier. In this article A, B, C, D, E, F symbols have been used to indicate the direction of

relationship between k^{th} row issues with respect to m^{th} column issues are as follows.

Issue k may be influencing issue m majorly

Issue m may be influencing issue k majorly

Issues k and m may help to attain each other -C

Issues k and m are unrelated

Issue k may be influencing issue m

Issue m may be influencing issue k

In methodology the steps are involved like describe problem and its objective, select issues for described problem; create a Structural Self-Interaction Matrix (SSIM) of issues by showing the pair-wise relations between the elements and level division of issues.

4.2. Structural Self-Interaction Matrix

A SSIM is created by correlating k^{th} row with respect to m^{th} column issue and thus their pairwise relationships have been converted into A, B, C, D, E, F symbols which gives the results like, when (k, m) entry in SSIM is A, then (m, k) entry may comes as B, if (k, m) entry in SSIM is B, then (m, k) entry may comes as A, if (k, m) entry in SSIM is C, then (m, k) entry may comes as C, if (k, m) entry in SSIM is D, then (m, k) entry may comes as D, if (k, m) entry in SSIM is E, then (m, k) entry may comes as F and while (k, m) entry in SSIM is F, then (m, k) entry may comes as E.

4.3. Reachability Matrix (RM)

The SSIM has been converted into reachability matrix by assigning numerical values to SSIM. In reachability matrix A, B, C, D, E and F have been substituted by 4, 3, 2, 1 and 0 as per the given case which gives the results as follows. When (k, m) entry in SSIM is A means its entry in RM becomes 0 and (m, k) entry becomes 1, if (k, m) entry in SSIM is B means its entry in RM becomes 1 and (m, k) entry becomes 0, if (k, m) entry in the SSIM is C means its entry in RM becomes 2 and (m, k) entry also becomes 2, if (k, m) entry in SSIM is D means its entry in the RM becomes 4 and (m, entry becomes 1 and if (k, m) entry in SSIM is E means its entry in RM becomes 3 and (m, k) entry becomes 4. Similarly if (k, m) entry in SSIM is F means its entry in RM becomes 0 and (m, k) entry may becomes 3.

4.4. Division Rank

Reachability and precursor set for each issue was found using reachability matrix. It consists of other issues which are driven by these issues, which may help to attain that issue, are listed in a precursor set. The connection of precursor and reachability sets is resultant for all issues. First level was allocated to the issues for which the reachability, precursor and the connection sets were the same. Issues which are coming under first level helped by issues of other level to attain and would not help any other issues to attain above their own level. After the identification top-level issues it has been removed from the remaining variables sets. From the analysis it was seen that Development of

Thoughts (DT), Talent and Knowledge (TK), Illumination Effectiveness (IE) are found in the top level which was obtained by Customized Interpretive Structural Modeling.

5. Results and Discussion

The customized Hierarchy Model using ISM is shown in the following figure. Based on this method the analysis was done and the results were obtained.



Figure I
Customized Hierarchy Model using ISM

To explore the level of issues after deciding the significant accomplishment issues for execution of green lean idea, Customized Interpretive Structural Modelling was implemented which states that the government assistance is most vital for execution of green lean manufacturing. And also it's clear that the government assistance must facilitate to accomplish other issues and thus lend a hand in easy execution of green lean more over another significant issues are financial ability and well management with good leadership.

6. Conclusions

Based on the above study and analysis the following conclusions were made.

1. Lean execution is the main tool to prolong in the competitive market for reducing the cost, producing quality of product and reducing time to market.
2. The significant success issues for execution of green lean system in small and medium scale enterprises. The main barrier for green lean execution is lack of government assistant.
3. If the people are not familiar with green lean manufacturing then teaching them by the government as it gives results into easy execution of both lean and green manufacturing.
4. Mainly lean and green are needed for high investment to establish, so that if the government will helps by means of funding then automatically lean and green idea may be executed in all small and medium scale enterprises.

This research may further extended in many industries in dissimilar areas of manufacturing for getting more examinations for green lean execution. This extensive study identifies the significant supply chain menace factors faced by SSI in India such as lack of banking support, lack of computer network facilities, Machine breakdown. Irrespective of different menace factors, SSI has to satisfy the requirement of OEM and Tier I by sacrificing its profit to have good relationship with them. The labour issues could be solved by providing sufficient salary, bonus, incentives, food and other perks for all employee including long service causal labour. The SSI should adopt 5S, KAIZEN to improve quality, production rate and safety. OEM and Tier1 has to conduct regular audit on them to avoid supply delay, improve quality and also make them to achieve less than 100 PPM. OEM and Tier 1 have to train the SSI in the latest quality production techniques such as lean, agile manufacturing etc., The government should monitor the growth of the SSI and should bring in new schemes to develop the infrastructure required by the customers and also to provide uninterrupted power supply.

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