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Lean practices and supply chain trends in Indian auto industry

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Abstract
Purpose: This paper focuses on studying existing supply chain management trends in SME's of Indian Auto Industry and its preparedness to adopt lean supply chain management practices.
Design/Methodology/Approach: The study is based on capturing the qualitative data through interviews during company visits and quantitative data collected by means of questionnaire response building. A case study approach is used to understand the lean practices that are adopted in the auto Industry.
Findings: The trends of supply chain practices in Auto Industry considering various stakeholders and business practices used across entire value chain are more or less uniform. The SME's by their capacity and constraints are more or less governed by OEM's and Tier I suppliers. The Tier 1 suppliers play major role in binding the SME's due to the fact that OEM's are interested in buying the complete assembly from Tier 1 suppliers barring few cases. While the culture of lean supply chain management is need of the hour, the industry maturity is reached only up to lean manufacturing or operational excellence at own premises as far as SME's are concerned.
Research Limitations / implications: The focus of study is limited to Teir 1 & Tier 2 suppliers of 4 big OEM players viz. Mahindra & Mahindra, Bajaj, Tata Motors and Maruti Udyog limited. The scope is to identify existence of lean practices across the entire value chain of supply chain.
Practical implications: Although supply chain management is getting prime importance in today's business world, penetration of best SCM practices is far away from reality. While the intent of SME's is always to adopt good practices, they are so much bogged down by their day to day activities and confined by limited resources that SCM participants at the far end of the value chain do not add much value thereby losing its rigour.

Keywords: OEM, Auto Industry, SME's, SCM

1. Introduction
Over past few years the Indian Auto Industry has seen the boom in the market and similar trend will continue for few more years to come. While the industry is becoming more competitive and demanding, the players are finding new ways to earn their pie. No wonder, global scenario is also experiencing the same pressure and hence low cost manufacturing base is the destination for OEM. That is where developing countries like India and China are getting the advantage of the situation. With digitization of technology on the forefront and expectations of customer for more sophisticated features like increased fuel efficiency, longer vehicle life, better performance, the OEM's are always finding challenge to fulfill the customer's demand of having power packed features in the vehicle at most competitive price. Since operational excellence at organizational level is considered as a hygiene factor these days, the industry is now looking for optimizing& enabling the processes, consolidating business entities, leveraging on expertise of partners and make the entire value chain lean and agile. Essentially this means looking at the process that cut across the various organizations that are the backbone of the industry. Supply Chain Management is one of the areas that play a vital role in the entire dynamics of the industry. Supply Chain Management is evolved over the years and is looked at as a strategic business function rather than looking to it as a logistics and distribution function. No wonder these days lean manufacturing has become necessity and is practiced by each and every organization, big or small that constitutes the part of value chain.

Different industries have different peculiarities and issues by nature of its operations, customer needs, global reach and industry maturity (Niranjan Mudholkar, Editor& Chief community officer, www.machinist.in). Thus supply chain management although a common business function applicable to each industry the practices and processes that are followed within the industry do vary across each domain.

The Government of India is obliged to strengthen the SME's that are the backbone of countries economy. National Productivity Council is apex organization oriented to promote productivity in all sectors of Indian economy (http://www.npcindia.gov.in/). This is an autonomous non-profit body established under Ministry of Industry, Govt of India 1958. The council offers various services in the area of consultancy, training, research, productivity and promotion and other International services. The idea is to enhance productivity for improved triple bottom line. Under this council, Lean Manufacturing Competitiveness Scheme (LMCS), for Micro, Small and Medium Enterprises is practiced. Several sectors are selected where this scheme can be promoted by OEM (in case of auto), primary manufacturer (in case of pharmaceutical) etc. A financial support by Govt. of India upto a maximum of 80% of consultant fees for each Mini Cluster is provided. The remaining 20% to be borne by beneficiaries of MSMEs. Major OEM's are found to be the beneficiary of these initiatives. In addition, Ministry of Heavy Industries and Public Enterprises has come up with the Automotive Mission Plan (2006-2016) to boost the Automobile industry. Especially Maruti Suzuki India Ltd has taken a benefit of this and has helped many suppliers to establish their facilities in DELHI NCR region. Considering these facts, the paper discusses the lean supply chain management practices amongst the SME's that are contributing to 4 big OEM's that are established under this scheme. The research is not only limited to the operational excellence that is practiced inside the organization but it tries to study lean practices that are established across the supply chain.

2. Literature Review

The automobile industry has matured over a period of time and has established its working model by creating an ecosystem that is complimentary to both suppliers as well as customers. However Kehoe and Boughton (2001) have observed that the power within the auto sector lies very much within the brand owners rather than with the dealers or the first or second tier suppliers. That is why OEMs dictate their terms on smaller partners. It is well known fact that most of the SME's are governed by the big players and to certain extent exploited by them because of their inability to develop the business model with big giants (Arend and Wisner, 2005).

Pertaining to Indian auto industry, literature review reveals that SME's play a secondary role when it comes to tying up with the value chain even though it is a well-known fact that they are very important part of entire supply chain. Some of the issues gathered from literature review about Indian SME's are:

Sr #	Problems	Reference
1.	Customers are demanding more of modular products but this has not yet been started because of inadequate infrastructure and preparedness on the side of local suppliers	Jitesh Thakker *et al*, 2013
2.	It is observed that the Indian industry, on an average, maintains an inventory turnover of 10.9 turns for raw materials and 22.7 turns for finished goods in the supply chain, which is very high as compared to global standards	Sahay *et al*. 2003
3.	The downstream constituents of the supply chain namely carrying and forwarding agents (CFAs), distributors, and retailers are major carriers of inventories. There is no strict control on these inventories	Sahay *et al*. 2003
4.	Some of the peculiarities of Indian automobile sector are: large number of auto assemblers, low-technological capability, poor quality, lack of reliability in terms of delivery, large number of players in automobile component sectors, small capacity of auto-ancillary firms leading to shortages and lack of availability of components, and lack of partnership among partners in the SC.	Sahay *et al*. 2003
5.	Missing Balance Score Card View of SCM for SME's : Finance, Customer, Learning & Growth, Internal Processes	Brewer and Speh (2000)
6.	The missing clarity on SCM is bottleneck in SME industry. Purchase department was renamed as supply chain department.	JiteshThakker *et al*, 2013
7.	Automation of SCM partners is a still not a reality. (Small players can think of e-Nagare is an electronic version of Kanban) system	ParikshitCharan Summary
8.	SME's Lack of familiarity with the technology and its benefits, and barriers related to high costs and security concerns were found to be significant	(Tiessen *et al*., 2001).
9.	The E-commerce has created new opportunities and challenges in the sales and procurement of the product and its components. Trust is necessary for information sharing among the various partners of a supply chain	RanjanTayal, 2013
10.	Most ERP solution providers extended their suites to include basic reporting and analytics rather than having dedicated BI solutions for SMEs.	RanjanTayal, 2013
11.	Missing holistic view of SCM and Performance Measurement	(Saad and Patel, 2006).
12.	Disparity in trading partner's capabilities	ParikshitCharan Summary
13.	SME's do not have enough resources to employ at various stages of the chain and hence often concentrate on individual components for optimising their internal operations	NiranjanMudholkar
14.	Each industry vertical has a unique set of issues	NiranjanMudholkar
15.	SMEs in general are not able to implement SCM to its full extent, mainly because	(Arend and Wisner, 2005

	they are managed at arm's length by larger customers and have to follow the norms stipulated by the buyer	
16.	Significant gap between SMEs and LEs with respect to implementation of state-of-the-art tools and systems supporting effective and competitive supply chains.	Arend and Wisner, 2004
17.	Missing Organisation culture: To create a sustainable supply chain and sourcing process means having a clear business code of conduct - a standard set of rules that is geared towards improving a company's triple-bottom-line: PEOPLE, PLANET AND PROFIT. Every effort or initiative should contribute to protecting the people and preserving natural resources while ensuring revenues remain intact.	firstcarbonsolutions.com
18.	Missing Communication: Communication seems to be a key tool for ensuring the efficiency of supply chain of cooperation as perceived by SME	HieuguyenTrung MekdesBelihu
19.	SME perceives that the usual difficulties they confront are less bargaining power, barriers to satisfy new demands from customers and the change in customers' decisions.	HieuguyenTrung MekdesBelihu
20.	The management structure in SMEs is often lacking specific departments and employees have multifunctional roles, working in many different situations and less clear assigned responsibility (Bodin, 2000). There is low degree of job specialization with more generalists. The coporation of different functions is not clearly seen in SMEs, because functions are less specialized and less likely to be separated by physical and organizational distance	Bodin, 2000).
21.	A majority of respondents, around 45%, put Inventory Reduction in the top slot in their list of supply chain issues. This was also corroborated by the fact that around 70% of respondents were carrying more than 30 days of inventory. Supplier management came second at 40%, while working capital reduction came third at 17%. Indian industries are in need of optimization tools and better process modeling in order to exploit available resources and sustain lean operations	cgn-Business Performance Consulting, 2009
22.	Demand planning was found to be another area offering scope for improvement, as around Demand planning applications that are presently available are not designed to respond to the real-time needs of today's fast-paced market. They are neither precise nor responsive enough to drive programs such as "the perfect order," "just-in-time" or "lean."40% of respondents said that mismatch between forecast and actual production is in the range of 20% to 40%. This area has good potential for improvement through the introduction of demand planning using statistical methods.	cgn-Business Performance Consulting, 2009
23.	The primary differences between large firms and SMEs are in the scope of information and product flows. Large firms have a much larger scope for these flows, through the complex relationship requirements within their supply chains. Large enterprises may formalize their documentation system practices and tend to be more timely in exploiting available technologies, in contrast to SMEs.	(Lambert and Cooper, 2000; Powell, 1995; Tsang and Antony, 2001
24.	Superior features and quality, as well as superior customer service, are ways that SMEs often use to differentiate their products and services from those of the more commoditized	(Porter, 1985).
25.	Supply chain inefficiency is one of the most prevalent issues facing the small-to-mid-size enterprise	(Lewis, 2005).
26.	Supply and process costs represent 30 per cent of an average manufacturing SME's budget and logistics cost incurs about 40 per cent of total supply spending. On the other side, SMEs are now more and more taking part in the global business network participating in many interlinked supply chains (Hvolby and Trienekens, 2002). But sustainability and ability to meet changing needs for SMEs are questionable when they do not have much flexibility in setting prices being a supplier to large organizations and for this, streamlining of their supply chain activities becomes equally important.	(Jonh and Riley, 1985)
27.	SMEs do not have the means to conduct detailed analysis nor do they have the time or resources to take away from day-to-day business	Wagner *et al*., 2003
28.	Management of risk across the supply chain is key to business sustenance and continued profitability.	cgn-Business Performance Consulting, 2009

The above facts initiate the need to go into the deep of the issues and identify the health of SME's in auto industry. Couple of papers are available in the Indian context as far as Supply chain issues are concerned. However literature review does not mention about the trends of different OEM's and their supply chain practices with respect to their suppliers.

3. Research Methodology

This paper will use exploratory research method to understand the core issues of SME's and their contribution to the entire supply chain of Auto Industry. The exploratory research will help to analyze the practices that are adopted in a particular region, by a particular OEM. The exploratory research will also help to formalize the theory and identify the constraints that will formulate the hypothesis for further research. Once the analysis of these practices is done, the instrument in form of questionnaire can be floated to do the quantitative analysis of the problem to understand the detail working model of these OEM's and study the various trends

with respect to SME's customer sensitivity, SME's operational excellence issues, and SME's preparedness to move towards lean and agile framework.

A case study base approach is the most advisable since it involves discussing with the real practitioners in a most natural manner and identify the real and unnoticed facts and experiences (Eisenhardt, 1989; Meredith, 1998). Multiple case studies are discussed in the paper to ensure that the facts and analysis are validated with sufficient data (Voss *et al* 2002). The selection of case study for the purpose of this paper ensures the spread of Auto manufacturers mostly in Maharashtra region. However Maruti Udyog Limited is added to the scope since it is a leading passenger car manufacturer with proven industry bench mark practices. The trends of other OEM's can hence be better compared.

The researcher has selected following Auto industry players

1. OEM Manufacturer (1), Aurangabad
2. OEM Manufacturer (2), Nashik
3. OEM Manufacturer (3), Pune
4. Maruti Udyog Limited, Gurgaon

No major thrust is given on studying the practices of OEM since the scope is limited to SME's of Auto Industry. Hence the starting point is Tier I suppliers and upstream thereon.

The initial meetings happened with the senior management of tier I company who are decision makers and can influence the tier II and tier III companies. The first visit consisted of introduction of Tier I organization, followed by plant visit to understand the linkages between OEM, tier I and tier II (SME's) companies. This was followed by visiting the tier II, tier III companies to know the ground realities and operational practices that are followed in the different regions of auto industry.

CASE 1

OEM1 group is diversified into many areas that include automobiles, home appliances, lighting, iron and steel, insurance, travel and finance. OEM 1's one of the flagship group is into the business of manufacturing two wheelers and three wheelers and is well known across various countries like Latin America, Africa, Middle East & South East Asia. This group has three plants viz Waluj, Chakan and Pant Nagar.

The plantwise production for the year 2013-14 is as below

Plant-wise capacities (in numbers) and product range

Plant	FY2014		Product Range
Waluj	Motorcycles	2,100,000	Boxer, Platina, Discover, Pulsar and Three wheelers
	Three-wheelers	600,000	
	RE	60 60,000	
	Waluj subtotal	2,760,000	
Chakan		1,200,000	Pulsar, Avenger , Ninja and KTM
Pantnagar		1,800,000	Platina and Discover
Source : Annual report 13-14			

The facility at Waluj located in Aurangabad is mainly into manufacturing of Boxer, Platina, Discover, Pulsar and Three wheelers.

Working Model of OEM1 Ltd and Tier 1 supplier, Aurangabad

Tier 1 supplier Group located at Waluj, Aurangabad is a supplier to this OEM. This group diversifies into making of automotive components, sub-assemblies for two, three wheelers and four wheelers and caters to domestic as well as global market. The group has two main business units named as Polymers and Engineering. Till recently, the main focus of business was on capturing two and three wheeler market in India and abroad narrated the senior manager. With increasing market potential in four wheelers industry, tier 1 supplier is now concentrating on becoming a preferred supplier for 4 wheeler components as well.

Tier 1 supplier has realized the market competitiveness and pressures in terms of cost, quality and speed to market. Hence TPM, lean manufacturing, and automated manufacturing has now become the DNA of organization says quality manager. Other lean concepts like JIT, Pull system, MSMED, VSM are practiced as a part of culture.

Tier 1 supplier: Way of handling its Suppliers

During last decade, this Tier1 supplier was dealing with almost 300 to 500 suppliers to manufacture its product range. Most of the suppliers were small and medium scale industries located nearby tier 1 supplier and were thriving on it. With the market pressures and need to deliver the best quality products at most competitive rates, tier 1 supplier realized the need to rationalize its suppliers and rely on only those who can withstand the quality requirements of ISO 14001, TS 16949 certification. The company focused on optimizing manufacturing operations to the extent that one of their plants has secured "Gold" rating for manufacturing excellence from Frost & Sullivan adhering to global quality standards.

Tier 1 supplier, executives are proud in mentioning that KANBAN principle which is nervous system of "Lean Manufacturing" is applied to supply chain for internal material movement as well as shipment to customers ensuring maximum efficiency. JIT is followed with all major OEM's eliminating the inventories of components and sub-assemblies. For overseas customers, warehouse facilities located at their manufacturing locations ensures that supply is done on JIT basis. The executive further mentioned that in order to control the internal material flow, a system of two bin Kanban (PULL) is uniformly implemented across all the plants ensuring maximum efficiency, minimum cost and shortest possible lead times.

An interview with Group Associate Vice President (Corporate Materials) revealed that advanced supplier quality management system with real time visibility in suppliers processes and product quality is where 1 tier supplier is gaining the competitive position in the market. Tear down exercises to find out the root cause of quality issues going deep down to the supplier delivery and understanding the supplier issues, helps to benchmark the practices to ensure that supplier understands the quality expectations and thus owes the responsibility in making the final product. Further talks revealed that Supplier system assessments are carried out through audits to verify the supplier's quality management systems, manufacturing processes, material handling and compliance to overall specifications. Tier 1 supplier believes that supplier is a part of extended family and hence equally equips them with all the best practices.

. In this case, there exists a separate focus group on supplier upgradation that ensures use of best practices like TPM, lean manufacturing etc. so that supply chain partners inculcate the values of tier 1 supplier and add value to the final product. During interview it was noted that "Excellence Award Scheme" to appreciate supplier's efforts in achieving remarkable success in quality and adopting perfection is a motivation to all its suppliers.

The rationalization of suppliers was one of the exercises carried out to identify and support the suppliers that form the backbone of upstream Value Chain.

One such supplier who won the quality award at the hands of Managing Director of tier 1 supplier is Sanjay Techno Product. Located in the Waluj MDIC at Aurangabad, Sanjay Group manufactures motor cycle parts, mirror components, suspension parts. Certified with ISO/TS 16949 certification and having extremely efficient facility, the group processes 40 different types of engineering plastics. With recognition from government of Maharashtra in 2008: "Best Industry in District", Appreciation from tier 1 supplier Group, and First Price for work in 5s by Quality Circle forum of India, Sanjay Group has already created a benchmark in adopting quality processes amongst SME's. This talks about the ownership that small and medium scale industry is having towards the industry.

There is no dearth of problems in achieving the end results, says one of SME's chief. He stated that being SME, they are sandwiched between their suppliers as well as customer. While there customer, is in near vicinity and demands auto component on JIT basis, they are at the mercy of their supplier who is not in the vicinity and is the big player. This SME being quality conscious and driven by tier 1 supplier, cannot compromise on quality. Hence they source main raw material i.e. plastic from Reliance Industries, Hajira. Hajira plant being located far off from Aurangabad, many a times goods in transit are not locatable and hence create problem while fulfilling the orders on JIT basis. In order to avoid such situations, this SME has to keep a raw material inventory in anticipation of these issues.

The representative list of OEM1's supplier is as under.

- Sanjay Group
- Sanjeev Auto Parts
- Aurangabad Auto Ancillary P Ltd
- Automobile Products Of India Ltd
- Marathwada Auto Compo P Ltd.
- Bombay Industrial Enterprises

After discussions with few SME's in this region, it is evident that some of the typical problems that are bothering SME's are

1. Purchasing issues like on time delivery by supplier's supplier
2. Right quantity of material from supplier's supplier
3. Pilferage of inventory items
4. Lack of integrated process and systems view
5. Lack of IT systems
6. Lack of visibility on goods tracking during transit

CASE 2

OEM 2, headquartered in Mumbai has its plant in Nasik, manufacturing Xylo, Quanto, Bolero, Scorpio, Verito, XUV 500 etc. The average number of parts that goes in complete assembly of passenger car is in the range of 3000 to 5000. The major components are in form of assembly e.g Engines, brake system, transmission system, wheel assembly, electrical system & seat system and metal body etc. The seat assembly for OEM 2 passenger cars is provided by Tier 1 supplier who is the leading global supplier of automotive seating and electrical power management systems. This Tier 1 supplier has its plant situated in Nasik and nearby place Gonde and supplies the seat assembly to OEM 2 on Just in Time basis.

Working Model of OEM 2 & TIER 1 supplier 1, Nasik

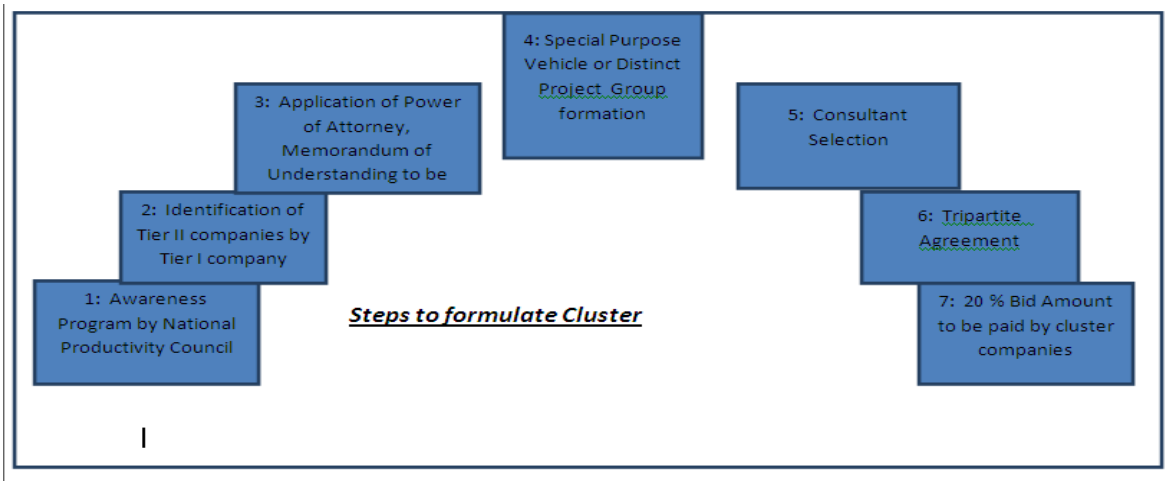
The initial discussion with Top management of Tier 1 supplier reveled that, OEM2 2 is situated in the vicinity of around 50kms. Over the years, the upstream operations between this OEM2 and tier 1 supplier are so evolved that production at supplier happens on the tunes of OEM. OEM shares the Production plan with supplier on the monthly basis depending on the market demand. This high level plan is then broken down into daily plan which is confirmed to supplier by automatic updates. This then decides batch size of that day which ensures that supply of seat assembly to OEM is on **JUST IN TIME** basis. Supplier has dedicated vehicle lined up for OEM so that as soon as seat assembly is ready it directly picks up them from line and loads them onto ever ready hungry assembly line of OEM thereby eliminating the inventory.

TIER 1 supplier Cluster: A Vehicle for integrating the SME's

Upon visiting Tier 1 supplier plant and few SME's nearby following information was gathered.

Tier 1 supplier in Nasik is heading the supplier cluster under the scheme of National Productivity Council since last few years. This cluster comprises of 25 to 30 small SME's. A typical framework required to formulate the cluster includes following steps.

Fig 1: Steps to formulate Cluster



The initial cluster activities during year 2009-2010 were carried out under WAVE I that formulated the working model of cluster. The thrust of cluster was on training, awareness and sustained quality improvement across all the SME's. This assisted tier II & tier III companies to understand the quality practices and adopt same in their organization. In addition to this, the SME's were assured of:

1. Sharing of Technology
2. Long term relationship
3. Training & Education on best practices from industry
4. Inclusion in a long value chain
5. Financial aid if needed and found to be promising

By now cluster had taken a very good shape and started showing the results in form of added value to the products and individual benefits to SME's in terms of waste minimization, increased productivity etc says senior manager of Tier 1 supplier. To continue the momentum and accelerate the growth of SME's. WAVE II of cluster was formed during the year 2014-2015. This supplier cluster is more mature and emphasizes on lean culture across all the partners.

As a part of cluster activities, Tier 1 supplier holds Monthly Management Review Meeting (MRM) with all their suppliers. The representative list of suppliers (cluster members) is given below.

S. No	Name of the Cluster Members	Nature of Business	Location
1	Soham Autotech Pvt Ltd	Seat frames, sheet metal parts, tubular parts	Nashik
2	Jhanvi Auto Mech	Press Component	Nashik
3	SI Inter- Pack	Foam Seat Covers	Nashik
4	ARS Auto Pvt Ltd	Mfg. of Auto Accessories.	Nashik
5	Rainbow Decoplas Pvt Ltd	Surface Finish	Nashik
6	Sterling Industries	Machining components	Nashik
7	Pratik Industries	Sheet metal parts and Engineering Job work	Nashik
8	Precision Auto Industries	Automobile components, Sheet metal parts, Automobile tubular parts	Nashik

Some of the facts gathered from Wave II MRM Cluster meetings and discussions with senior management are detailed below.

1. Lean Activity Calendar is prepared for the month. Some of the activities planned are
   a. *Training on TPM*
   b. *Red Tagging campaign*
   c. *Training on SMED*
   d. *Workshop on SPC*
   e. *5 S audit*
   f. *Training on Inventory Turns Ratio*
   g. *Training on Kaizen*
   h. *Training on 3 M*
2. Safety Audits are conducted on regular basis
3. 5 S Audits are conducted on regular basis
4. Training in the area VSM, SMED, 5s, SPC, TPM, Kaizen, Lean manufacturing are conducted on regular basis. The new employees are trained on this as a part of induction.
5. Red Tagging campaign is carried out on regular basis and action is taken accordingly
6. The data with respect to defects, process capability indices, customer complaints, cost of poor quality, labor productivity, on time delivery %, floor space utilization, kaizen, Overall Equipment Efficiency, VSM are captured and shared in the MRM meeting.
7. The monthly meetings are hosted by each company on rotation basis that gives a chance to every organization to show case their best practices.

The above facts indicate that tier II suppliers under cluster are now geared up to operate within the framework laid down by Supplier cluster. It is apparent that Lean is practiced within organization and focus is operational excellence.

Tier 1 supplier has plants at Halol and Chennai. While Halol plant supplies seats to General Motors, the plant at Chennai supplies seats to Nissan & Ford. However there is no concept of supplier cluster at these 2 locations.

Note: As in case of OEM 2 & its tier 1 supplier i.e. Case Study 2 mentioned above, where the existence of supplier

cluster is prominent and ensures that suppliers are geared up for taking various challenges in the industry, in case of OEM1 and its tier 1 supplier the formal supplier cluster is not seen.

CASE 3

OEM3 established in Pune during 1966 at Pimpri and Chinchwad manufactures Tata Indica and Tata Indigo in the category of passenger vehicles. The facility at these locations also design and manufacture sophisticated press tools, jigs, fixtures, gauges, metal pattern as well as models for development of new range of automobile products.

The passenger car division housed at this facility has five shops i.e. engine, transmission, press and body, paint shop, trim and final assembly shop. Latest technology implemented in all the shops ensures minimum error in the manufacturing processes. With every passing year, the OEM is offering world class products to every class of people across the globe. Latest launch being GenX Nano cars with Electrical Power Assisted Steering, latest design, Easy shift automated manual transmission, connectivity features etc is an example of value to the customer. One of the latest press release dated April 2015, tells Global wholesale of all passenger vehicles including Jaguar and Land Rover were at 51,021 nos higher by 6% compared to April 2014.

Working Model of OEM3 and Tier 1 supplier supplying Tyres

Tier 1 supplier, the flagship company of RPG group is one of the leading tyre manufacturing company in India having presence in global market. Right from light commercial vehicles, to trucks, to autorickshawas to earthmovers, to forklifts, to Tractors, to trailers, to Cars and to Motor cycle tier 1 supplier is the preferred name when it comes to TYRES, says Senior Manager Production. Having plants at Mumbai, Nashik, Halol catering to global needs around 110 countries in the world, RPG is creating additional capacity by setting up a new plant at Nagpur with investment of 400 crores. With daily production of 95000+ tyres, the company is first to get TUV certification in Tyre Industry. R & D specialist mentions that the company's focus on building best in class products through a culture of continuous innovation makes it more accountable when it comes to material development that is required for ensuring grip, safety and life of tyre. The company works closely with OEM to understand the needs of passenger vehicles that are at par with global standard. There exists a Automotive Tyre Manufacturing Association (ATMA) that collaborates all branded tyre companies and works continuously on innovation of product. A typical raw material that goes in making tyre consists of Natural rubber, Nylon Tyre Cord fabric, Carbon black, Rubber Chemicals, Butyl Rubber, PBR, SBR and some others.

Tier 1 supplier- Way of handling the Suppliers

In case of Tyre Industry the raw material is sourced from different locations. In fact 60 % of the raw materials are imported and remaining is purchased from different locations of India. The main constituent of Tyre, i.e. rubber comes from Thailand & Sri Lanka and others like Cord Fabric, Carbon Black comes from coutries like China, Indonesia.

The representative list of Raw material suppliers to Tier 1 supplier

Sl no	Company Name	Location	Raw Material
1	SRF Limited	Manali Gurgaon	TUFNYL brand of Polyamide 6 & Polyamide 66 engineering resins TUFBET brand of Polybutylene Terephthalate (PBT) engineering resins TUFPC brand of Polycarbonate (PC) engineering resins
2	RajashreePolYfill	Gujarat	Chord Fabric
3	PMC Rubber Chemicals	Kolkata	rubber chemicals covering Accelerators, Antioxidants, Antiozonants, Retarders &Peptisers
4	English Indian Clay	New Delhi	EICL has two key divisions, viz., "clay" and "starch".
5	Chetan Trading	Gujarat	Metal cutting & grinding tools
6	Modi Chemical	Gujarat	All types of chemicals like organic & inorganic chemicals, Mg0, Pigments And Recovered Solvents.....
7	Acmechem	Thane	Specialty Chemicals for Rubber which although used in small dosages but are critical inputs and where sources of such chemicals being very limited.
8	FlexilisPvt Ltd	Goregaon East	Natural Rubber, Synthetic Rubber, Chemicals, and Adhesives.
9	Philips Carbon Black	AndheriEst	Carbon black manufacturer
10	Dujodwala Resins	Mumbai	Gum Rosin, Oil of Turpentine and their derivatives.

After talking to SCM Manager of tier 1 supplier, it seems that the ecosystem of Tyre Industry which is a main product in Automobile is different than that of other tier I suppliers mentioned in case study 1 & 2. He mentioned, apart from main raw material i.e. natural Rubber coming from Sri Lanka and China, the domestic suppliers are even not in the close vicinity. Most of the raw material suppliers are in Gujarat, Mumbai, and Kerala. This does not allow tier 1 supplier to work on JIT principles that are applicable to tier 1 suppliers of case study 1 &2 which operates on per day production orders from OEM1 and OEM 2 respectively. In this case study, the tier 1 supplier operates in a conventional manner of producing the tyres based on economies of scale thus ending up in holding large inventory and at times selling it off to retail market at very low prices. Holding inventory always becomes an issue when OEM's production plans changes says the SCM Manager. Rationalization of suppliers, long term contract, and Economic Order Quantity purchase are the practices that are prevalent in this industry.

The typical problems faced by tier 1 supplier are:

1. Huge raw material & finished goods inventory
2. Logistics and transportation issues
3. Locational issues
4. Dependence on very few suppliers

Case 4

Maruti & Its Ecosystem

Maruti Suzuki India Ltd (MSIL), is one of the leading car manufacturer's in India with sale of more than 3.46 lacs of vehicle recorded in quarter 4, 2015 (From annual report MSIL). On 12th May 2015, the Company has rolled out its 15th million car on road (Press release 12th May). The company is proud to share its success that is dedicated to the journey of "Continuous Improvement".

Maruti Centre of Excellence: A way to practice Quality

Maruti Centre of Excellence, MACE plays a vital role in evangelizing the culture of Lean practices across the entire supplier network. The initiatives like "Quality Circle Competition", "Kaizen", 5s ensure competitive culture amongst the suppliers.

The representative list of MSIL supplier is as under

Sr No	Name of the company	Type of Supplier	Product Line
1	Bharat Seats	Tier I	Seat Frames, Four wheeler seating system, Two wheeler Seating System, Moulded Carpets, Two wheeler frames and sheet metal components, Muffler, Independent front suspension
2	Sharada Motors	Tier II	Supplier of a large variety of automotive seat covers to Bharat Seats Ltd (MarutiUdyog Ltd.).
3	SI Interpack	Tier II	Foam Seat Covers
4	Rico Auto Industries Ltd.,	Tier I	Products Manufactured: Engine: Oil Pump Assembly, Fuel System Parts, Exhaust Manifolds, Turbo Charger Parts, Flywheel Assembly, Main Bearing Caps, Balancs Shaft Assembly, Watter and Air Connections, Cylender Head Covers, Intake Manifolds Covers, Oil Pans, Cylender Block & Heads, Timing Case, Housing and Brackets; Transmission: Clutch Assembly, Case Differencials, Transmission Support Assembly, Gear Shift Forks; Chassis, Suspension and Braking Systems: Wheel Hub and Brake Panel Assembly, Drum and Roters, Steering Knuckles, Brackets etc.; Manufacturing and Engineering Capabilities-Machining & Assembly: Over 1000 CNC & Special Purpose Machines; Aluminium High Pressure Die Casting: Over 76 HPDC Machines(135 to 1800 tn Locking Force); Ferrous Casting: 4 Fully Automated Casting
5	Lumax Industries Limited,	Tier I	Products Manufactured: Electrical: Automotive Lighting Solutions (Head Lamps, Rear Combination Lamps, Side Indicator Lamps and Other Sundry Lamps), Suspensions: Two Wheeler Chassis & Sheet Metal Parts, Interior/Exterior: Plastic Trim Parts, Gear Shifter, Parking brake, Exhaust & Air Intake System, LED- Infrastructure light
6	Anand NVH Products Pvt. Ltd.,	Tier I	Products Manufactured: Anti Vibration Rubber & Rubber to Metal/Plastic Bonded Parts.
7	KiranUdyog	Tier I	Products Manufactured: Machined High Pressure Die Cast Components & Assemblies, Engine Components, Rocker Valve Cover, Front Cover, Transmission Components, Steering Rack & Pinion Housings, Worm Housings, Auto Electrical Components, Engine Brackets, Compressor & Alternator Mounting Brackets, L Covers, Cylinder Block, Cylinder Heads, Complete Wheel Assembly for Motorcycles & Scooters
8	Madhusudan Auto Ltd.,	Tier I	Products Manufactured: Mechanical Contol Cables, Transmission Shifting Systems and Alternate Fuel Systems
9	Mark Exhaust Systems Ltd., is	Tier I	Products Manufactured: Catalytic Convertors for Euro 3, 4 & 5, Exhaust Systems for Passenger Cars, Mufflers for 2 Wheelers, Door Sash and Rolled Section for Passenger Cars, EGR Pipes, Sheet Metal Parts and Assemblies
10	Roop Polymers Ltd.,	Tier I	Products Manufactured: Rubber & plastic molded components, Rubber & plastic extruded components, Rubber to metal bonded parts

The culture of Maruti is to encourage owning and grooming of the suppliers as per their requirements. The concept of "Full System Supply" ensures that all Tier I supplier weaves Tier II suppliers as well in the network instead of supplying each component separately. This also brings lot of accountability from Tier II suppliers.

MACE Quality Circle programs conduct extensive facility audits of tier I as well as tier II supplier. This ensures that quality is right at the source. This also reduces inspections at MSIL factory premises.

After talking with few of these suppliers, it is observed that "Maruti Production System" based on lean manufacturing principles is followed by all of them, making them tuned to the MSIL needs of lean supply chain and logistics management. Some of the best practices that suppliers have adopted are

- E-Nagare : An electronic flow of production plans from the vendors to Maruti's Shop floor
- Working with MSIL on the basis of 15 days of production plan
- Supplying the material during the night shift to reduce the traffic congestion
- Adopting milk run system to accommodate nearly 30

suppliers under one logistics company
- Understand world best practices in automobile industry through training and workshops

4.0 Data Analysis and Trends

A Questionnaire was floated to understand the overall business processes of SME's with respect to supply chain management and manufacturing processes. Emphasis was given to understand the maturity of quality processes and supply chain practices that are followed within the organization and across all the business entities across the value chain. Out of 34 suppliers who were contacted, only 12 suppliers returned with their answers.

The questionnaire had 4 parts

a. Brief Description of the SME's
b. Current challenges faced by the SME's
c. SME's and their customer sensitivity
d. Quality Practices adopted by SME's
e. Awareness of SME's in lean manufacturing

The following tables and graph shows the trends of above data captured through questionnaire

Table 1: Brief description of SME's

SR No	Name of the OEM	Tier I Supplier	Tier II supplier	What is the turnover of your company (Tier II)?	How many varieties of products do you have?	How many number of customers do you have for your product?
1	OEM 1	OEM1 – Tier 1 supplier	Supplier 1	> 40 Crores to <=100 Crores	>50	1 to 50
2	OEM 1	OEM1 - Tier 1 supplier	Supplier 2	> 60 Crores to <=100 Crores	1to 20	1 to 50
3	OEM 1	OEM1- Tier 1 supplier	Supplier 3	>100 crores	21 to 50	1 to 50
4	OEM 2	OEM2 - Tier 1 supplier	Supplier 1	> 1 Crore to <=5 Crores	1 to 50	1 to 50
5	OEM 2	OEM2 - Tier 1 supplier	Supplier 2	< 10 Crores to <=15 Crores	1 to 10	1
6	OEM 2	OEM2 - Tier 1 supplier	Supplier 3	< 10 Crores to <=15 Crores	1 to 10	1 to 50
7	OEM 2	OEM2 - Tier 1 supplier	Supplier 4	> 15 Crores to <= 40 Crores	1	2
8	OEM 3	OEM 3- Tier 1 supplier	Supplier 1	>100 crores	> 50	>150
9	OEM 3	OEM 3- Tier 1 supplier	Supplier 2	> 40 Crores to <=100 Crores	1 to 50	1 to 50
10	OEM 4	OEM 4- Tier 1 supplier	Supplier 1	> 15 Crores to <= 40 Crores	1 to 10	1 to 50
11	OEM 4	OEM 4- Tier 1 supplier	Supplier 2	> 15 Crores to <= 40 Crores	1 to 10	1 to 50
12	OEM 4	OEM 4- Tier 1 supplier	Supplier 3	> 15 Crores to <= 40 Crores	1 to 10	1 to 50

Table 2: Current Challenges faced by SME's

1	2	3	4	5	6	7	8
Tier II company	Do you hold Large WIP? Codes: 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree	Is High Production lead times (Cycle times) a concern to you Codes: 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5- strongly agree	Do you have issues in Making reliable delivery commitments Codes: 1-strongly disagree, 2-disagree, 3- neutral, 4-agree, 5- strongly agree	Does the supply of raw material quality a issue to your orgnisatopn Codes: 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5- strongly agree	Does the lead time from supplier a concern to your organisation Codes: 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5- strongly agree	Is reliability on supplier a concern to your organisation Codes: 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5- strongly agree	Is location of the supplier an issue to commit deliveries to the supplier Codes: 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree
OEM1 – Supplier 1	2	2	1	2	3	2	2
OEM1 – Supplier 2	2	2	1	2	3	2	2
OEM1 – Supplier 3	2	3	1	4	4	2	4
OEM 2 – Supplier 1	2	4	2	4	3	3	2

OEM 2 – Supplier 2	3	3	2	2	4	2	4
OEM 2 – Supplier 3	5	4	4	2	5	2	5
OEM 2 – Supplier 4	4	5	2	2	2	2	4
OEM 3- Supplier 1	4	4	1	4	5	2	4
OEM 3- Supplier 2	4	4	1	4	4	4	4
OEM 4 – Supplier 1	2	5	2	4	2	2	1
OEM 4 – Supplier 2	2	5	2	2	2	2	1
OEM 4 – Supplier 3	2	5	2	2	2	2	1

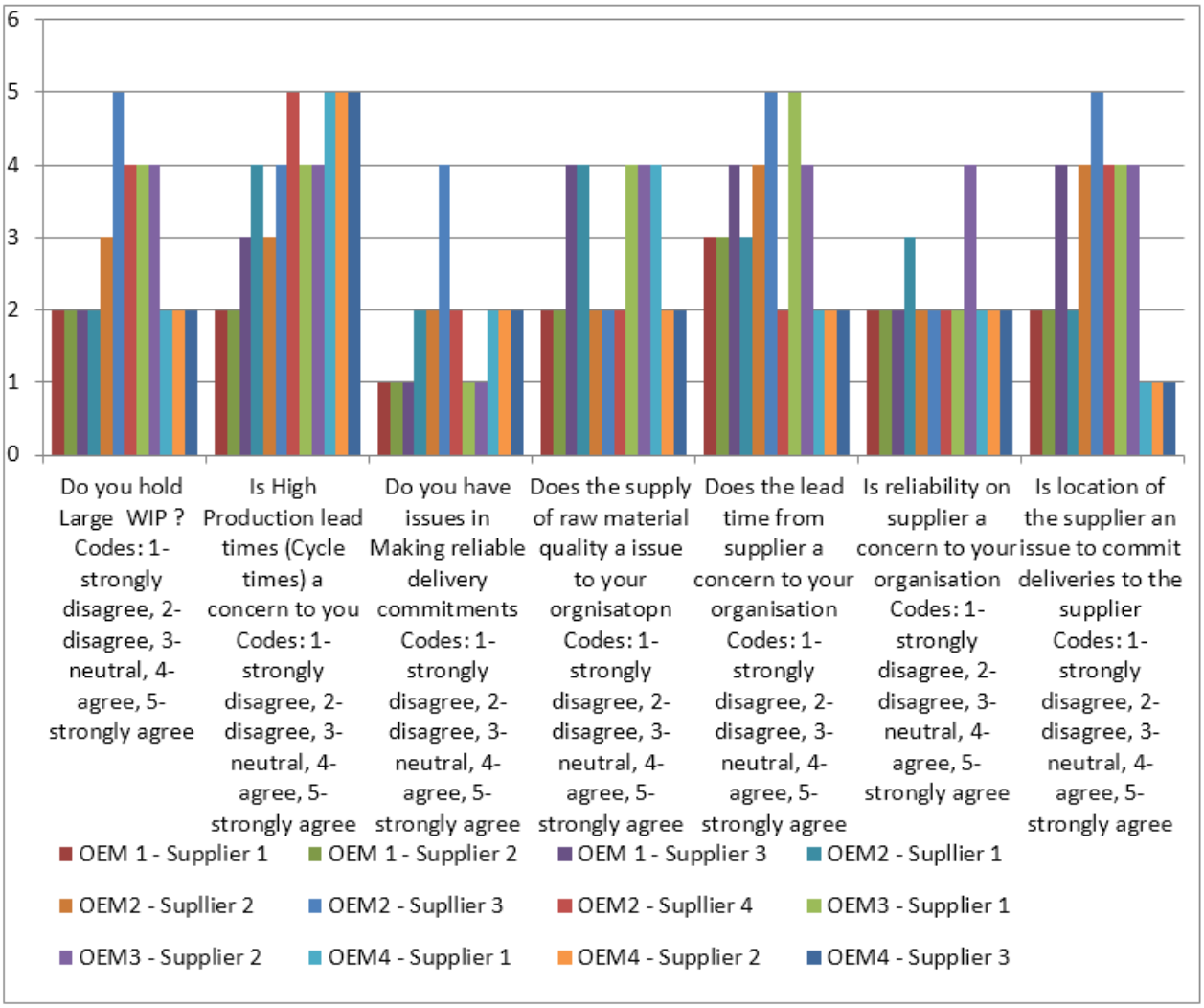


Fig. 2: The Graphical interpretation of current challenges faced by Organization

4.1 Analysis & Inference

A. The SME's residing in same region (nashik/Aurangabad/pune) & supplying raw materials to same OEM show similar trends

- All the SME's of tier 1 supplier in Aurangabad do not hold high inventory. This can be related with the fact that customers of these SME's are in the same location (barring few), allowing SME's to operate on Pull based system.
- All the SME's residing in Nasik Zone do hold considerable inventory as far as seat assembly is concerned. This may be related with the location of the supplier's feeding these SME's. Another reason why these SME's are holding considerable inventory is that they do supply the components to other tier I supplier situated out of Nashik e.g. SME's supplying to Tata Motors in Pune etc.
- In case of SME's of OEM3, where these SME's holds substantial inventory, the reason is clear that location of their suppliers is a constraint.
- SME's of MSIL shows they do not hold much of the inventory because their suppliers are located in nearby vicinity.

B. As far as delivery commitments to Tier I supplier is concerned, most of the SME's are consistently making delivery. This shows that SME's are sensitive to the customer requirements.

C. As far as quality of raw material is concerned, the trends show that it is a concern to the SME's of OEM3Tyres. This may be specific to the industry. In case of OEM1, OEM2 and Maruti, the raw material quality seems to be under control.

D. Lead time from the suppliers seems to be the issue except in case of Maruti. Supplier lead time and location of the customer seems to be related. The trends show that where-ever suppliers are away, lead time is a constraint and this is directly related with inventory holding. In case of Maruti, all factors are additive and hence shows healthy supply chain. These includes
   1. Suppliers are in the vicinity of OEM
   2. Even Suppliers supplier are nearby
   3. Suppliers supplier are governed by MACE

E. High production lead times seem to be a concern to all SME's. This can be related to the fact that while supply to OEM's is on JIT basis, production is batch specific adding to the inventory. It should be noted that OEM's are demanding complete assemblies rather than components. This can be one of the reasons that building of assembly takes a longer time and hence the high production lead times. Howeverall the efforts are made to adhere to customer demand.

F. Of all supply chains, Maruti Suzuki supply chain seems to be more reliable and mature. This is shown by the trends such as
   a. Low inventory holding
   b. Reliable delivery commitments
   c. Less issues with Raw material quality
   d. No constraints as far as lead time from supplier is concerned
   e. No locational constrains as far as suppliers are concerned.

Table 3: SME's and their Customer Sensitivity

Following Questions were asked to understand the SME's sensitivity towards customer needs

a. Name of Tier II company
b. From your customer's point of view, how would a "Predictability in Delivery Date" help them? In other words, if you could predict accurate delivery date at the time of accepting orders and your manufacturing facilities consistently kept these promises, will it benefit your customers? Codes: 1-strongly disagree, 2- disagree, 3- neutral, 4-agree, 5- strongly agree
c. From your customer's point of view, would a "Improved Quality" help them? Codes: 1-strongly disagree, 2- disagree, 3- neutral, 4-agree, 5- strongly agree
d. If your plant significantly cut down on the delivery required, would that be helpful to your customers? Codes: 1-strongly disagree, 2- disagree, 3- neutral, 4-agree, 5- strongly agree
e. Would it reduce instances of stock outs and the needs for customers to wait occasionally? Codes: 1-strongly disagree, 2- disagree, 3- neutral, 4-agree, 5- strongly agree
f. Would the less instances of stock outs help your company reduce lost sales and retain more customers? Codes: 1-strongly disagree, 2- disagree, 3- neutral, 4-agree, 5- strongly agree
g. Would it demand more needs to expedite the manufacturing set up? Codes: 1-strongly disagree, 2- disagree, 3- neutral, 4-agree, 5- strongly agree

The response to the above questions is collated as under

Table 3: Current Challenges faced by SME's

a	b	c	d	e	f	g
OEM1 – Supplier 1	5	5	2	4	2	4
OEM1 – Supplier 2	5	5	4	4	4	4
OEM1 – Supplier 3	5	5	4	4	4	4
OEM 2 – Supplier 1	5	5	2	3	4	3
OEM 2 – Supplier 2	4	4	4	2	2	3
OEM 2 – Supplier 3	5	5	5	5	5	2
OEM 2 – Supplier 4	4	5	4	4	4	2
OEM 3- Supplier 1	5	5	4	4	4	4
OEM 3- Supplier 2	5	5	4	4	4	4
OEM 4 – Supplier 1	4	5	4	4	4	4
OEM 4 – Supplier 2	4	5	4	4	4	4
OEM 4 – Supplier 3	4	5	4	4	4	4

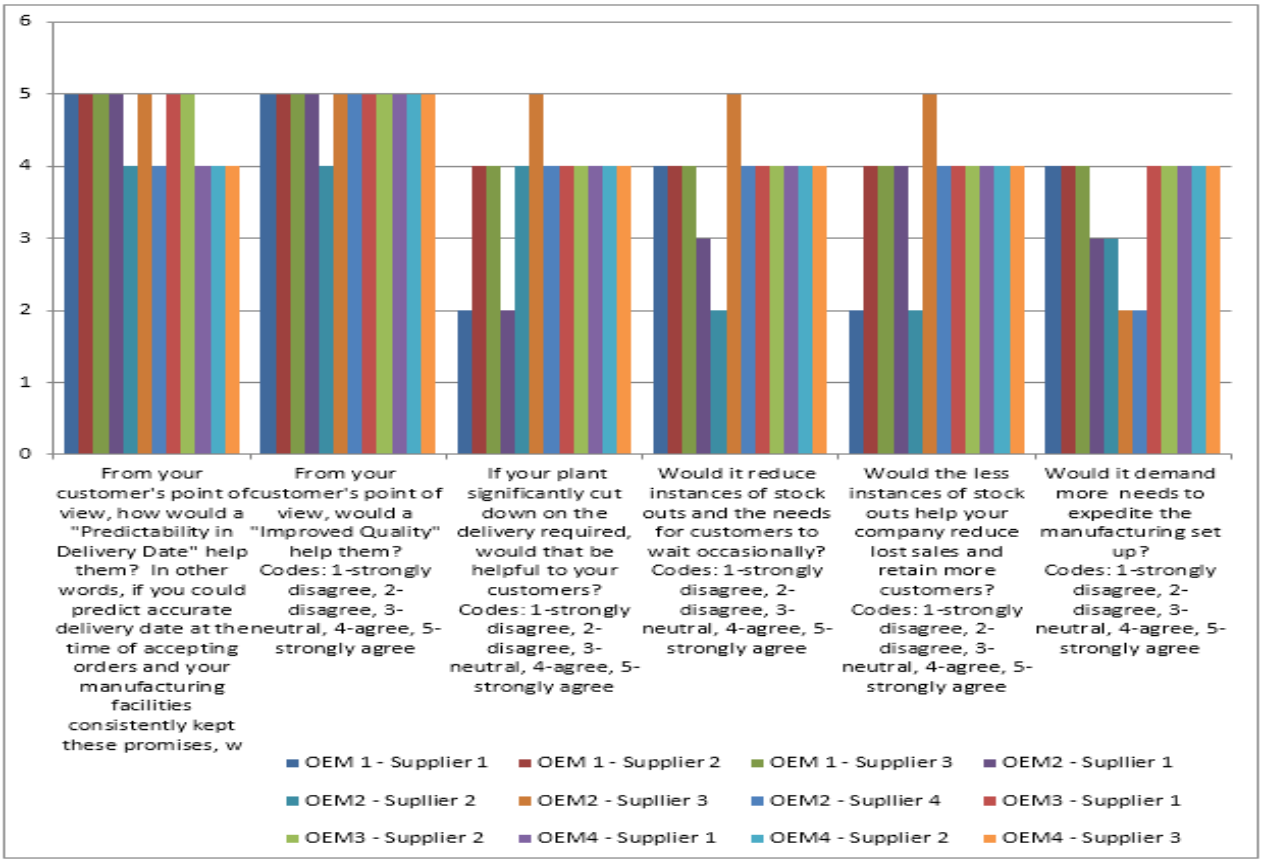


Fig. 3: Graphical representation of SME's and their Customer Sensitivity

4.2 Analysis & Inference

The above trends shows that as far as sensitivity to customer needs are concerned, the SME's are highly aware of the same and want to fulfill customer needs on highest priority. The areas of concern as voiced by SME's are:

- Predictability in delivery date
- Need for improved quality

Predicting accurate delivery date to customer is related with external factors like location of supplier's supplier, non-availability of information on Goods in Transit, supplier's capability to supply right quantity. This may need a intelligent GPS system to track the goods in transit which will provide most updated information to the SME's thereby making their production schedule on real time.

Need for improved quality is operational excellence issue that can be perfected through continuous improvement programs in the companies. However right quality at source can also improve the overall product quality. The models adopted by Maruti is the best examples to have tier II and tier III suppliers tightly integrated in overall value chain.

Cutting down of production lead times in order to fasten the delivery takes a back seat. The spirit of Lean principle to produce right quantity at right time and at right place is thus compromised at the cost of having huge inventory in order to satisfy the customer.

The less instance of stock out is never a scenario with SME's since they store enough to deliver the customer order. This again is contradictory to lean principles and hence needs change in SME's working.

Taking a deep dive approach in understanding the quality practices that are followed in Auto industry the following is the scene.

Table 4: Quality Practices

Following Questions were asked to understand the quality practices adopted by SME's

A. Tier II company

B. Has your company been certified by one or more of the following standards? Please tick more than one box if appropriate

1. ISO/TS 16949 2. ISO 9001:2000 3. ISO 14001:1996 4. Any other, please mention

C. What major challenges (e.g. competition) is your company facing at present?

1. Process Challenges 2. Quality Challenges 3. Challenges on Supplier side 4. Challenges on Customer side

D. Purchasing issues like

1. Reliability 2. On time 3. Right Qty 4. Right Quality

E. E What best practices you follow from the Industry for your Supply Chain Management

Table 4: Quality Practices adopted by SME's

A	B	C	D	E
OEM1 – Supplier 1	ISO/TS 16949	1. Process Challenges 2. Quality Challenges	Right quantity	Inventory Management Releasing Schedule time to time, Continous Interaction With Suppler
OEM1 – Supplier 2	ISO/TS 16949 ISO 9001/2000	1. Quality Challenges	Right quantity	Inventory Management Releasing Schedule time to time, Continous Interaction With Suppler, PokaYoka
OEM1 – Supplier 3	ISO 9001/2000	1. Process Challenges 2. Quality Challenges	Right quantity	TPM, 5 S
OEM 2 – Supplier 1	1. ISO/TS 16949	3. Challenges on Supplier side	On time	JIT - FIFO
OEM 2 – Supplier 2	1. ISO/TS 16949	--------	On time	We following all guideline as per process manual of SCM.
OEM 2 – Supplier 3	ISO 9001:2000	challenges on customer side	On time	maintaining minimum inventry level and successfully using the KANBAN system
OEM 2 – Supplier 4	ISO 9001:2008	1. Process Challenges	Reliability	
OEM 3- Supplier 1	ISO 14000, ISO 18000	1. Process Challenges 2. Quality Challenges	Right quantity	TQM
OEM 3- Supplier 2	ISO 9001:2008	1. Process Challenges 2. Quality Challenges	Right quantity	Kaizen, 5 s
OEM 4 – Supplier 1	ISO 9001:2008	1. Process Challenges	Reliability	Maruti Production System, Quality Circle
OEM 4 – Supplier 2	TS 16949	1. Process Challenges 2. Quality Challenges	Reliability	Maruti Production System, Quality Circle
OEM 4 – Supplier 3	TS 16949	1. Process Challenges 2. Quality Challenges	Reliability	Maruti Production System, Quality Circle

4.3 Analysis and Inferences

- The above data states that even though SME's are following ISO 9000 and TS16949 quality standards, they still face process challenges and quality challenges. Both these are related with each other and to certain extent are internal issues, barring controlling the quality right at the source.
- The SEM's always operate with constrained resources may it be human resources or otherwise. The great tools like Six Sigma improvements, lean practices although introduced in SME's, always takes back seat when it comes to delivery commitments. With the introduction of cluster and making supplier's supplier as their extended partmers, the SME's have started adopting to processes that are laid down by big players.

Table 5: Awareness to Lean Manufacturing

Following questions were asked to understand the awareness and adoption of lean manufacturing in SME's

A. Tier II company
B. Do you practice reducing production lot size
   Codes: 1- To a Great Extent, 2- Somewhat, 3- Little, 4- Very Little, 5 -Not at All
C. Do you believe in reducing set up time
   Codes: 1- To a Great Extent, 2- Somewhat, 3- Little, 4- Very Little, 5 -Not at All
D. Do you practice sourcing from single supplier?
   Codes: 1- To a Great Extent, 2- Somewhat, 3- Little, 4- Very Little, 5 -Not at All
E. Do you practice implementing preventive maintenance
   Codes: 1- To a Great Extent, 2- Somewhat, 3- Little, 4- Very Little, 5 -Not at All
F. Do you practice cycle time reduction
   Codes: 1- To a Great Extent, 2- Somewhat, 3- Little, 4- Very Little, 5 -Not at All
G. Do you practice "reducing inventory to expose manufacturing distribution and scheduling problem"
   Codes: 1- To a Great Extent, 2- Somewhat, 3- Little, 4- Very Little, 5 -Not at All
H. Do you practice using new process equipment or technologies
   Codes:1- To a Great Extent, 2- Somewhat, 3- Little, 4- Very Little, 5 -Not at All
I. do you practice quick changeover techniques
   Codes: 1- To a Great Extent, 2- Somewhat, 3- Little, 4- Very Little, 5 -Not at All

Table 5: Awareness to Lean Manufacturing

A	B	C	D	E	F	G	H	I
OEM1 – Supplier 1	To a great extent	To a great extent	Somewhat	To a great extent	To a great extent	To a great extent	To a great extent	To a great extent
OEM1 – Supplier 2	To a great extent	To a great extent	little	To a great extent	To a great extent	To a great extent	To a great extent	To a great extent
OEM1 – Supplier 3	To a great extent	To a great extent	little	To a great extent	To a great extent	To a great extent	To a great extent	To a great extent
OEM 2 – Supplier 1	1- To a Great Extent	1- To a Great Extent	2- Somewhat	1- To a Great Extent	1- To a Great Extent	1- To a Great Extent	1- To a Great Extent	2- Somewhat
OEM 2 – Supplier 2	4-Very Little	2-Some what	4-Very Little	1-To a great extent	2-Somewhat	2-Somewhat	2-somewhat	2-somewhat
OEM 2 – Supplier 3	To a great extent	To a great extent	To a great extent	To a great extent	2-Somewhat	3-Little	3-Little	4-Very Little
OEM 2 – Supplier 4	3.Little	3.Little	4.Very Little	1.To a Great Extent	2.Somewhat	4.Very Little	4.Very Little	2.Somewhat
OEM 3- Supplier 1	To a great extent	To a great extent	very little	To a great extent	To a great extent	To a great extent	To a great extent	To a great extent
OEM 3- Supplier 2	To a great extent	To a great extent	very little	To a great extent	To a great extent	very little	little	little
OEM 4 – Supplier 1	To a great Extent	To a great Extent	4.Very Little	1.To a Great Extent	To a great Extent	To a great Extent	To a great Extent	To a great Extent
OEM 4 – Supplier 2	To a great Extent	To a great Extent	4.Very Little	1.To a Great Extent	To a great Extent	To a great Extent	To a great Extent	To a great Extent
OEM 4 – Supplier 3	To a great Extent	To a great Extent	4.Very Little	1.To a Great Extent	To a great Extent	To a great Extent	To a great Extent	To a great Extent

4.4 Analysis & Inferences

- Both tables 4 & 5 explain that SME's are not only aware of lean manufacturing but are practicing these principles barring few examples. What is interesting to note is that even if they are practicing these principles, the maturity level and professionalism in practicing them needs more rigor and sustenance.
- The above tables indicate that as far as manufacturing process of SME's Is concerned, following is practiced religiously
  - 5 s
  - Kanban
  - SMED
  - Pull based system
  - PokaYoka
  - Rank Order Clustering
- While these practices are helping the SME's in operational excellence, the Lean SCM on the entire value chain is missing. The most weakest link on the supply chain is integration of suppliers for tracking the information and material flow across the value chain.

5.0 Conclusions

- The concept of supplier cluster is established and practiced in Auto industry since last few years by players like Mahindra, Maruti etc. Under this concept, the OEM tries to strengthen the partnership with the suppliers by way of outsourcing the operations that are not core to them. This allows OEM to enter into long purchase contract with suppliers for assured quality and delivery at most competitive prices. In addition, the OEM also tries to share the best practices that are followed in their organizations with suppliers to ensure that entire value chain is dependable and optimized to eliminate the waste.
- Tier 1 suppliers in automotive value chain have grown along with the OEM and are capable of adapting to the demands of the markets. They have become flexible and can sustain the VUCA world by consistently providing the required quality at most competitive cost. They have adopted the culture and best practices of OEM viz six sigma, lean manufacturing, TQM, TPM. However, the benefits of the cluster activities and professionalism in Tier I suppliers is not seen uniformly across SME's. A comprehensive, holistic growth & improvement of Tier II& Tier III suppliers in terms of Productivity, Quality, Cost, Delivery and Safety becomes the necessity to make the entire value chain competitive and sustainable.
- While SME's are practicing lean manufacturing on their shop floors, the practice of lean supply chain management should become the culture of industry as a whole.
- SME's are not only aware of lean manufacturing but are practicing these principles barring few examples in the case study. What is interesting to note is that even if they are practicing these principles, the maturity level and professionalism in practicing them needs more rigor and sustenance.
- Automation of processes, Integration of processes and use of IT enabled services in SME's world is far from reality.

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