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AN INSIGHT INTO SOME PRODUCTIVITY AND COMPETITIVENESS IMPROVEMENTS IN SOME INDIAN AUTOMOBILE INDUSTRIES USING KEY BUSINESS IMPROVEMENT TOOLS

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ABSTRACT

The Indian automotive industry is one of the largest in the world and in India it accounts for 7.1 % of total GDP. This paper presents an overview of contribution of business excellence tools in some VSMEs/SMEs in India for the eradication of hurdles in achieving desired productivity and competitiveness in some Indian automobile supplier industries. The study was conducted using a semi-structured questionnaire and 5 automotive spare-part industries are selected for the further study. From the survey it has been found that the participant industries have implemented business excellence tools like why-why analysis,1s,2s,5s, kaizen, My-machine concept, total employee involvement, visualisation technique, single minute exchange of dies (SMED). The study also highlighted the grey areas in these participant industries. The above-mentioned business excellence tools are used for the waste elimination, OEE improvement, productivity enhancement and for the development of better employee suggestion system.

Keywords: Productivity, Competitiveness, Cluster, 5S, Kaizen, My-Machine Concept, Waste Elimination, OEE.

1. INTRODUCTION

The globalisation has intensely motivated the industries to perform in the market for their survival. The outbreak of many VSMEs/SMEs in Indian automobile sector also intensified the competition. The main objective of this paper is to provide a better picture of approaches adopted by some the Indian industries towards the sustainable growth in a developing country. (Rosenfeld, 1997) pointed that areas having similar, related or complementary businesses having specialized infrastructure, labour markets and services, and that are faced with similar type of opportunities and threats. Micro, small and medium enterprises in each geographical location producing same or a similar type of products or services and these enterprises face similar type of opportunities and threats. Globalisation has prepared a platform where the industries of both developed and developing countries compete with each other for their profit goals (Ülengin, Önsel, Aktas, Kabak, & Özaydin, 2014).

The dynamic nature of business condition and diversified customer needs makes the market more competitive. For a competitive Business excellence, it desired to have either cost advantage or value advantage or both (Demeter, Chikán, & Matyusz, 2011). The main strengths and advantages of Indian manufacturing industries against the close neighbouring Asian industries as well as industries in the other part of world are relatively inexpensive, adequate and skilled labour force, cost-effective and competitive prices of goods produced, large manufacturing base and proximity to fast growing Asian markets. India is one of the leading producers and exporters in a number of commodities and enjoys significant advantages in terms of lower labour costs as compared to other economies (Lakshmanan, Chinngaihlian, & Rajesh, 2007). Sustained increase in competitiveness of an economy is a hallmark of economic strength and stability of that economy. Worldwide, there has been an increasing awareness, especially among emerging market economies (EMEs), about the need to strive for improved competitiveness to face the realities of the globalised trading environment.

Productivity is a term which describes the measures of efficiency of system and the system may be a person, machine, factory etc. under consideration. The productivity is the ratio of output to input. At national level a higher productivity indicates high living standards of the people of that country. In context to manufacturing industry following are some productivity indexes (Brealey, Myers, & Marcus, 2001). The vast literature on competitiveness

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and reveals that single measure of competitiveness does not poster the exact image of the concept. Competitiveness is a dynamic relationship between potential, process and performance (Buckley, Pass, & Prescott, 1988).The sources of competitiveness i.e. comparative advantage, cost and price distortion due to government policies in Malian manufacturing sector. Transportation infrastructure also plays an important role in deciding level of competitiveness (Cockburn, Siggel, Coulibaly, & Vézina, 1999). Financial ratios are very commonly used as a measure of global performance comparators between different companies (Brealey et al., 2001). A mathematical model of competitiveness index was developed, which is a number-based index to measure company competitiveness. This index is a function of six elements i.e. Research and development, changing targets of market, adaptation to change, rate of marketing budgets, participation in strategic alliance and work force fluctuations (Schmuck, 2008).

Business excellence tools such as line balancing, multi-machine activity, 5S, significantly helped in the improvement of the productivity, with significant reduction in inventory, cycle time, floor space, manpower, etc. and the organisation going to be more competitive than its rivals (Gurumurthy & Kodali, 2011). (Randhawa & Ahuja, 2017b) the 5S foundation plays an Important role in strengthening the performance of SMEs. Various organisations have demonstrated total commitment towards implementation of 5S methodology. These organizations have implemented the 5S in stages like first implementation of 1s, 2s and so on at all levels in the organizations through better communication among employees.

The implementation of 5S resulted in improved outcomes like overall organizational targets, targets related to production, quality improvement achievements, cost optimizations, employee related achievements, effective workspace utilization; and safety related achievements in most of Indian manufacturing organizations. Many industries have reported about the eradication of serious chronic problems such as delays, breakdowns, poor employee morale, declining profits, unsatisfied customers, poor visual management, dirty machines and equipment, wastage of various kinds and crowdedness of work floor. It has also been observed that 5S principle acts as foundation and can successfully integrate with other quality tools such as TPM, Kanban system, Quality Circles, Kaizen, and Lean (Randhawa & Ahuja, 2017a). The 5S (Shitsuke) implementation and basic 5S issues are the crucial factors in providing significant improvements of key performance indexes governing the business excellence of the organisations (Randhawa & Ahuja, 2017c).

The validated SEM_5S model shows that the significant variables such as Top Management Involvement Initiatives (TII), Employee Involvement Initiatives (EII) and 5thS Initiatives (Shitsuke) (FSIS) of 5S implementation program have performed extremely significantly towards accruing the business excellence performance parameters in manufacturing organizations (Randhawa & Ahuja, 2017d). The increased availability of equipment in the industries has reduce the further capital investment in the form of the purchase of new equipment and thus resulting in increase in productivity of model machines by 83% (Chan, Lau, Ip, Chan, & Kong, 2005). The factors like communication between the top management and its employees, clear strategy, Kaizen champion having good knowledge are required for successful implementation of Kaizen. On the other hand, challenges faced by the organization in implementing Kaizen include factors such as the lack of ability to manage the continuous improvement itself, the resistance to changes and lack of motivation among the employees due to poor reward system (Mĺkva, Prajová, Yakimovich, Korshunov, & Tyurin, 2016).

5S system in combination with ISO system significantly improves the productivity of an organisation. 5s lays the foundation of TPM (McCarthy, Rich, McCarthy, & Rich, 2015). (Ahmed, Hj. Hassan, & Taha, 2005) In order to make a manufacturing system efficient, effective, and environmentally sound and fair to the human society, TPM can be combined with EOM concept and Japanese 5Ss housekeeping rules. TPM is a worldwide accepted strategy to enhance the productivity and competitiveness on the global scale. The companies having TPM is their principle business excellence strategy forced to abandon TPM methodology due to negative attitude of the top management (Rodrigues & Hatakeyama, 2006) Consideration of 8 pillar strategies helps in motivation the employees towards adoption of concept of maximising OEE (Kigsirisin, Pussawiro, & Noohawm, 2016).

Availability, performance, quality rate and OEE of the plant will increase by adopting mobile maintenance concept (Jain, Bhatti, & Singh, 2015). The increase in OEE of an industry due to implementation of TPM directly increase the sales volume of that organization(Gupta & Vardhan, 2016).(Singh & Singh Ahuja, 2014) TQM and TPM

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implementation initiatives are very necessary in Indian industry for accruing strategic benefits for meeting challenges posed by global competition.(Ahuja & Khamba, 2008) TPM can act as key strategy for business organizations in this competitive world. Both TPM and TQM philosophies are the tools intended to improve the business excellence in terms of improving productivity and competitiveness so therefore it become more important to study synergic implementation of these two philosophies. Transfusion of TPM-TQM strategies can be seen as catalyst in achieving sustainability in the manufacturing organization along with enhanced business performance leading towards competitive advantage (Kaur, Singh, & Singh Ahuja, 2012).TPM is a continuous improvement philosophy which enables the organization to achieve business excellence in terms of productivity and competitiveness but there are cases where TPM implementation fails to provide the desired results, a graph theoretic approach has been has been adopted for the analysis of the intensity of barriers of TPM enactment in an industry.

The barriers were indexed using GTA methodology and it is observed that there are five major barriers and among them Behavioural barrier category comprising of lack of top level management, employee resistance, lack of clear vision, lack of job security and poor coordination has maximum intensity and operational barrier category constituting lack of standard operating barrier, absence of preventive maintenance schedule, and untidy work place shares the second most influential barrier among others (Attri, Grover, & Dev, 2014).TPM has been accepted by various organization as a competitive strategy. Indian Small and medium enterprises (SMEs) doomed by the global competition see this strategy as the soul saviour.

There exist a number of implementation strategies for TPM in various forms of industry so there is need of identification and evaluation of strategy which suits best for SMEs to improve their productivity and competitiveness. From the available literature it can be said that Indian SMEs are lacking motivation to adopt TPM and they needed to adopt this philosophy to improve productivity and competitiveness (Jain, Bhatti, & Singh, 2014).It is very important to understand the relationship between TPM philosophy and manufacturing performance in the context of Indian manufacturing industries. TPM philosophy aimed to improve productivity and competitiveness has done a remarkable job in attaining these objectives by improving the equipment availability, performance and product quality (Kumar, Kumar Soni, & Agnihotri, 2014). (Singh & Singh Ahuja, 2014) both TPM and TQM share synergistic relationship with each other and plays a vital role in improving the business performance of the industry in terms of productivity and competitiveness. And it can be said that the transfusion of TQM-TPM is more effective in realization of business goal than TPM alone on global platform (Singh & Ahuja, 2015).

Small and Medium Enterprises (SMEs) facing tough competition on global platform can be beneficiated by the continuous improvement strategies like TPM,TQM, JIT for business performance improvement (Sraun & Singh, 2017). The JH (Jishu Hozen) pillar of the TPM plays a very important role in the course of TPM implementation(Gupta, Vardhan, & Sharma, 2014).(Pinto, Pimentel, & Cunha, 2016) My-machine concept (TPM) brings the psychological sense of ownership in the mind of a worker in an industry so that the worker can be motivated to attain higher level of productivity. They have found that the implementation of TPM tools played a vital role in bringing the sense of ownership in worker's mind thus resulting higher productivity. The activities carried out under shadows of the QM pillar of TPM helps in reducing customer complaints along with achievement of zero defects, zero loss and zero breakdowns (Vardhan, Gupta, & Gangwar, 2015).(Hooi & Leong, 2017) investigated that TPM played a vital role in improving the manufacturing performance in a Malaysian manufacturing sector. (Panwar, Nepal, Jain, Rathore, & Lyons, 2017) lean practices lay positive impact on inventory control, waste reduction, cost reduction, productivity and quality improvement in Indian process industries. (Ahmad, Hossen, & Ali, 2017) the improvement of OEE by the application of kaizen which is one of the pillars of TPM. Because of kaizen OEE was increased from 75.09 to 86.02 % thereby increasing productivity by 23.93% and reduction in defective items by 49.5%. a study done by (Putri, Yusof, Hasan, & Darma, 2017) reveals that TQM implementation has positive influences on employee's productivity. Morale, skills and cultural enrichments are the some of the important aspects of the TPM philosophy (Gupta, Vardhan, & Al Haque, 2015).

2. RESEARCH METHODOLOGY

The research methodology adopted for the above study is based on questionnaire. The questionnaire was prepared with set of questions seeking the information about the existence of key issues (

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Table *1*) present in the

organisations. The questionnaire also deals with the tools adopted for the solving the above issues and the outcome of their implementation. The fundamental objective of the survey is to assess the implementation approaches of business excellence tools in the Indian VSMEs and SMEs.

The list of industries selected for the survey is extracted from the various newsletters published by consultants like TPM club India, CII and from online websites like LinkedIn. Only the industries in automobile spare- part sector are selected for the survey. To assess the content validity the questionnaire was pilot tested with some TPM practitioner, academic researchers. Based on the expert suggestion final version of the questionnaire was sent to 50 VSMEs /SMEs. Out 50 industries 23 industries responded. The received responses were checked for the normality of distribution. Out of 23 industries 5 industries have agreed to be included in case study without naming them.

Table 1:Key challenges

S. No.	Key Challenges
1.	Customer complaints on poor quality, tardy delivery and rejections
2.	Poor resource utilization (man, machine, material)
3.	Employee absenteeism, moral, skill and participation
4.	High WIP inventories
5.	Low productivity (production/man-hour)
6.	Poor standardization
7.	Poor data collection and reporting
8.	Automation

The analysis of the questionnaire reveals that most of the industries were struggling with some or all the above key challenges, for example all of them were dealing with employee related problems such as absenteeism, low morale, poor employee participation, customer satisfaction and high rejection rate. To address above key challenges industries have selected some key performance indicators (KPIs) which helped them to achieve their respective targets. Following table depicst the list KPIs and their measures

Table 2: List of KPIs

S.NO.	KPI	Measure
1.	Productivity	Parts produced per man-hour
2.	Inventory reduction	• Work in process • Raw material
3.	Quality	• Rejects • Reworks • Warranty claims
4.	Floor space	• m^2
5.	Delivery	Number parts produced in delivery schedule
6.	Employee training	No. of employee trained
7.	Employee suggestion	No. of suggestions forwarded by employees
8.	OEE	Machine downtime
9.	Number of changeovers	Total change over time
10.	Morale	Absenteeism
11.	Safety	No. of accidents

3. SELECTION OF IMPROVEMENT TOOLS FOR PRODUCTIVITY AND COMPETITIVENESS

The improvement program adopted by the industries was based on the principles of lean manufacturing, TPM and

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TQM. The TPM or TQM both presents the paths towards the waste elimination or Lean manufacturing. Since the industries were of either small or very small it was difficult for them to bear the cost of in-toto implementation of either TPM or TQM, so the industries had selectively opted for the main three pillars for the achievement of their targets.

(1) Total waste elimination
(2) Total employee participation
(3) Customer satisfaction

In a drive towards business excellence in an industry many tools play important role. The selection of the tools is very important, and it varies from industry to industry depending on the baseline of the problem but some tools like 5s, poke-yoke etc. are very basic and fits in most of the situations. Following is the list of tools that were commonly employed by the industries for their improvement.

Table 3: Tools of business excellence

S.NO.	TOOLS	OUTPUTS
1.	5s	Waste elimination, better space utilization
2.	Kaizen	Waste elimination, total employee participation
3.	SMED	Reduced setup time and WIP, improved customer response
4.	Visualization technique	Better quality control
5.	Total Employee involvement	Improved data collection system and better employee suggestion system
6.	My machine campaign	Autonomous maintenance (TPM pillar)
7.	Poke-yoke	Zero defect
8.	Why-why analysis	Better space utilization, problem solving
9.	Standardization	Reduced cycle time as well as process variation
10.	7QC tools	Better quality control
11.	Overall equipment effectiveness (OEE)	Reduced machine downtime proved productivity

4. IMPLEMENTATION STRATEGIES AND OUTCOMES

For the implementation of these tools the industries had done several meetings with the with the consultants they have appointed. The consultants also did their meeting with the employees of the industries for creating a better channel of communication between the management and the employees and to define the company's goal with respect to the program. The top management briefed about the role of consultant and his very purpose of visit to the employees. Following the initial introductory visit, the consultant visited industries three times in every two months to review the progress and to identify the root cause of the problem and to analyse the action taken. The consultants provided the new guidelines and assigned new task to the top management to drive toward the company goals.

5. CUSTOMER COMPLAINTS ON POOR QUALITY, TARDY DELIVERY AND REJECTIONS

This was the one of the main concern areas of most of the industries in survey. Most of them were plagued by the in-house rejections, rejections done at the part of customer due to poor quality control. The company C1 was dealing problem of customer complaints associated with the poor quality of product such as waviness on edges, scratches and chip offs along with in house rejection. For awareness of employees on customer concern a quality status board with daily updates on quality issues is placed at main entrance of company. All standard operating procedures (SOP) were written in vernacular languages with coloured sketches for better of workers regarding "good" and "no good" part. Daily production meetings were conducted to review the customer's complaints and tools like WHY-WHY analysis and QC were used to analysis the problems.

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In order to improve the in-house rejection daily PPM tracking was done ate Gemba by the production and quality in-charge. Red bin analysis meeting at Gemba on the same day to discuss, analyse the defect. Company C2, C3, C4 and C5 was having problems related to customer complaints and in-house rejections and they have adopted

SOPs, shadow boards, why-why analysis, QC tools, poke-yoke to reduce their problem of customer complaints and in-house rejections.

The following chart shows the effect of these on these tools on the problem of customer complaints and in-house rejections and it is found that company C1, C2, C3, C4 and C5 has got reduced their total rejections by 79%, 79%, 93% and 77% respectively. Company C5 had problem on customer complaints and in-house rejections but denied sharing its data but said that using poke-yoke their customer complaints were reduced by 60%.

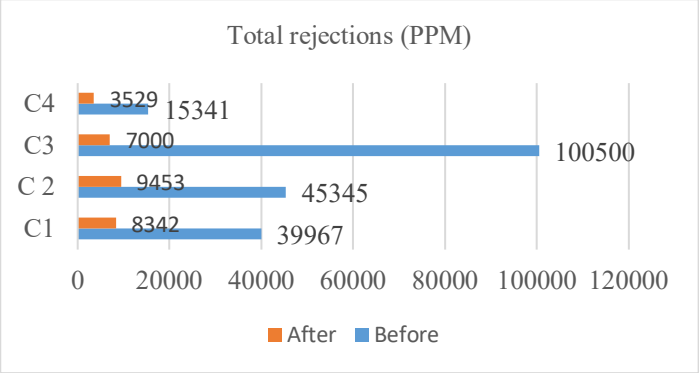

Figure 1: Total Rejection in PPM

6. POOR RESOURCE UTILISATION

Poor resource utilisation is major loss generator for an organisation. Resource utilisation integrates the use of man, machine, material and space and if one of these is not properly manage it will add hefty cost to balance sheets. Improper space utilisation results in increased work-in-process (WIP) and increased chances if accidents. Why-Why analysis and kaizen were extensively employed to address these issues. Why -Why analysis was used to identify the roots cause of the problems. Once problems are found, critical machines are identified and designated as Model machines under the My-machine campaign.

7. OVERALL EQUIPMENT EFFECTIVENESS IMPROVEMENT (OEE)

Productivity improvement was the major concern of these cluster partner industries and OEE was one of its measure. To improve OEE focus was there to use 5s, my machine campaign where the operator of a machine gets rights to maintain its machine and that brings a sense of ownership and responsibility in that operator. The main concern of OEE is improve the overall effectiveness of the equipment /machines by reducing their breakdowns. The following figure shows the relative change in OEE of companies and it can be seen that company OEE increase in company C1, C2, C3, C4 and C5 is 68%, 35%, 21%, 10% and 73% respectively.

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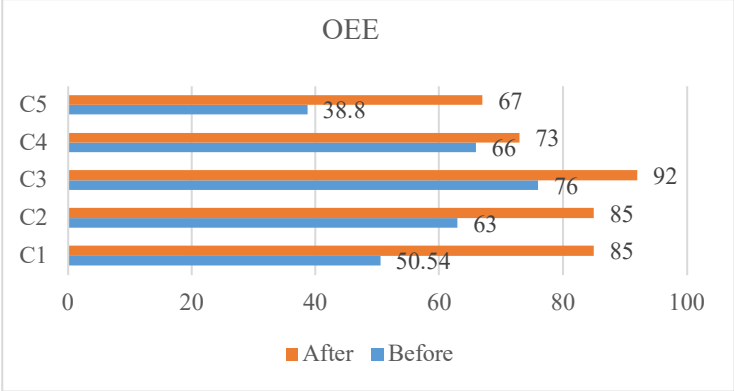

Figure 2: Overall Equipment Effectiveness (OEE)

8. ABSENTEEISM

One of the major concerns of the cluster participant was the employee absenteeism and sudden absence from the workplace without any prior notice as this affects the smooth production flow and delay delivery schedules. The employees of these organisations were motivated to not be absent due to no specification reason during to peak times. These organisations adopted various strategies towards the employee satisfaction and motivation some of them are as follows.

- Organising welfare activities like contribution towards school fee of the meritorious wards of employees.
- Advances payments for the medical treatment, marriages in the families of employees.
- Family get-togethers and picnics were organised.
- Training of employees toward safety procedures like firefighting.
- Training and education of employees towards team working, leadership quality etc.
- Attendance bonus was also started.

The above said practices help the companies C1, C2, C3and C5 to reduce absenteeism by 42.3%, 20%, 50% and 30%. The company C4 did not provided any data on this but said that their employee participation has increased by 65% from the previous year.

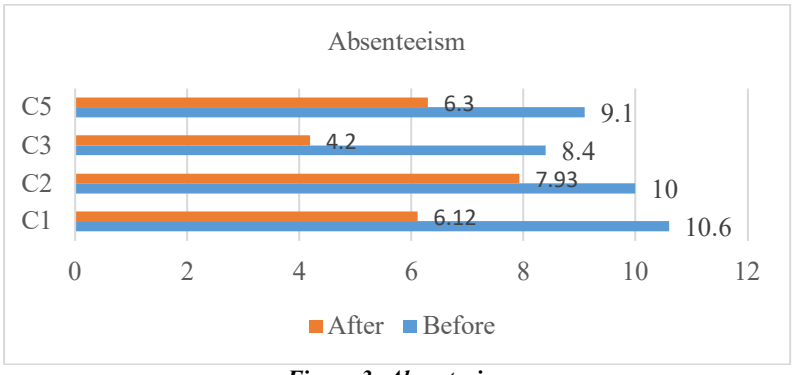

Figure 3: Absenteeism

9. ACCIDENTS SEVERITY (RATIO)

Both minor and major accidents pose serious threats towards the productivity and employee morale. None of the company was spared from this threat. Initially there were 23.6, 1012, 74, 214 and 5959.62 accidents were reported in the respective companies shown in the figure. The lessons on safety procedures, use of 5s principles, and several small changes in the machines/ equipment were made like use of hand guards on machine, use of safety equipment while performing. After the application of business excellence tools company C1, C3, C4 and C5 were able to reduce to accidents to zero whereas for company C2 these were reduce to 14 from 1012.

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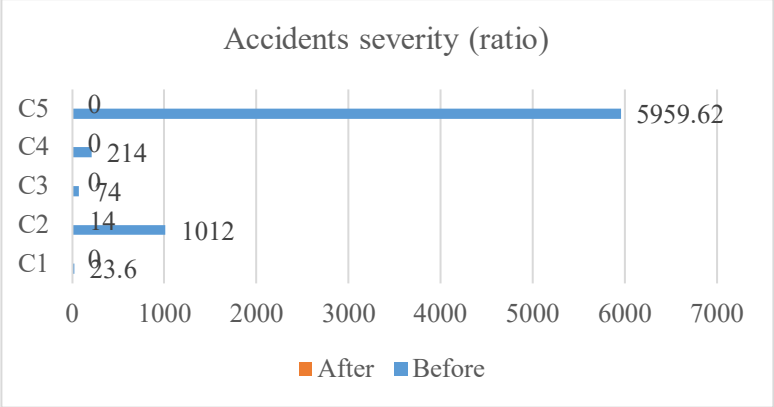

Figure 4: Accident Severity (Ratio)

10. PRODUCTIVITY (PRODUCTION/MAN-HOUR)

The company C1 was able to increase its production from 1080 pieces/hr. to 1680 pieces/hr. a total number of 1113 Kaizen along with 13 quality circles were implemented that helped the industries to increase its productivity by 84% with improvement of 50% in inventory turn ratio (ITR). Similarly, company C2 implemented total number of 777 kaizens with which they were able to reduce its machine setup time 104 min. to 30 min. on bore grinding machines and from 90 min. to 18 min on facing and centring machines. All these efforts were transformed in increase in productivity by 48%. Company C3 introduced 1400 kaizens along with more than 1200 visual controls. Inventory turn ratio was increased by 43% with saving in cycle time by 97% using SMED. The company did not provide its data of productivity in production/man-hr rather it says its productivity has improved by 21%. Company C4 also did not provided any direct data regarding its productivity but said that it has impended 850 kaizens and improved its ITR by 315% over a period of 30 months with 10% increase in productivity. Company C5 has reported an increase of 36% in its productivity with the use of kaizens, poke-yoke, visual control, visual stream mapping, concept of JIT.

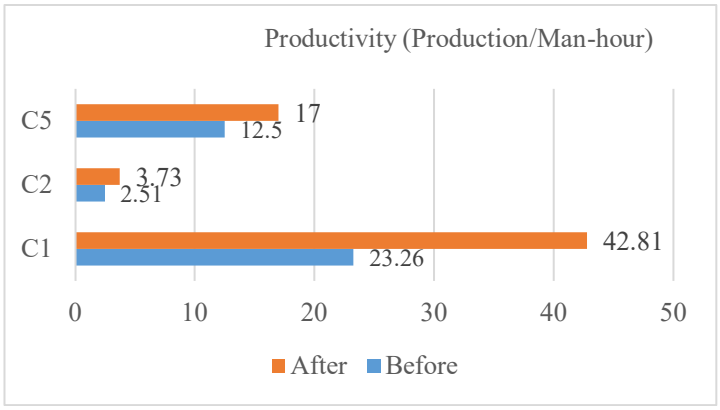

Figure 5: Productivity

11. IMPROVED COMPETITIVENESS

The improvement in competitiveness of these firms can be seen from the fact that the companies along with the increase in their productivity were also able their product portfolio as well as added new customers in their customer data base also showing increase in sustainability

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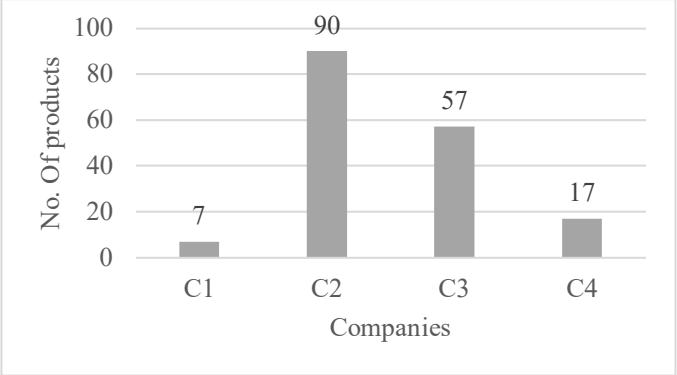

Figure 6: No. of new products added

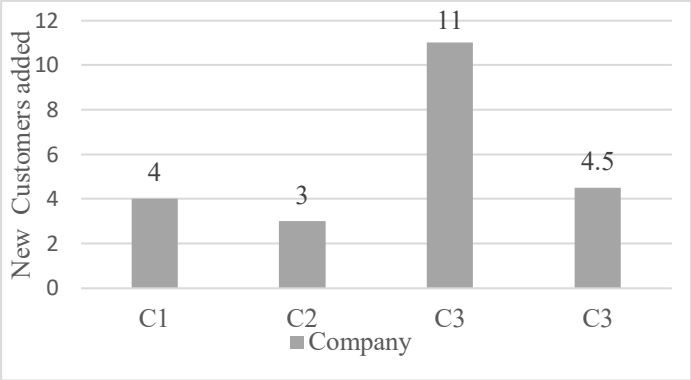

Figure 7: No. of new customers added

12. CONCLUSIONS

The industries had adopted the tools of lean manufacturing for improving their business excellence. The research highlighted the contribution of these tools viz kaizens, SMED, visual flow, VSM, Poke-yoke etc on the performance of SMEs and the efforts done to prepare to SMEs to face challenges posed by global competition. The study reveals that the influence of these tools is far more effective than traditional practices. This establishes that tools are very effective in improving the overall organisation competencies. The study also shows that systematic excellence tool implementation contributed significantly towards improvement in the value added per employee (VAPCO), safety, reduction in scrap area, reduction in accidents along with increase in the total employee participation, morale boosting and employee satisfaction. These practices also helped in reducing total rejections (ppm) along with customer satisfaction. The findings suggest that business excellence tools can significantly improve the dynamics to a manufacturing organisation for the global competition.

REFERENCES

[1] Ahmad, N., Hossen, J., & Ali, S. M. (2017). Improvement of overall equipment efficiency of ring frame through total productive maintenance: a textile case. International Journal of Advanced Manufacturing Technology, 1–18. https://doi.org/10.1007/s00170-017-0783-2

[2] Ahmed, S., Hj. Hassan, M., & Taha, Z. (2005). TPM can go beyond maintenance: excerpt from a case implementation. Journal of Quality in Maintenance Engineering, 11(1), 19–42. https://doi.org/10.1108/13552510510589352

[3] Ahuja, I. P. S., & Khamba, J. S. (2008). Total productive maintenance: literature review and directions. International Journal of Quality & Reliability Management, 25(7), 709–756. https://doi.org/10.1108/02656710810890890

[4] Attri, R., Grover, S., & Dev, N. (2014). A graph theoretic approach to evaluate the intensity of barriers in the implementation of total productive maintenance (TPM). International Journal of Production Research, 52(10), 3032–3051. https://doi.org/10.1080/00207543.2013.860250

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

[5] Brealey, R. A., Myers, S. C., & Marcus, A. J. (2001). Fundamentals of Corporate Finance. In McGraw Hill.
[6] Buckley, P. J., Pass, C. L., & Prescott, K. (1988). Measures of international competitiveness: A critical survey. Journal of Marketing Management, 4(2), 175–200. https://doi.org/10.1080/0267257X.1988.9964068
[7] Chan, F. T. S., Lau, H. C. W., Ip, R. W. L., Chan, H. K., & Kong, S. (2005). Implementation of total productive maintenance: A case study. International Journal of Production Economics, 95(1), 71–94. https://doi.org/10.1016/j.ijpe.2003.10.021
[8] Cockburn, J., Siggel, E., Coulibaly, M., & Vézina, S. (1999). Measuring Competitiveness and its Sources: The case of Mali's Manufacturing Sector. Canadian Journal of Development Studies / Revue Canadienne d'études Du Développement, 20(3), 491–519. https://doi.org/10.1080/02255189.1999.9669852
[9] Demeter, K., Chikán, A., & Matyusz, Z. (2011). Labour productivity change: Drivers, business impact and macroeconomic moderators. International Journal of Production Economics, 131(1), 215–223. https://doi.org/10.1016/j.ijpe.2010.11.003
[10] Gupta, P., & Vardhan, S. (2016). Optimizing OEE, productivity and production cost for improving sales volume in an automobile industry through TPM: A case study. International Journal of Production Research, 54(10), 2976–2988. https://doi.org/10.1080/00207543.2016.1145817
[11] Gupta, P., Vardhan, S., & Al Haque, M. S. (2015). Study of success factors of TPM implementation in Indian industry towards operational excellence: An overview. 2015 International Conference on Industrial Engineering and Operations Management (IEOM), 1–6. https://doi.org/10.1109/IEOM.2015.7093740
[12] Gupta, P., Vardhan, S., & Sharma, A. (2014). The Impact of Implementation of Jishu-Hozen Pillar in a Process Industry: A Case Study. Journal of Sustainable Manufacturing and Renewable Energy, 3(1/2), 5.
[13] Gurumurthy, A., & Kodali, R. (2011). Design of lean manufacturing systems using value stream mapping with simulation. Journal of Manufacturing Technology Management, 22(4), 444–473. https://doi.org/10.1108/17410381111126409
[14] Hooi, L. W., & Leong, T. Y. (2017). Total productive maintenance and manufacturing performance improvement. Journal of Quality in Maintenance Engineering, 23(1), 2–21. https://doi.org/10.1108/JQME-07-2015-0033
[15] Jain, A., Bhatti, R. S., & Singh, H. (2015). OEE enhancement in SMEs through mobile maintenance: a TPM concept. International Journal of Quality & Reliability Management, 32(5), 503–516. https://doi.org/10.1108/IJQRM-05-2013-0088
[16] Jain, A., Bhatti, R., & Singh, H. (2014). Total productive maintenance (TPM) implementation practice. In International Journal of Lean Six Sigma (Vol. 5). https://doi.org/10.1108/IJLSS-06-2013-0032
[17] Kaur, M., Singh, K., & Singh Ahuja, I. (2012). An evaluation of the synergic implementation of TQM and TPM paradigms on business performance. International Journal of Productivity and Performance Management, 62(1), 66–84. https://doi.org/10.1108/17410401311285309
[18] Kigsirisin, S., Pussawiro, S., & Noohawm, O. (2016). Approach for Total Productive Maintenance Evaluation in Water Productivity: A Case Study at Mahasawat Water Treatment Plant. Procedia Engineering, 154, 260–267. https://doi.org/10.1016/j.proeng.2016.07.472
[19] Kumar, J., Kumar Soni, V., & Agnihotri, G. (2014). Impact of TPM implementation on Indian manufacturing industry. International Journal of Productivity and Performance Management, 63(1), 44–56. https://doi.org/10.1108/IJPPM-06-2012-0051
[20] Lakshmanan, L., Chinngaihlian, S., & Rajesh, R. (2007). Competitiveness of India's manufacturing sector: An assessment of related issues. Reserve Bank of India Occasional Papers, 28(1), 33–77.
[21] McCarthy, D., Rich, N., McCarthy, D., & Rich, N. (2015). Chapter Two – The Lean TPM Master Plan. Lean TPM, 27–54. https://doi.org/10.1016/B978-0-08-100090-8.00002-1
[22] MÍkva, M., Prajová, V., Yakimovich, B., Korshunov, A., & Tyurin, I. (2016). Standardization – One of the Tools of Continuous Improvement. Procedia Engineering, 149, 329–332. https://doi.org/http://dx.doi.org/10.1016/j.proeng.2016.06.674
[23] Panwar, A., Nepal, B., Jain, R., Rathore, A. P. S., & Lyons, A. (2017). Understanding the linkages between lean practices and performance improvements in Indian process industries. Industrial Management & Data Systems, 117(2), 346–364. https://doi.org/10.1108/IMDS-01-2016-0035

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[24] Pinto, H., Pimentel, C., & Cunha, M. (2016). Implications of Total Productive Maintenance in Psychological Sense of Ownership. Procedia - Social and Behavioral Sciences, 217, 1076–1082. https://doi.org/10.1016/j.sbspro.2016.02.114
[25] Putri, N. T., Yusof, S. M., Hasan, A., & Darma, H. S. (2017). A structural equation model for evaluating the relationship between total quality management and employees' productivity. International Journal of Quality & Reliability Management, 34(8), 1138–1151. https://doi.org/10.1108/IJQRM-10-2014-0161
[26] Randhawa, J. S., & Ahuja, I. S. (2017a). 5S – a quality improvement tool for sustainable performance: literature review and directions. International Journal of Quality & Reliability Management, 34(3), 334–361. https://doi.org/10.1108/IJQRM-03-2015-0045
[27] Randhawa, J. S., & Ahuja, I. S. (2017b). Evaluating impact of 5S implementation on business performance. International Journal of Productivity and Performance Management, 66(7), 948–978. https://doi.org/10.1108/IJPPM-08-2016-0154
[28] Randhawa, J. S., & Ahuja, I. S. (2017c). Examining the role of 5S practices as a facilitator of business excellence in manufacturing organizations. Measuring Business Excellence, 21(2), 191–206. https://doi.org/10.1108/MBE-09-2016-0047
[29] Randhawa, J. S., & Ahuja, I. S. (2017d). Structural equation modelling for validating impact of 5S implementation on business excellence of manufacturing organizations. International Journal of Quality & Reliability Management, 21(2), 00–00. https://doi.org/10.1108/IJQRM-08-2016-0129
[30] Rodrigues, M., & Hatakeyama, K. (2006). Analysis of the fall of TPM in companies. Journal of Materials Processing Technology, 179(1–3), 276–279. https://doi.org/10.1016/j.jmatprotec.2006.03.102
[31] Rosenfeld, S. a. (1997). Bringing business clusters into the mainstream of economic development. European Planning Studies, 5(1), 3–23. https://doi.org/10.1080/09654319708720381
[32] Schmuck, R. (2008). Measuring Company Competitiveness. Business Sciences–Symposium for Young Researchers: Proceedings, 199–208.
[33] Singh, K., & Ahuja, I. S. (2015). An evaluation of transfusion of TQM-TPM implementation initiative in an Indian manufacturing industry. Journal of Quality in Maintenance Engineering, 21(2), 134–153. https://doi.org/10.1108/JQME-04-2013-0017
[34] Singh, K., & Singh Ahuja, I. (2014). Effectiveness of TPM implementation with and without integration with TQM in Indian manufacturing industries. Journal of Quality in Maintenance Engineering, 20(4), 415–435. https://doi.org/10.1108/JQME-01-2013-0003
[35] Sraun, J. S., & Singh, H. (2017). Continuous improvement strategies across manufacturing SMEs of Northern India-an empirical investigation. International Journal of Lean Six Sigma, 8(2), IJLSS-05-2016-0019. https://doi.org/10.1108/IJLSS-05-2016-0019
[36] Ülengin, F., Önsel, Ş., Aktas, E., Kabak, Ö., & Özaydin, Ö. (2014). A decision support methodology to enhance the competitiveness of the Turkish automotive industry. European Journal of Operational Research, 234(3), 789–801. https://doi.org/10.1016/j.ejor.2013.09.044
[37] Vardhan, S., Gupta, P., & Gangwar, V. (2015). The impact of Quality Maintenance Pillar of TPM on manufacturing performance. 2015 International Conference on Industrial Engineering and Operations Management (IEOM), 1–6. https://doi.org/10.1109/IEOM.2015.7093741.