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Lean Manufacturing - Implementation of Concept to Reduce Defects in Small Scale Industries: A Case Study

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Abstract: Lean Manufacturing is process of identifying waste which provides opportunity of improvement arises Kaizens which implements in those areas which suffer high rate of rejection results in high PPM (Part per Million). The concept of Lean Manufacturing Methodology is discussed with case studies which are conducted in Small Scale Industries to improve the quality by reducing defects to Zero Level. The Finding of this research work is rejection rate in drilling process reduced from 27% to 7% and many others which results in reduce the cost of industry and improve the quality of product and process.

Keywords: Lean Manufacturing, Kaizen, Parts per Million, Rejection Rate.

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1. INTRODUCTION

Lean Manufacturing method is one of the leading, most efficient and effective technique eliminates of non-value added work in order to optimize production through cost reduction and improve sand increase the quality and quantity of product respectively. The lean manufacturing improves quality system by providing proper documentation(Kumar and Harms 2004). Lean Manufacturing introduced and successfully implemented first by Toyota Production System, then to other manufacturing settings, enterprises, healthcare, and government services. Kaizen is a Japanese philosophy which focuses on process improvement. It is the combination of two words 'Kai' and 'Zen', which means 'continuous' and 'improvement' or 'change for' and betterment' (Brunet and New 2006). The Kaizen Institute defines Kaizenas the Japanese term for continuous improvement. It is a philosophy in which rigorous, scientific method by statistical quality control and an adaptive framework of organizational values and beliefs that keeps workers and management focused on zero defects(Van Aken, Farris et al. 2010). It provides opportunities of improvement for change. Team work plays a key role in process improvement and participation and collaboration speed things up and support the building of a local common sense (Holtskog 2013).A well trained work-group quickly review the problem, brainstorm possible improvements, select best possible solution and implement the idea in work place to achieve quick results.

2. LITERATURE SURVEY

Kumar and Harms (2004) explained use of process mapping tools, blitz activities, formalized and documented work instructions and work measurement tools through proper education of their employees and team work. The study revealed that Continuous improvement can be achieved through process mapping procedure by using Flowcharts and their relationship helps to visualize wastes and trigger kaizen blitz activities by systematic documented work instructions. Employee involvement is vital to achieve continuously growth for an industry. It is extremely important to gain the employee's trust and commitment to sustain growth.

Bateman (2005) stated that Process Improvement activities have been conducted widely throughout many industries and countries, but little analytical work has been done into what sustains the improvements made by these activities. The study states that Lean-Kaizen implementation is triggers the way of improving the performance in internal and external quality of service processes by providing good example in the case study.

Anand and Kodali (2009) affirm that many lean manufacturing initiatives have failed due to the lack of its understanding by managers and employees. Therefore, a lean manufacturing framework that integrates the practices in different areas is required to allow practitioners understand clearly the requirements for implementing lean manufacturing.

Magnier-Watanabe (2011) illustrated comprehensive approach which highlighted the requirement of accessing the organization and knowledge management of any organization forkaizen.

Holtskog (2013) stated that Quality Training is that learning tools makes each employee capable to do work independent, simplifications helps to memorize easily and employee can take autonomous decisions during work. Team work plays akey role in process improvement and participation and collaboration speed things up and support the building of a local common sense.
Anupama Prashar (2014) examined Lean-Kaizen approach implemented through value stream maping (VSM) for process improvement to steering systems largest manufacturer results in drastically improvement in their internal efficiency by deploying Kaizen events. The study categorically illustrates the employment of value stream mapping (VSM) to target the areas for Kaizen improvement events which exhibits implementation of Lean-Kaizen approach for redesigning assembly line in an auto component manufacturing unit.

3. Lean Manufacturing Methodology & Key Factors

Lean Manufacturing methodology covers the concept of Lean Manufacturing and Kaizen Approach to achieve the desired output in terms of process & product improvement. Lean Manufacturing Methodology contains six steps which will be done systematically to achieve the defect free environment in small scale industry. In this Lean Manufacturing methodology, each step includes a Kaizen tool which is implemented to get the result and this result will become the input to the next step. Each Step must have key factors which describe a Kaizen tool which is used to get the output.

These steps should be followed systematically to reduce the waste of industry. These steps are discussed as follows in Figure 1.

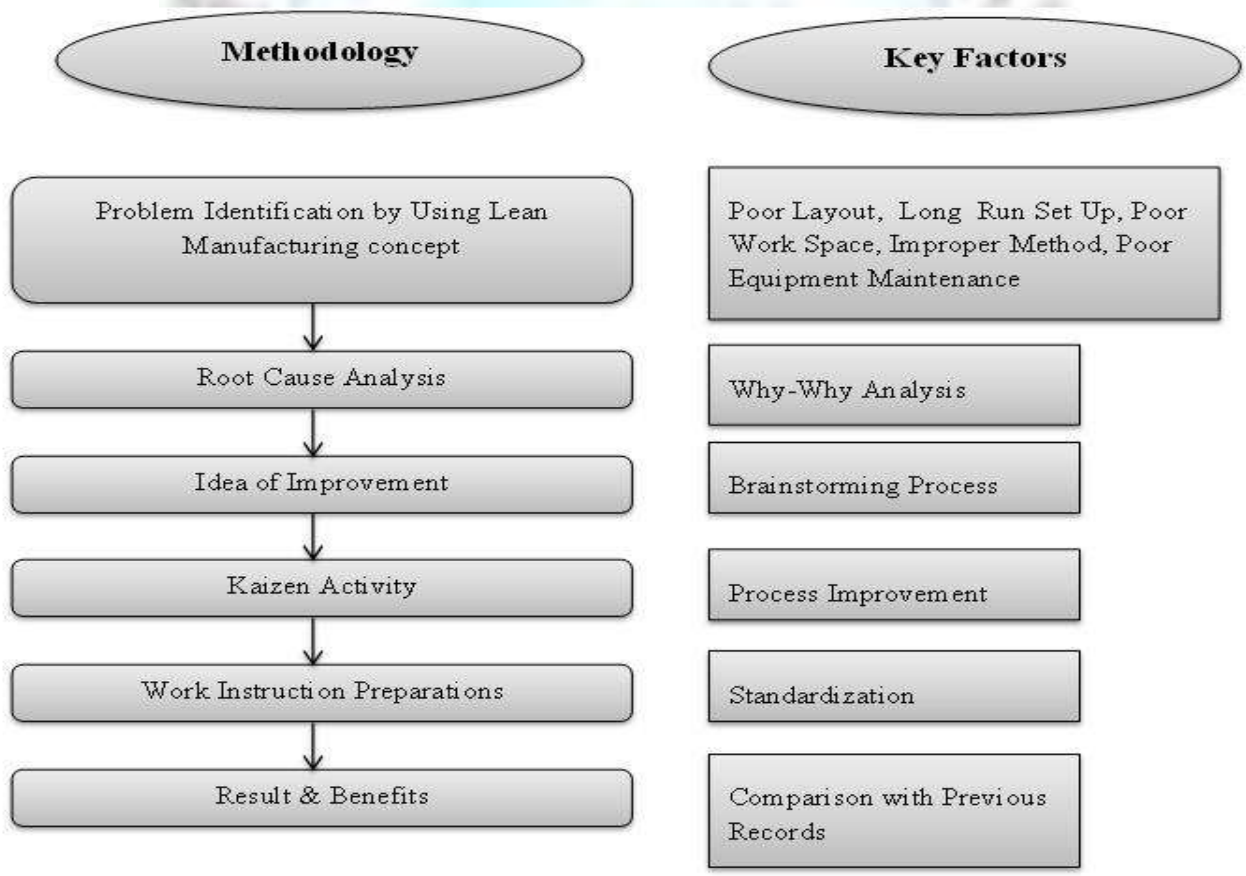

Figure 1: Lean Manufacturing Methodology

4. Application of Lean Manufacturing Methodology

The methodology is implemented to a small scale industry which is a manufacturer of Automobile Parts for various customers companies in Gurgaon.

4.1 Study of Present Situation of Industry

A study is made to understand the present situation of industry in terms of production & quality by studying various processes to produce products before implementation of Lean Manufacturing Methodology. This data has worked as a data base for finding out ideas of improvements in various processes.

4.2. Data Analysis & Problem Discussion

The data obtained by various department & problem discussion is made by conducting regular visit and meeting with manager, supervisor & worker of the industry for the purpose to find out those problems which affect the industry prominently. By the discussion, it is found That the most valuable data is obtained in Final inspection area of the industry and internal as well as external complaints are discussed on that platform is affected most in terms of reduction in quality and increase in cost of product.

4.3 Final Inspection Data (Daily Inspection Report) Compilation

Final Inspection is the area where In house rejection and customer rejection is recorded for each product and process. It is the last stage of thoroughly inspection of every product. A record of product inspected and rejected to scrap is prepared to calculate Part Per Million level of the industry which signifies the overall quality level of the industry. The higher PPM (part of rejected per million of product) of any product mean higher the qualify cost to the manufacturing industry that can be identified as problem. Regular visit of 7-10 days is made to obtain monthly data of PPM (Overall PPM), Product wise PPM & Defect wise Report of any products of the industry in order to find the case product on which further study can be done.

4.4 PPM Trend of All Products

The quality data of six months (on the basis of previous performance of industry in year 2015) is study for the purpose to understand the present quality level of the industry. The data available is of six months i.e. July 14 to Dec 14 which shows over all PPM Level of the industry in these months. The PPM Trend of all the products before the implementation of Lean Manufacturing Methodology is shown in Fig. 2 provided below:

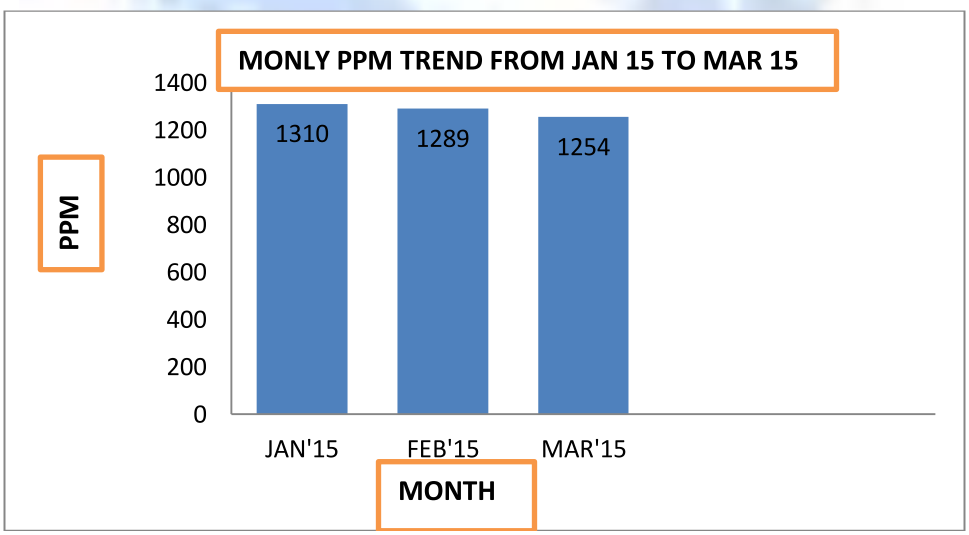

Fig. 2: Monthly PPM from Jan 15 to Mar 15

4.5 Present Situation of Working Tools and Methodology Adopted

It is obvious that many programs were installed in order to minimize this high level of PPM by the prominent level of management & employee. The management was ready to adopt any methodology to reduce the PPM Level to minimum level which affect the cost to the industry and affect the market value of the industry. Random Problem was selected for the solution of problem. No permanent system is present for reliable and permanent solution of the problem. No Focus was made on the customer complain and trivial efforts are applied to find the root cause of the problem. The solution of problem is done to fulfill the requirement of paper work and the corrective, preventive action is just for the name only.

4.6Study after Implementation of Lean Manufacturing Methodology

The proposal of reduction of PPM Level of Industry by implementation of Lean Manufacturing Methodology is presented to the management which gets approved with a general consent / condition that the implementation would be conducted without interrupting regular production / working at the shop floor. The brief discussion is made (on the data obtained from Final Inspection) for the purpose to revise the basics steps of methodology which performs systematically to achieve the objectives of the study. The Table is obtained in which contribution in PPM of each product is displayed. The top three products are taken as case study in this research work. The discussion of improvement is made through three case studies which performed during the time of course work.

Table 1: Contribution of Product in PPM (Three Months from Jan 15 to Mar 15)

Product wise PPM Contribution					
SR. NO.	Item name	Qty.	Cumm. Qty.	%age	cumm. %age
1	Spindle Kick Starter (284)DH111012	334	334	39	39
2	Plain Coller (606) (DS101336)	183	517	21	60
3	Axle front wheel (52DJ0105)	117	634	14	73
4	Axle rear wheel (52DJ0105)	80	714	9	82
5	Coller sprocket (695) (DK101245)	48	762	6	88
6	59050008	45	807	5	93
7	DK151008	29	836	3	97
8	DK151009	8	844	1	97
9	DK171003	7	851	1	98
10	DK171006	6	857	1	99
11	DH171012	6	863	1	100
12	59050002	3	866	0	100
13	Rack (162) DH101141	0	866	0	100
14	Assly. Tie rod (DK 101180)	0	866	0	100

The top three products are taken as case study in this research work. The discussion of improvement is made through three case studies which performed during the time of course work.

5. CASE STUDY

The final inspection data is studied and discussed in which three products were found prominently contributed in PPM which is taken as case study. The first product is Spindle Kick Starter. The PPM Contribution for each month is discussed in Chart 4.2.

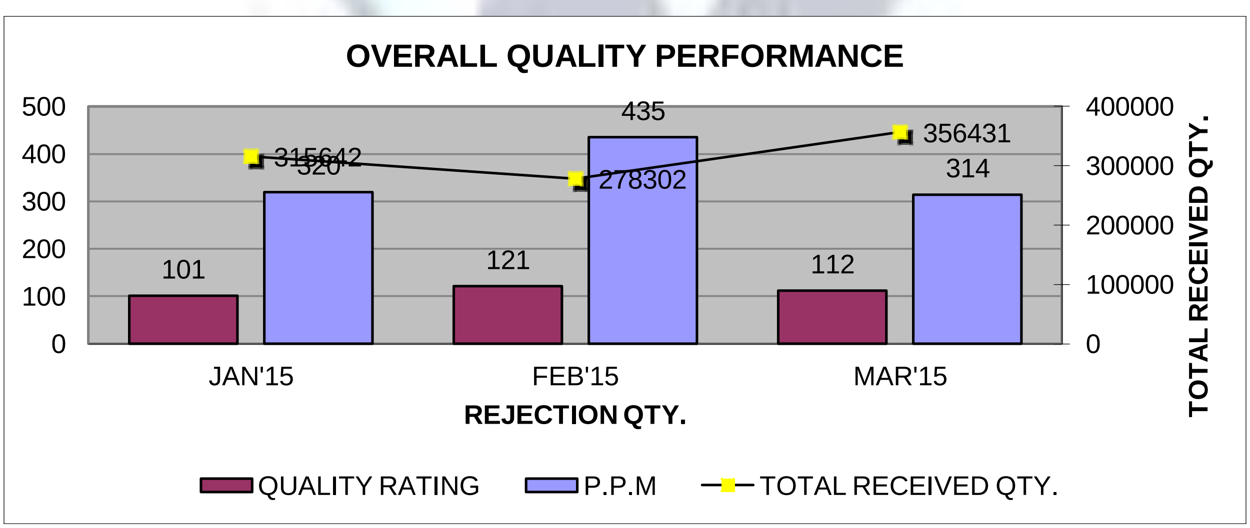

Fig. 2: Monthly PPM Trend of Spindle Kick Starter (From Jan 15 to Mar 15)

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5. Problem Discussion

The Problem is identified by monitoring the Final inspection Quality status and In-process quality status. The case product Spindle Kick starter drills at shank up to depth 75mm from teeth end which is observed 74.60 mm (less than the required specification) by petrol inspection. The work piece is fitted in fixture on drill machine for drilling operation which is performed on each work piece. This problem is due to improper cleaning of chip from the surface where the work piece rest for clamping. Swart (Chip) sticks to the surface increase the height of the work piece against drilling result in decrease drill depth of product. The Problem Selection is made on the basis of defect wise monthly report of spindle kick starter which is displayed in Table 2.

Table 2: Defect Wise Monthly Report of Spindle Kick Starter

DEFECT WISE MONTHLY REPORT OF SPINDLE KICK STARTER								
		MONTH NAME			Total	Comm.	Contribution	
SR. NO.	STANDARD DEFECT NAME	JAN'15	FEB'15	MAR'15	Defects	Defects	in 100%	REMARKS
1	WIDTH U/SIZE	31	65	63	159	159	48	
2	OPERATION MISSING	3	2	1	6	165	50	
3	THREAD MISSING	1	1	5	7	172	52	
4	O.D U/SIZE	0	0	3	3	175	53	
5	THREAD DAMAGE	8	2	13	23	198	59	
6	DAMAGE	0	33	8	41	239	72	
7	FITMENT NOT O.K	5	1	0	6	245	74	
8	BEND/TWIST	1	0	0	1	246	74	
9	STEP MARK / LINE MARK	0	0	6	6	252	76	
10	BURR FOLDING	1	1	0	2	254	76	
11	RUST	1	0	0	1	255	77	
12	CUT MARKS	1	0	0	1	256	77	
13	THREAD N.G	1	5	0	6	262	79	
14	O.D O/SIZE	39	2	0	41	303	91	
15	MIX UP	0	0	0	0	303	91	
16	WRONG PART SUPPLIED	1	5	5	11	314	94	
17	PITTING MARK	1	1	1	3	317	95	
18	LEAK	1	1	2	4	321	96	
19	THREAD TIGHT	1	1	1	3	324	97	
20	LENGTH O/SIZE	3	1		4	328	98	
21	LENGTH U/SIZE	0	0	3	3	331	99	
22	STEP ON O.D	0	0	1	1	332	100	
23	S.S.T NOT O.K	0	0	0	0	332	100	
24	HARDNESS NOT O.K	0	0	0	0	332	100	
25	HOLE BLOCKED	1	0	0	1	333	100	
26	WITHOUT GROOVE				0	333	100	
	TOTAL INSPECTED QTY	100	121	112				

The drilling fixture of case product Spindle Kick starter is as shown in Figure 3. This cause increases parts per million defects of industry or internal failure of parts which are not confirming customer specifications.

Figure 3: Drilling Fixture of Spindle Kick Starter (Before LM Implementation)

5.2 Implementation of Lean Manufacturing Methodology for Improvement in Drilling Process

In reference to drill under size problem which increase parts per million defects of case product Spindle Kick starter, the idea works behind elimination of the problem is that the component resting face should be properly rest with fixture resting face through proper cleaning of resting surface. The case product Spindle Kick starter drilled at shank up to depth 75mm which is observed 74.60mm in fixture of milling operation which is 0.40mm short than required specification for each work piece. Swart (Chip) which gets stick to the bed surface of the fixture must be properly cleaned by a brush. The drilling fixture of case product Spindle Kick starter is as shown in Figure 4. Thus the process is found producing defective items in view of lean manufacturing.

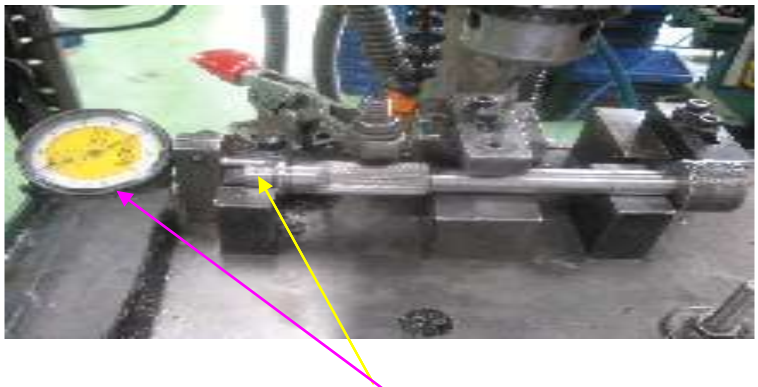

Figure 4: Dial indicators with Fixture of Spindle Kick starter (After LM Implementation)

a) Problem Identification

The Problem is identified by monitoring the Final inspection Quality status and In-process quality status.

b) Idea of Improvement

The ideas of improvement is achieved through Why-Why analysis which is done as follows.

i. Why-Why analysis

Why 1: Resting face of component not rested properly with fixture resting face.
Why 2: Chips particle between the component resting face & fixture resting face.
Why 3: Component face not cleaned by operator before clamping.

ii. Root Cause

Component face not cleaned by operator before clamping.

c) Kaizen activity

The problem can be solved by fixing dial indicator at the base which provides reading while resting of work piece on the fixture. The dial must be calibrated on monthly basis through proper calibration method. A master work piece is used for checking right location of drill and dial at the starting of work in each shift.

d) Work instructions

These are provided on the machine while performing drilling operation on the case products as follows.

1) Operator cleans the component before clamping.
2) Modify the resting face of fixture by using two points resting of component instead of full face resting.
3) One dial provided on machine to check the proper resting of component.

e) Benefits observed

Following benefits are observed immediately after performing Kaizen Method.

1) It reduced the length drill under size problem and provided a database for 100% inspection of case product.
2) It worked towards achievement of zero defects (especially drill under size problem) and decreased PPM level of Plant.
3) It improved skill level of manpower through inspection of each and every product during drilling operation.

f) Result Analysis

The result analysis of drilling of case product immediately before and after Kaizen method is shown in Fig. 5. Followings are the result analyzed immediately after Kaizen method.

1. Eliminate length variation problem.
2. Reduces no. of defective items i.e. PPM.

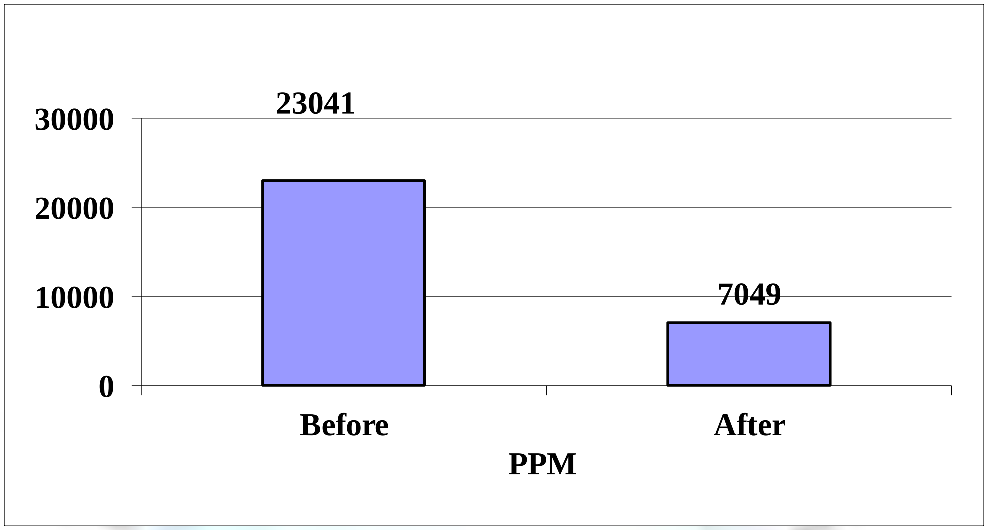

Fig. 5: Parts per million (PPM) Defects of Drilling

6. Conclusions & Scope of Improvements

From the above study we conclude that the Lean Manufacturing is the main factor for finding opportunity of improvement in any organization. The industry Devki Auto Industries (P) Limited under this case study implemented Kaizen to improve process, quality and system through recognizing waste in performing various processes in industry. Every management knows that continuous improvement is the main concern for stability, growth and profit especially in automobile industry as this industry directly affects human life. Implementation of Kaizen guarantees positive effects on everything that makes an organization produce better quality, better results and low rejection. All these factors motivate the employees for better work. In the present study the Kaizen approach is applied to Automotive manufacturing industry to reduce various types of wastes which decrease the rejection and to increase productivity. There is wide scope for future work as:

a) Kaizen approach can be applied to other industries like rubber, textile, power plant, cement and other service sector to increase production and to solve the daily routine problems faced by the workers of the above mentioned industries. This shall also improve the work environment.
b) The Kaizen approach can be applied to all level of Indian as well as overseas industries.
c) Apart from Kaizen approach other approaches like Six Sigma, Just In Time, Total Quality Management etc. can also be studied and implemented on Automotive manufacturing industry.

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