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Kaizen performance in an Engineering Industry in India: A Case Study

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ABSTRACT:
Thousands of small & medium scale industries are present in India. All are facing certain problems resulting in shortage of production and quality issues. This case study deals with the kaizen implementation in an industry in an assembly line in India that manufactures front and rear axle for heavy and medium vehicles. Kaizen technique has tremendous effect on operations of a firm, including design, distribution, marketing etc. and thus all level of a firm's management. A case study is presented to motivate practitioners to implement in small & medium scale Industries.

Keywords: *Kaizen performance, TPM, JIT, TQM*

INTRODUCTION

Improving customer service, making operation faster, more operation and reduction in costs are challenges faced by manufacturers today. To meet these challenges many companies in India searching to improve their ability to compete globally. Wastage during production process is rapidly growing day by day in industries. This is because of change in taste of the customer. Which will lead to increase in production costs? There are different techniques of waste reduction and performance enhancement like Just In Time (JIT), Total Quality Management (TQM), Total Productive Maintenance (TPM), Kaizen etc. JIT is a strategy for inventory management in which raw materials and components are delivered from the vendor or supplier immediately before they are needed in the manufacturing plant. Their effects are significant in improving the overall performance of the whole organization.

Total Quality Management (TQM) is an integrative philosophy of management for continuously improving the quality of products and processes.TQM concept is based on that the quality of products and processes is the responsibility of everyone who is involved with the creation or consumption of the products or services offered by an organization. In other words, TQM capitalizes on the involvement of management, workforce, suppliers, and even customers, in order to meet or exceed customer expectations. TPM is a systematic approach to eliminate waste associated with production equipment and machinery. TPM focuses on involving machine operator in the routine checks and cleaning of the machine to detect problems earlier. Other areas of emphasis include minimizing machine "downtime" resulting from unexpected breakdowns, fully utilizing a machine's capabilities, and tracking life cycle cost. Kaizen is Japanese technique for "improvement", or "change for the better" refers

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to philosophy or practices that focus upon continuous improvement of processes in manufacturing, engineering and business management.

The Toyota Production System is known for kaizen, where all line personnel are expected to stop their moving production line in case of any abnormality and, along with their supervisor, suggest an improvement to resolve the abnormality which may initiate a kaizen. The cycle of kaizen activity can be defined as:

- ✓ Standardize an operation and activities.
- ✓ Measure the standardized operation (find cycle time and amount of in-process inventory)
- ✓ Gauge measurements against requirements
- ✓ Innovate to meet requirements and increase productivity
- ✓ Standardize the new, improved operations
- ✓ Continue cycle

Kaizen is also known as the Shewhart cycle, Deming cycle, or PDCA (Plan do check & Act). Other techniques used in conjunction with PDCA include 5 Whys, which is a form of root cause analysis in which the user asks “why” to a problem and its answer five successive times. There are normally a series of root causes stemming from one problem, and they can be visualized using fishbone diagrams or tables.

Kaizen helps to:

- ✓ Reduce the human efforts
- ✓ Increase the productivity
- ✓ Reduce the strain of operator
- ✓ Reduction the manufacturing cost
- ✓ Improve the quality

This study was motivated by one high-tech Company’s upper management concern over the behavioral and organizational aspects of kaizen in their organization. Management felt that they had brought about a lot of changes with respect to the technological aspects of their organization, including the purchase of new computerized equipment for manufacturing and a reorganization of the production process to allow for kaizen manufacturing. Very little attention, however, had been given to whether the workers were successfully adjusting to these changes. Although management perceived their kaizen implementation as successful and were pleased with improvements in throughput time, quality and inventory levels, they felt that additional improvements would only be possible if the behavioral aspects of the situation were better understood.

The purpose of this paper is to provide an overview of changes implemented in a Rear Axle Manufacturing company especially in Assembly line over the last six months because of continuous implementation of Kaizen. This case study will reveal how the kaizen system could improve the case company competitive strength.

Background of the Study

Kaizen is a Japanese word that has become common in many western companies. The word indicates a process of continuous improvement of the standard way of work (Chen et al., 2000). It is a compound word involving two concepts: Kai (change) and Zen (for the better) (Palmer, 2001). The term comes from Gemba Kaizen meaning ‘Continuous Improvement’ (CI). Continuous Improvement is one of the core strategies for excellence in production, and is considered vital in today’s competitive environment (Dean and Robinson, 1991). It calls for endless effort for improvement involving everyone in the organization (Malik and YeZhuang, 2006).

Wickens (1990) describes the contribution of teamwork to make the concept of Kaizen. The key role and authority of each supervisor as a leader of his team has been described by taking an example of Nissan Motor Plant in the UK. Emphasis is placed on teamwork, flexibility and quality. Teamwork and commitment do not come from involving the representatives of employees, but from direct contact and communication between the individual and his boss.

Bassant and Caffyn (1994) define the Continuous Improvement concept as ‘an organization-wide process of focused and sustained incremental innovation’. Many tools and techniques are developed to support these processes of incremental innovation. The difficulty is the consistent application of Continuous Improvement philosophy and tools and techniques. As an organization wide process, Continuous Improvement requires the efforts of all employees at every level.

Radharamanan et al. (1996) apply Kaizen technique to a small sized custom-made furniture industry. The various problems that have been identified through brainstorming process are absence of appropriate methodology to assure quality, less compatibility of the individual protection equipment, old machines, and disorganized workplace, inadequate and insufficient number of measuring instruments, lack of training, insufficient illumination at certain places and poor quality of raw material. Suggestions are also given to solve these problems. The main aim is to develop the product with higher quality, lower cost and higher productivity to meet customer requirements.

Balakrishnan et al. (1996) analyze a sample of 46 firms that publicly disclosed adoption of JIT production. Using a matched pair sample of non-JIT firms, they found no significant differences in inventory utilization for the two samples prior to JIT adoption. JIT firms, however, show superior utilization of overall and working process inventories relative to their control firm counterparts after adopting JIT production. Nevertheless, they found that these benefits by and large do not translate into significant Return On Asset (ROA) changes.

Kochan (1997) explain that with the new developed JIT system supported with sophisticated aerial tunnels connecting Ford with its suppliers, production lead times can be minimized, product quality can be improved, responsiveness towards customer demands can me boosted and the most important thing is inventory, space requirements, handling and transportation cost can be dramatically reduced.

Vrat et al. (1997) have conducted a Delphi Study for the applicability of JIT element in Indian context. This study indicated that JIT implementation in India is not an impossible task. Bowen (1998) found that Empowering employees mean dividing problem solving and decision making responsibilities from management level to its individual team directly related with the task. With careful planning and adequate team work, this element will increase quality, productivity and flexibility of the manufacturing process.

Droge (1998) explain that JIT manufacturing results in lower total system costs and improved product quality. With JIT, some plants have reduced inventory more than fifty-percent and lead time more than eighty-percent JIT is lowering costs and inventory, reducing waste, and raising the quality of products.

Burns (2000) describes the importance of two techniques namely Overall Equipment Effectiveness (OEE) and set up reduction, taking an example of Weston EU Company. No appropriate measures of the process and equipment usage are available. Initially, six pilot areas have been identified, out of these three turned out to be successful. OEE is actually used to drive CI in the development of a company. Setup reduction has been applied to reduce change over times, to meet the customer demand for greater product mix and to overcome the difficulties in machine loading. Both techniques are described in terms of how they help the company to drive improvement in the core of Business-70 capital equipment CNC machines.

Prybutok (2001) made an empirical assessment of JIT practices and surveyed implementation among American manufacturers. In both studies, they focused on implementation differences between small and large American manufacturers using ten management practices supposedly constituting the JIT concept.

Doolen et al. (2003) describe the variables that are used to measure the impact of Kaizen activities on human resource. These variables include attitude toward Kaizen events, skills gained from event participation, understanding the need for Kaizen, impact of these events on employee, impact of these events on the work area, and the overall impression of the relative successfulness of these events.

Granja et al. (2005) study the target and Kaizen costing concept in a construction company. The aim is to develop the framework taking together these two matching approaches, which provides a basis for a total cost management system. The authors explain that the continuing series of Kaizen activities are needed to achieve product performance and reduce the cost. Combining target and Kaizen costing is a powerful approach for the construction company by assuring value for the customer at a low but profitable price.

Malik et al. (2007) conduct a survey by a comparative analysis between two Asian developing countries, China and Pakistan, by investigating how they are deploying CI practices. The questionnaire consists of 18

selected blocks of questions related to organization and its operation of CI, supporting tools used in the improvement activities, effects of improvement activities and company background and its characteristics. The result shows
that the industries in both of the countries are deploying CI methodologies, but with different proportions.

Some Related Terms

Kaizen

Kaizen is a Japanese term for "improvement", or "change for the better" refers to philosophy or practices that focus upon continuous improvement of processes in manufacturing, engineering, and business management. By improving standardized activities and processes, kaizen aims to eliminate waste.

Productivity

The ratio between output and input is known as productivity. It may also be defined as the arithmetic ratio of amount produced to the amount of resource used in any production. The resource may be land, plant, labor, material, machines, tools or it could be a combination of all.

Cycle Time

It is defined as the actual time taken to complete a set of activities (one cycle).

Takt Time

It is the theoretical time allowed to produce one product ordered by customer. It can be determined by ratio of net available time by customer demand.

Takt Time = net available time / customer demand

It is used to match the pace of production with customer demand.

MUDA'S

It is a Japanese term which means anything that increases the cost but creates no added value. There are basically seven types of MUDA's:

- ✓ Muda of over-production
- ✓ Muda of waiting
- ✓ Muda in transportation
- ✓ Muda in processing
- ✓ Muda of inventory
- ✓ Muda of motion
- ✓ Muda of defective parts and reworking

MURI

MURI is a Japanese word for overly hard work or the strain. It is an important factor that helps in determining the productivity.

Case Study

Axles India is a joint venture of Wheels India, Sundaram Finance and Dana Holding Corporation, USA. Axles India has the capability to provide Axle Housings for entire range of Medium and Heavy Commercial Vehicles. The production of pressed Axle Housings is at an annual level of 280,000 pressed Axle housings, manufactured in plants at Sriperumbudur and Cheyyar.

Axles India was started in 1982, as a joint venture with Eaton. In 1998, Dana Holding Corporation purchased Eaton Axles Business and Axles India's shares were part of this arrangement.

Axles India commenced production at its Sriperumbudur plant, with an annual volume of 10,000 axle housings to Ashok Leyland. In 1995, to meet the increased demand of domestic OEMs, an additional facility for Axle Housings was set up at Cheyyar. In 2003, facility to manufacture Drive Head assemblies was installed. In 2006, Export oriented unit (EOU) was established for catering to export markets. In 2011, Drive head business was sold to Dana India Private Limited. Axles India supplies to Tata Motors, Ashok Leyland, VE Commerical Vehicles, Dana India Private Limited, SML Isuzu, Mahindra Trucks and Buses and Daimler India Commercial Vehicles. Axles India also exports to Dana, USA and Volvo Trucks Asia.

This company is mainly focused on manufacturing as per customer's design. Axles India currently has a total annual sales volume is INR4.64 Billion and total employees are 544, out of which 316 persons work in Axle division where the case study was taken up. In this division 210 employees are permanent as operator's level and 156 in supervisory. This work is on HVAL, Rear Axle (Assembly Line 1) in which target production is 300 Axles per shift but the current production is 110 Axles per shift (8 Hours). This is due to lack of multiskilled development, lack of training to operators, no proper utilization of resources, and Non involvement of staff in Kaizen Program etc. Our main motto was to achieve the target production and find the factors which are responsible for lack of the production in the company.

For completing a Rear Axle assemblies there are 35 work-stations corresponding 56 operators.'

Problems faced in company:

- ✓ Number of operators like to be exceeds in assembly line.
- ✓ Production efficiency
- ✓ Product cost
- ✓ Turn over of company
- ✓ Quality maintaining problem
- ✓ System for simplification

Implementation Process

These problems were discussed to managerial personals, engineers and operators levels, by considering different factors and found to be improved by using Kaizen. One of the major objectives in implementing Kaizen System is to achieve a common goal of the whole company. The main thing to implement kaizen is improve the level of training, continuous improvement programs and give incentive schemes (providing additional value canteen coupons, Dairy, pens or cash according to saving in product manufacturing) for encouraging the employees. Thus planned programs were run by the Human Resource department to improve skill for the upper level employees. Also training by Internal/external faculties was carried out to create awareness, improving communication and operating skills of the employees. There were involvement of employees through group activities like Quality circles, suggestion Schemes and Kaizen.

JIT was already successfully implemented in that existing company. Electronic Data Interchange Technique was used to Link between Company and its suppliers through monitoring system. This system had achieved quick response in production line and close relationship between company and its supplier. The Production planning and material preparation was stable with respect to end consumption. This leads to maintain inventory at a reasonably low cost. For quality, quality indicators had been employed to examine the achievement of suppliers in quality, on time delivery etc. For encouraging the suppliers, JIT programs were organized and suppliers are invited for participated in JIT program. Mostly supplier companies were near to the case company. Thus supplier can reduce the time spent in distribution and coordinate tightly with company.

Kanban was used for transforming the information throughout the production process hence more visibility in production process. By using Kanban, waste of Production resources or lose of orders can be eliminated and resulting in achievement of balanced production.

Kaizen shows a lead role for improving the productivity and quality of the products. To meet the target/Productivity from 210 axles per shift (8 hours) to 300 axles per shift the cycle time should be equal to the Takt Time and hence meeting customer requirement. The company receives the raw material in the form of cast iron beam, then various operation are carried out on this beam like clamping, putting dowel pins, shellac and gasket, fixing and tightening of stud, picking and tightening of anchor plate, placing Z bracket, putting bush and grease filling, placing oil seal, placing hub and brake drum etc to obtain the final product. Table 1 shows detail of station wise operator's function and time taken for completion of job at their station. Let T1 and T2 are time taken by the operator in completion of job in two iterations. Mean time is calculated for getting the average time for completing a job at different work stations.

Table 1: Station wise details and time taken to complete the job (before KAIZEN)

Station Number	Operator Number	Component Task	Time T1	Time T2	Mean Time
1	1	Loading the Beam	57	54	56
	2	Clamping	30	48	39
2	3	Putting the pressure ring	68	78	73
	4	Tightening of clamps	62	58	60
	5	Rotating it by 90 degree	34	30	32
3,4	6	Putting the dowel pins, apply shellac and gasket & applying silicon paste	70	84	77
	7	Fixing the stand	59	72	66
	8	Tightening of stud	78	84	81
5	9	Picking and Placing drive head	55	67	61
6	10	Putting the nut bolt	67	65	66
	11	Putting the second nut	64	70	67
	12	Tightening the both nut	65	84	75
7,8,9,10	13	Picking of anchor plate (left)	72	68	70
	14	Picking of anchor plate (right)	70	77	74
	15	Tightening (left)	75	79	77
	16	Tightening (right)	74	60	67
	17	Application of thread binder	68	77	73
11,12	18	Tightening of anchor plate (2 workers)	42	54	48
	19	Placing Z bracket	54	62	58
	20	Putting bush and grease fill	58	59	59
13,14	21	Placing slack adjuster, bush and tightening nuts	87	86	87
15,16	22	Placing of Hub (left)	72	80	76
	23	Placing of Hub (right)	50	45	48
	24	Tightening of Hub	40	52	46
	25	Tightening with hand spanner Hammering	55	54	55
17	26	Hammering	24	22	23
18	27	Fitting and tightening of check nut	72	77	75
19,20,21	28	Placing oil seal	30	38	34
	29	Hammering	36	48	42
	30	Tightening	51	55	53
	31	Checking of hub	32	28	30
22	32	Lifting of Shaft (left)	43	52	48
	33	Lifting of Shaft (right)	34	37	36
23	34	Lifting and placing brake drum (left)	41	53	47
	35	Lifting and placing brake drum (right)	32	38	35
24	36	Placing shaft cover (left)	56	54	55
	37	Placing shaft cover (right)	48	52	50
25,26	38	Placing of bolts (left)	16	17	17
	39	Placing of bolts (right)	15	18	17
	40	Tightening of bolts (torque m/cn)	32	28	30
24,25,26	41	Tightening of bolts (hand)	60	58	59
27	42	Checking of axle leakage	81	76	79
	43	Applying shampoo	65	68	67
28,29,30	44	Fitting of oil spanner	74	84	79
	45	Fitting and opening of coupling	63	67	65
	46	Fitting of flushing machine	77	70	74
	47	Bringing the motor for checking brakes	70	75	73
31	48	Detaching the flushing machine	30	32	31
32	49	Fixing the label	51	48	50
33	50	Checking barcode and filling oil	66	64	65
34	51	Removing clamp	55	51	53
	52	Tightening of oil bolt	57	54	56
35	53	Lifting the axle	67	80	74
	54	Attaching hook to right	52	58	55
	55	Attaching hook to left	64	62	63
	56	Attaching hook to middle	57	55	56
		Total Mean Time			**3182 Seconds**

Takt Time Calculation before Kaizen

Requirement: 300 axles per shift (8 hours)
Available time: 480 minutes (8 hours)
Lunch break: 30 minutes
Tea break: 15 minutes
Net available time: (480-30-15) =435 minutes/ shift

Takt Time= Net available time/customer requirement= (435/300) = 1.45 minutes=87 seconds

Thus Takt Time for each operator is 87 seconds at every station.

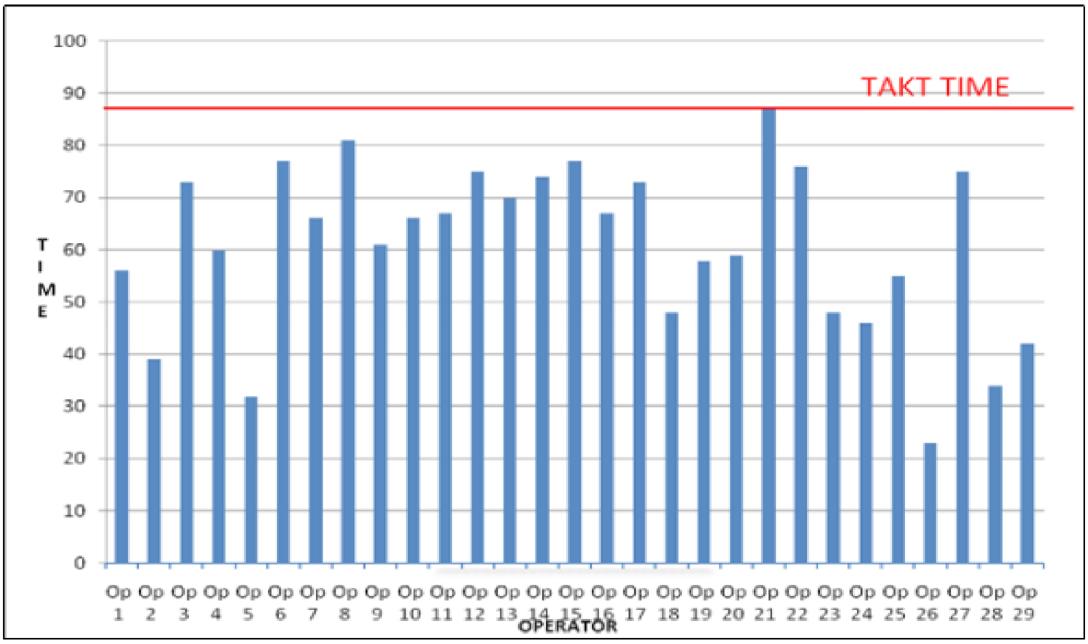

Figure 1: Operator load charts (from operator -1 to operator-29) before KAIZEN

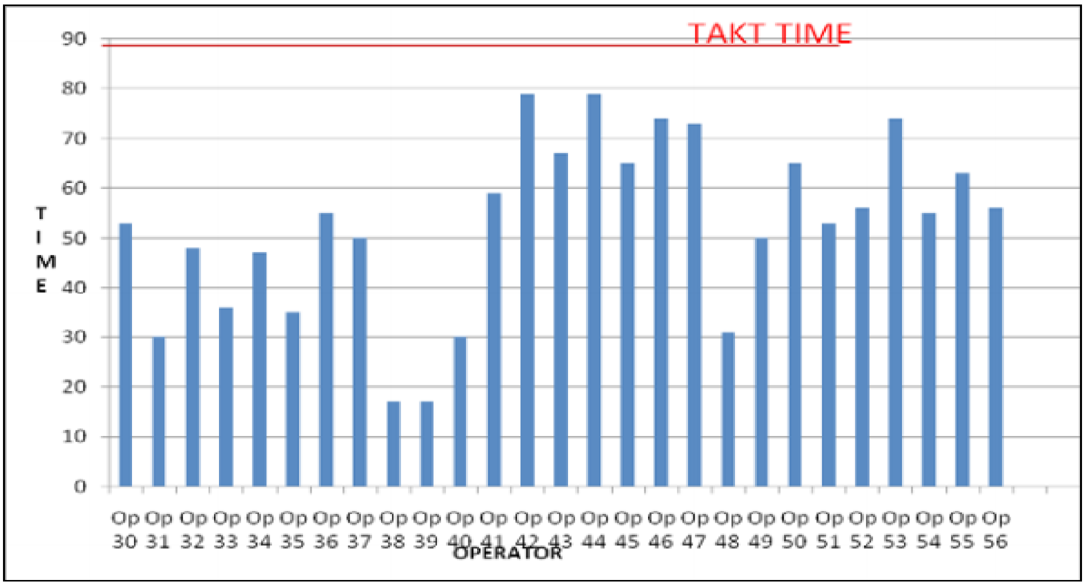

Figure 2: Operator load charts (from operator -30 to operator-56) before KAIZEN

(Figures 1 and 2, Total Operators Load Chart before KAIZEN)

From the above fig. 1 & fig. 2, it is clear that Takt Time is 87 second and no- one operator is close to that Takt Time. Thus there is need for improvement there. As some operators have very less time for their operation like operator no.5, 26, 38, 39, 40,48etc.

Thus there is need for recalculation of number of workers for Assembly Line 1.

Theoretically Calculation for Number of Operators

Sum of mean time =3182 seconds

Takt Time = 87 seconds

Number of operators required = (Cycle Time) / Takt Time

= 3182/87

= 36.57

Hence 37 operators are required to meet the current customer demand.

Thus from this total numbers of operator required for that assembly line is 37 but actual number of operators working are 56. Hence 19 operators are in excess as per calculation. As this calculation is done by theoretically and taking all parameters as standardized. i.e. workers are not able to move from his workstation in any difficulty and they have to stay on his line in any condition (to satisfy their personal needs). Here machine fault time, material delay due to any difficulty etc are not considered. But there is certain need for improving the operator's time to meet the Takt Time in order to meet the customer demand at minimum cost and adequate quality. For this clubbing of operators is required so that they will meet the same target and achieve the quality.

Table-2 shows station wise details and time taken for completion of job after Kaizen where clubbing of manpower and workstation is done to meet the Takt Time.

Hence, number of operator after KAIZEN = 50 To prevent the production of unnecessary (including parts, products and documentations), many ideal facilities are created. Every check points in company are created with these facilities so that operator would not carry unnecessary task and prevent him from industrial accidents. This would reduce in work in process, reduced in production lead time, improved equipment utilization and its efficiency. The current layout of the company is U shape. This will lead to increase workers interaction and reduce in material handling cost.

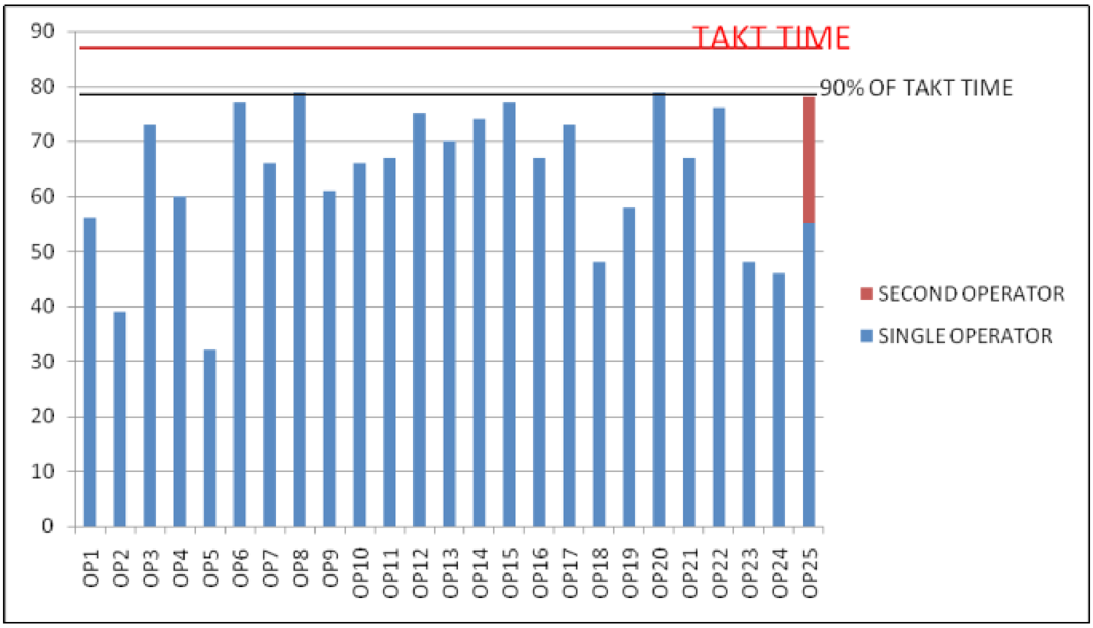

Figure 3: Operator load charts (from operator -1 to operator-25) after KAIZEN

Table 2: Station wise details and time taken to complete the job (after KAIZEN)

Station Number	Operator Number	Component Task	Time T1	T2	Mean Time
1	1	Loading the Beam	57	54	56
	2	Clamping	30	48	39
2	3	Putting the pressure ring	68	78	73
	4	Tightening of clamps	62	58	60
	5	Rotating it by 90 degree	34	30	32
3,4	6	Putting the dowell pins, apply shellac and gasket & applying silicon paste	70	84	77
	7	Fixing the stand	59	72	66
	8	Tightening of stud	78	84	81
5	9	Picking and Placing drive head	55	67	61
6	10	Putting the nut bolt	67	65	66
	11	Putting the second nut	64	70	67
	12	Tightening the both nut	65	84	75
7,8,9,10	13	Picking of anchor plate (left)	72	68	70
	14	Picking of anchor plate (right)	70	77	74
	15	Tightening (left)	75	79	77
	16	Tightening (right)	74	60	67
11,12	17	Application of thread binder	68	77	73
	18	Tightening of anchor plate (2 workers)	42	54	48
	19	Placing Z bracket	54	62	58
	20	Putting bush and grease fill	58	59	59
13,14	21	Placing slack adjuster, bush and tightening nuts	87	86	87
15,16,17	22	Placing of Hub (left)	72	80	76
	23	Placing of Hub (right)	50	45	48
	24	Tightening of Hub	40	52	46
	25	Tightening with hand spanner Hammering	55+24	54+22	55+23
18	26	Fitting and tightening of check nut	72	77	75
19,20,21	27	Placing oil seal	30+36	38+48	34+42
	28	Tightening	51	55	53
	29	Checking of hub and Lifting of Shaft (left)	32+43	28+52	30+48
	30	Lifting of Shaft (right)	34	37	36
22	31	Lifting and placing brake drum (left)	41	53	47
	32	Lifting and placing brake drum (right)	32	38	35
23	33	Placing shaft cover (left)	56	54	55
	34	Placing shaft cover (right)	48	52	50
	35	Placing of bolts (left) and Placing of bolts (right) and Tightening of bolts (torque m/cn)	16+15+32	17+28+28	17+17+30
24,25,26	36	Tightening of bolts (hand)	60	58	59
	37	Checking of axle leakage	81	76	79
	38	Applying shampoo	65	68	67
27	39	Fitting of oil spanner	74	84	79
	40	Fitting and opening of coupling	63	67	65
28,29,30	41	Fitting of flushing machine	77	70	74
	42	Bringing the motor for checking brakes	70	75	73
	43	Detaching the flushing machine and Fixing the label	30+51	32+48	31+50
31	44	Checking barcode and filling oil	66	64	65
32	45	Removing clamp	55	51	53
33	46	Tightening of oil bolt	57	54	56
34	47	Lifting the axle	67	80	84
	48	Attaching hook to right	52	58	55
35	49	Attaching hook to left	64	62	63
	50	Attaching hook to middle	57	55	56

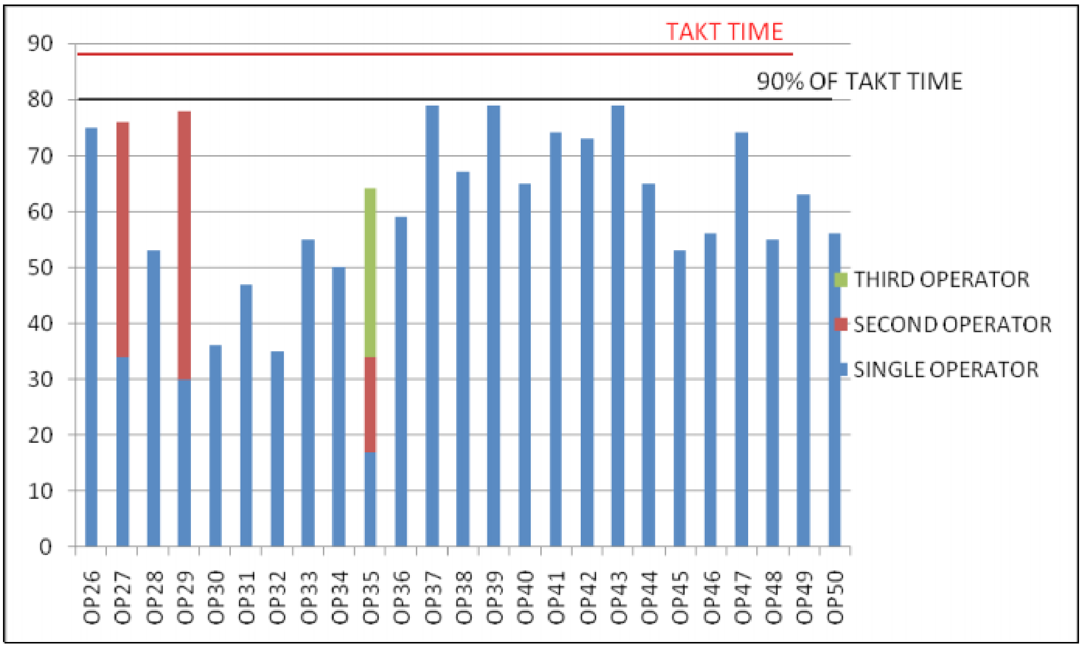

Figure 4: Operator load charts (from operator -26 to operator-50) after KAIZEN

Discussion on Results of the Implementation

From fig. 3 & fig. 4, it is clear that using kaizen techniques number of operators remain 50. i.e. 50 numbers of operators are required for performing the same operation, meeting the customer demand. This was only possible by multi skilled and well trained operators for performing the different task at different work stations and major success was reduced Work In Progress (WIP) at the work stations. In this study operator number 25 has assigned some relevant task along with his work as the mean time for performing

his job was very less. Thus at the same time he will perform these task on the same station. Similarly operator number 27, 29, 35 have to assigned some relevant task at their stations in order to meet Takt time. Thus, after kaizen they will meet the required production and target with the adequate quality. Hence the production is improved from 210 Axle per shift to 300 Axle per shift by less number (50) of operators. One more interested thing is observed from the study that not a single operator after Kaizen reach to 90% of the Takt time. These will results in minimum cost and increase in productivity. This kind of cooperation will strengthen the organization and sprit of the Axle India. So that it can be more competitive in the long run.

Concluding Remarks

In this paper, a case study is presented with the objective of discussing the implementation Kaizen in the industry. Continuous improvement is a key goal for healthy company. Kaizen is a philosophy that needs the involvement of all people in the company. Emphasis should be placed on reduction in throughput time, addition of workstation to meet the Takt time, and elimination of unnecessary operations, activities and workstation. This study proves that with the Kaizen and other techniques, the company can survive with lower manufacturing cost and higher quality. Multimedia can be used in educating the workers about JIT concept and their implementation issues.

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