Financial incentives – a potent weapon for higher productivity

Sasanka Sekhar Ghosh
Global Industrial Engineering Consulting Solutions, Bengaluru, India

Received 17 February 2016
Accepted 1 April 2016

Abstract

Purpose – This paper, in fact is the saga of turnaround of an ailing PSU plant, which in spite of all kinds of improvements measures taken up by the Company had never seen productivity beyond 65 percent of installed capacity. The purpose of this paper is also to showcase the amazing power of financial incentives in enhancing productivity, if rightly designed. On the other hand, it will also serve a lesson of caution to the users by highlighting the extent of damages what a faulty incentive plan can cause.

Design/methodology/approach – The methodology of Lean Six Sigma helped analyzing and improving the problem and tools like "Fishbone diagram" and "Analytical Hierarchy process" were very handy in identifying root causes for this complex problem and prioritization of those, respectively.

Findings – Root cause of low productivity being identified as "demotivated workforce on account of poor incentive earnings", the existing financial incentive plans were given a relook. LSS tools like SIPOC, "heijunka", "brainstorming" etc. were applied for revealing critical faults in the existing financial incentive schemes. Some unorthodox and very common methods were adopted in modifications and implementation of incentive plans.

Research limitations/implications – Modification of incentive scheme involving labor union bargain is commonly resisted by both the parties, i.e. labor unions as well as the management. Although their interest behind the same remains different. One fears to loose, while other is afraid of conceding more. This case study was not an exception too.

Practical implications – Expecting resistances, a good and thorough Shadow working with all kinds of "extremities tests" were prepared. This along with complete transparency followed by well explanations made both the parties happy. Accordingly, the modified incentive plans were agreed upon and subsequently were approved by the management for implementation. Few other remedies and countermeasures suggested were also implemented.

Social implications – The entire workforce was extremely happy and highly motivated. Provisions of equal incentive weightage with ample individual scope of earnings for both rival production groups in the modified incentive scheme successfully converted the inter-group hatred into healthy completion. Both the groups were gearing for much higher performance and earn more. Self-motivations were turned into group motivation, which is always a blessings for any incentive scheme.

Originality/value – Post-implementation period results were extra ordinary and unprecedented. Productivity was significantly enhanced to 15 percent in first six months, which increase up to 39 percent next year. Customer order and quality fulfillment met for the first time, relieving the management from great embarrassment. The annual incremental financial gain was more than Rs 1,000 millions. The methodology of identification of the root causes and the unique style of finding the solution are original in nature and would be helpful and guide for students, professionals of financial incentive designers, industrial engineers, managers and entrepreneurs.

Keywords Analytic hierarchy process (AHP), Pareto analysis, Productivity improvement, Lean Six Sigma (LSS), Heijunka (production levelling), Toyota Production System (TPS)

Paper type Case study

1. Introduction

This paper presents the saga of the turnaround of a prestigious manufacturing plant of an Indian Integrated Steel Company. The plant manufactures primarily two types of forged steel products, namely, Types A and B. The plant was commissioned way back in the seventies with an annual installed rated capacity (termed as rated capacities (RC) herein after) of 90,000 of Type A and 40,000 of Type B (equivalent to 40,000 and 15,000 tonnes, respectively, in terms of weight). Raw materials for these two products are small steel ingots that are also manufactured internally in other plants of the company. Type A has a few varieties ranging from simple to complex shapes; the latter requiring extra precision

International Journal of Productivity and Performance Management
Vol. 66 No. 4, 2017
pp. 554-571

1741-0401
DOI 10.1108/IJPPM-02-2016-0040

machining; while Type B is comparatively simpler and has no variety. Unfortunately, however, performance and yield of this plant, both in respect of quantity and quality, has been a major problem since its inception. Year after year, productivity of this unit remained stagnant around 60-65 percent RC, and over time it became a major challenge for the company. The problem was more painful because all other adjacent manufacturing units, also commissioned during the same time, were performing well – some even well above their RC levels. The management carried out all kinds of efforts from method/process improvements to introduction of motivational incentive plans for the employees. Although productivity improved temporarily this was not to the expected height nor was the improvement sustained for a substantial period. Management, becoming desperate, then decided to technologically upgrade the production line for Type A and to reduce production of Type B. The RC of both lines were also reassessed and downgraded to 70,000 of Type A and 10,000 of Type B (equivalent to 26,800 and 4,700 tonnes in weight, respectively). Apart from these measures, management implemented a number of other steps such as reducing annual production targets, monitoring by senior management, enhancing monetary incentives for employees, and partial outsourcing of precision machining. However, these measures also worked for an initial small period before falling back to the same old levels.

Nobody had any clue whatsoever why the plant was behaving so mysteriously and inconsistently. Faced with this situation, management began to consider even more serious steps than had been instituted previously. However, before committing to more serious action, the study described here was instigated by management as a challenge with the objective of once-and-for-all finding out the real reason(s) for the decades-old productivity problem and, thus, identify remedial measures to save the plant from the brink of closure. The management decided to use Lean Six Sigma (LSS) (Arthur, 2011) given its systematic and structured approach, to identify the reasons for poor productivity as well as to help explore improvement opportunities (Raisinghani *et al.*, 2005). The study described in this paper makes use of the DMAIC process of LSS and of popular tools such as Fishbone diagram, Pareto analysis and analytical hierarchy process (AHP).

The structure of the paper is as follows. Section 1 introduces the case study, Section 2 deals with the major concepts that are applied in Section 3 where the practical activities are described. Section 4 makes some final conclusions.

2. Concepts

2.1 Six Sigma

Process capabilities and process control activities had been undertaken by conventional statistical tools until in the eighties. Motorola first introduced the concept and methodology of Six Sigma for the purpose of stringent quality control and improvement (Raisinghani *et al.*, 2005). Prior to Six Sigma, industrial processes were held to work up to three Sigma level which allows 2,600 defects per million. However, in many modern situations this level was not acceptable such as in the production of the electronic circuit boards or other precision products. With this new requirement, the new paradigm of Six Sigma was introduced in the area of manufacturing strategies. Since its first introduction, the Six Sigma approach has been increasingly adopted worldwide in the manufacturing sector to enhance productivity and quality performance, and to make the process robust to quality variations (Desai and Shrivastava, 2008).

The Six Sigma methodology follows the DMAIC approach, which stands for:

- Define: understanding of process and problem. Formation of team.
- Measure: understanding capability of the process by collecting data and information.
- Analysis: analyze the process, its unevenness, variation and limitation, find out best cause.

- Improve: identify possible corrective measures, shadow working of solution in real-time situation, implement and follow-up.
- Control: verify results and plan to sustain through control mechanism.

2.2 Lean manufacturing

In lean manufacturing, or lean production, practice is based on the principles of the Toyota Production System (TPS) (Dennis, 2016). Lean means doing more with less – less time, less space, less human effort, less machinery, less material – while giving the customer what they want (Dennis, 2016). Lean considers the expenditure of resources for any goal other than the creation of value for the end customer, to be wasteful and thus focuses on eliminating different types of process or waste using a variety of tools and methods to bring about such improvements. Basically, lean guides how to eliminate the wasteful activities by removing the non-value added processes, or activities, from the workflow and thereby making it smoother. Lean manufacturing primarily focuses on four objectives – productivity, quality, cost and delivery time. The approach aims to provide the customer with the highest quality, at the lowest cost, in the shortest possible time while continually eliminating waste (Dennis, 2016). In totality this approach aims to focus on nothing but productivity.

2.3 LSS

As the name implies, this is an integrated methodology combining the approach of Six Sigma and using lean philosophy and principles employed by companies to enhance their manufacturing performance (Thomas *et al.*, 2009). Lean techniques aim to reduce waste, e.g. by reducing changeover time without sophisticated analysis and therefore are not always useful in solving complex problems. Here, the systematic procedure of Six Sigma is found more suitable given its use of statistics and its capability of sophisticated analysis. Therefore, the integrated approach of LSS is increasingly finding favor. Conventional process flow mapping is often relied upon to help understand the bottlenecks, and loopholes; and to indicate whether to apply Six Sigma or lean tools to solve the problem. The LSS approach often looks out for these three major contributors to waste in the process:

(1) overdoing;

(2) unevenness; and

(3) process methods.

2.4 Prioritization using the AHP

The AHP is a useful method for prioritizing alternatives from among causes that lead to the desired goal. The AHP method was originally developed by Thomas L. Saaty (1979, 1980) in the late 70s of the last century. The approach relies on pair-wise comparisons between alternatives and relies on the judgements of experts to derive priority scales. These scales can measure intangibles in relative terms. The alternatives are structured hierarchically at different levels, each level consisting of a finite number of elements that may contribute to the decision-making process. The comparisons are made using a scale of absolute judgements that represents how much more one element dominates another with respect to a given attribute. The judgements may be inconsistent, and how to measure inconsistency and improve the judgements, when possible to obtain better consistency, is a concern of the AHP. In situations containing tangible and intangible criteria, AHP is very useful for prioritizing the alternatives.

2.5 Heijunka or production leveling

Heijunka (Dennis, 2016), as it is called in Japanese, is a technique for reducing the mura (unevenness) which in turn reduces muda (waste). Heijunka was vital to the development of production efficiency in the TPS and lean manufacturing. The Ford "mass production" principle, which relies on stable demand, did not suit the Japanese due to their fluctuating demand. Instead they developed the concept of "lean production," where a mix of models could be manufactured with ease on the production line. This was called "production leveling" or production smoothens. Where demand is constant, production leveling is easy, but where customer demand fluctuates, two approaches have been adopted: demand leveling and production leveling through flexible production.

3. Productivity improvement through financial incentives

Productivity in any manufacturing plant is adversely affected due to imbalances in one or more elements of the important four M(s): Man, Material, Machine or Method. In striving for productivity improvement, one needs to examine the reasons (sub-causes) for productivity deficiencies in all four elements and determine which affect productivity the most. This analysis problem is a chronic one, the task is more difficult and complicated than people often appreciate. Over time, in the manufacturing plant under study, many people have tried their best to improve one or more of these causes. But in the absence of a structured approach, most of those efforts were random and, hence, failed. It was therefore important in this case study to approach the problem systematically with the DMAIC methodology of LSS and, thus, identify all possible reasons for poor productivity and present them in fishbone diagrams for further analysis. Pareto's 80/20 analysis would help segregate the vital 20 percent that caused the most problems and AHP would also be useful for prioritizing these for consideration for improvement. In carrying out these activities, co-operation and participation of the shop's workmen, management and the top management of the company would also be required to be suitably integrated. Accordingly, the improvement and implementation process was planned and accomplished in two phases as described next.

Phase I define:

(1) getting acquainted with plant production processes and work environment;

(2) drafting the supplier, input, process, output, and customer (SIPOC) diagram;

(3) collecting present and past preliminary data; and

(4) writing problem definition statements and critical to quality.

Phase II: measure, analyze and improve:

- study and record manufacturing methods and workflow processes;
- examine products and their specification;
- interact with plant employees and managers to establish details of the problems and reasons;
- understand grievances, address conflicts, share feelings, etc. at the company level;
- brainstorming to list all possible causes;
- categorization of the vital few;
- prioritization of all causes;
- interact with and assist plant teams;
- refine methodologies, reports, etc.;

- analyze the key cause to improve with the available inputs and tools;
- frame the solutions for testing results in real time and past situation;
- report solutions to the top management seeking their co-operation in implementation;
- implement and control;
- work out gains; and
- develop system to sustain.

3.1 Define

3.1.1 Process flow. The plant has two distinct and separate production lines, namely, Type A stream and Type B stream. The process flow diagram of both these lines as observed were as follows:

3.1.1.1 Process flow activities of type a product:

- receipt and storage of steel ingots;
- cutting of ingots into pieces (called as blocks);
- heating of blocks in furnace-I and feed to Forging Press;
- forging in press to give rough shape to Product A;
- reheating of forged products in furnace-II before rolling;
- rolling and dishing of hot pieces to give final shape (semi-finished Type A product);
- stamping;
- heat treatment of black products;
- inspection and testing of semi-finished Type A product;
- partial dispatch of OK semi-finished product to outside agencies for machining[1] or;
- dispatch to own CNC machines group for process;
- receipt of machined finished products from both internal and outside sources;
- inspection and testing; and
- final dispatch to customer.

The above activities were carried out in different "production centers," namely, "Block cutting," "Forging," "Heat Treatment," "Machining," etc. There are a few common crew groups as well to help these production centers like EOT Cranes engaged in material handling, Store, finishing/shipping, tool room, etc.

3.1.1.2 Process flow activities of Type B product:

- receiving blooms from supplier;
- inspection and testing of received blooms;
- gas cutting of blooms into desired lengths for forging;
- heating and soaking of gas cut blooms in reheating furnace;
- shaping of bloom through forging of soaked blooms at pneumatic forging hammer;
- stamping of identification no. on forged Type B product;
- heat treatment of forged Type B product;
- end cutting;

- testing; and
- sending of entire semi-finished Type B products to external agencies for machining[2].

3.1.2 SIPOC data. SIPOC refers to the technique for analyzing a process relative to these parameters to fully understand their impacts. The SIPOC data for the above explained manufacturing processes for Types A and B products are given in Tables I and II, respectively.

3.1.3 Collecting preliminary data. As a part of the define phase of the LSS methodology, preliminary historical data were collected to define the nature and depth of the existing problems. The production records in the previous three years from 2009 to 2011 are as given in Table III.

Data related to breakdowns and defects were also collected for analysis.

3.1.4 Problem statement. The problem statement was agreed as:

> To identify the root causes of poor productivity of the plant, segregating the 20% vital few, priorities among them and improve the prioritized cause for productivity improvement for 100% customer order fulfillment.

3.2 Measurement

The measure phase was performed in three main steps:

(1) process mapping;

(2) data measurement; and

(3) down time measurements.

(1) As defined in the process flow of the Type A stream, it can be seen that this stream has two distinct parts, namely, Semi-Finishing stage and Finishing Stage. The semi-finished stage comprised the main production centers among which the most vital were "Block cutting section (cutting by sawing machines)" and Forging Press, based on performance of which the semi-finished output (black type before machining) of Type A depends. The finishing stage contains only CNC machines.

(2) and (3) From the production data shown in Table III it can be seen that to enhance finishing output, the company sent a sizable quantum of black product for outside machining. Considering 2009-2010 as the base year, there was a 47 percent increase in outside machining during 2010-2011 and as expected the RC utilization was increased,

Supplier	Input	Process	Output	Customer
SMS	Steel ingots	Sawing/Cutting	Cylindrical blocks	Heat treatment furnace-I
Block cutting	Blocks	Heating	Hot blocks	Forging Press
Forging Press	Hot blocks	Forging	Rough product	Reheating furnace
Reheating furnace	Soaked product	Machining and shaping	Rolling Mill	Heat treatment furnace-II
Heat treatment furnace-II	Rolled black product	Tempering	Finished rough product	CNC machining/Outside machining
CNC machining	Rough black product	Machining	Machined product	Inspection and testing section
Outside parties	– do –	– do –	– do –	– do –
Inspection and testing section	Machined product	Testing	Finished OK product	Dispatch section
Start boundary				End boundary
Raw ingots from supplier				Final product for sale

Table I. SIPOC data for Type A manufacture

Supplier	Input	Process	Output	Customer
Outside supplier	Steel bloom	Gas cutting	Bloom blocks	Re-heat furnace
Reheating furnace	Bloom blocks	Heating and soaking	Hot bloom blocks	Forging Press
Forging Press	Hot bloom blocks	Pneumatic forging hammer	Shaped axle	Reheating furnace
Reheating furnace	Shaped product	Stamping	Shaped and stamped product	Heat treatment furnace-II
Heat treatment furnace-II	Shaped and stamped axles	Heat treatment	Heat treated product	Cutting machine
HT furnace-II	Heat treated product	End cutting	Finished axle	Inspection and testing section
Inspection and testing section	Machined product	Testing	Finished OK product	Dispatch section
Start boundary Raw blooms from Supplier				End boundary Final product for sale

Table II.
SIPOC data for Type B manufacture

	Type A					Type B	
Year	Outside machined no (annual % change)	Internal machined no (annual % change)	Total saleable (nos)	% RC (annual raw % points change	% APP	Output (nos)	% RC
2009-2010	19,537	26,905	46,442	57	71	7,189	35
2010-2011	28,650 (47%)	25,647 (–5%)	54,297 (17%)	66 (+9%)	75	7,122	35
2011-2012	22,826 (–20%)	22,561 (–12%)	45,387 (–16%)	55 (–11%)	70	5,243	30

Table III.
Yearly production

to 66 percent (a raw percentage points increase of about 9 percent). But the trend was negated next year as productivity declined by 11 percent in spite of 17 percent increase in outside machining w.r.t "9-10" baffling the management. The problem was not different in the case of Type B. With this background, it was decided to explore the problem from its root and to closely interact with workmen and shop floor management. Some of the important observations are briefly outlined below:

- All production centers and material handling system were manual. Equipment used for material handling was limited to Fork lifts and EOT cranes.
- Production of semi-finished black Type A depends upon the capacity and the operational time of the Forging Press. But this vital equipment was found to be grossly underutilized. Its maximum operating range was only 200-220 units of forged Type A per day as against its rated output capacity of 340 forged units per day. Some of the important reasons for the under-performance of the Forging Press were shortage of blocks, frequent breakdowns and input restriction of CNC machining.
- Shortage in block cutting in turn was due to aged and inadequate sawing machines as well as the practice of only using two shift operations a day, leaving one complete shift unused to carry out preventive maintenance.
- The CNC section was affected by operator's restricted practices with an availability of less than 15 machines at any time.
- High rejection percentage was another vital reason, due to stringent inspection criteria and testing done by the customer-employed external agency.

- The entire workforce including shop management was highly demotivated. Negative qualities like mistrust, non-cooperation, frustration, etc. had engulfed the entire plant. Employee morale was at its lowest.

3.3 Analysis

The third phase of the DMAIC process dealt with the listing of all possible main causes and sub-causes responsible for the low productivity based on valuable information and data collected during the previous two phases. This phase also made use of tools like fishbone diagrams to systematically record and analyze all these causes and sub-causes as illustrated in Figure 1.

Since many of the causes and sub-causes were intangible in nature, the AHP was applied to prioritize the criticality of the different causes of low productivity by assigning comparative weightages as assigned by a number of experienced multi-disciplined company officials.

3.3.1 Prioritization for the main causes of low productivity. This section illustrates the use of the AHP, which was used to prioritize the main causes of low productivity. As shown on the fishbone diagram, the main factors that needed to be ranked with regard to their effect on the productivity were the famous four of Man, Material, Machine and Method. These factors were ranked against one another using the AHP method as shown in Table IV. Since the principle of AHP is based on primarily individual judgments for accuracy, the participation of a group of a few key officials of the company were obtained for judging the pair-wise comparisons.

The weightage factors in the AHP scale are allocated as 1, 3, 5, 7 or 9 (which stands for importance as equal, moderate, strong, very strong and extreme strong). Similarly, weightage factors of 2, 4, 6 and 8 can also be allocated as intermediate values between any of the above

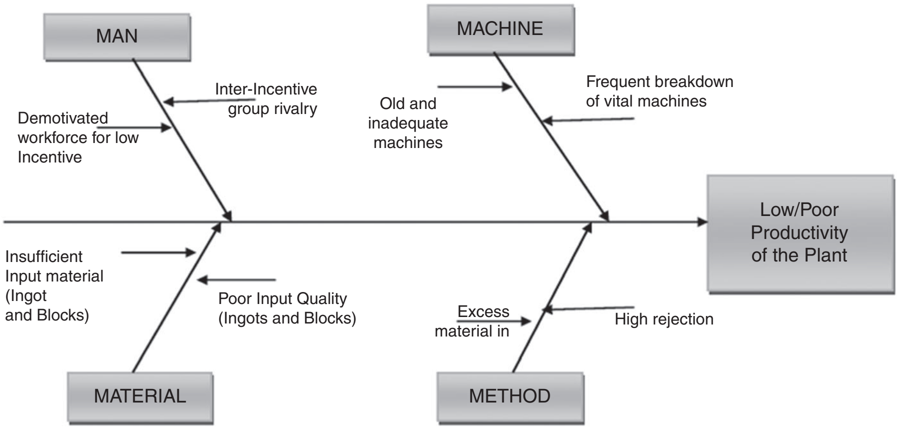

Figure 1. Fishbone diagram leading to productivity

Table IV. Prioritization of main causes (example of one official judging the weightages)

Factor	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Factor
					More important than							Less important than						
Man					5													Material
Man	9																	Method
Man							3											Machine
Material					5													Method
Material												**4**						Machine
Method															**7**			Machine

defined values depending upon their relative importance. The evaluator would judge the influence of one factor compared to the other factors in affecting productivity and assign values appropriately. For example in row 1, when comparing the influence of Man to the influence of Material on the productivity, one of the evaluators sees that the Man has a higher influence than the Material and has given it five out of nine. In the case of row 2, comparing the Man's influence to the Method's influence, this evaluator sees that the Man has a higher influence than the Method, so he gives a grade on the left scale with a weight of nine out of nine. Further, the main causes were divided into sub-causes as shown on the fishbone diagram in Figure 1.

Using the AHP method, the weights of the sub-causes were also calculated in the same manner and normalized weights were calculated as shown in Table V. Refer to Saaty for a complete explanation of the AHP method and the calculations of the relative weights for the sub-causes.

Figure 2 shows the ranking of the eight sub-causes based on the normalized weight as per aggregations of the decision-making group's pair-wise comparisons in descending order. It can be seen from this chart that demotivated workmen had the highest impact as the cause of "low productivity" compared to that of "Old & Inadequate machinery" or "Frequent breakdown" and so on until the factor "Excess material in semi-finished product" which had the lowest weightage.

The important tool "Pareto chart or 80-20 Rule" was used to recognize the vital few causes that have the most influence on productivity. The analysis indicates the vital few causes that generate the majority of problems. Based on this principle, the analysis carried out on the eight sub-causes of AHP analysis clearly shows (as indicated in Figure 3) that the major cause, namely, "demotivating workmen," was responsible for 36 percent of the productivity problems and that half of the causes were responsible for approximately 80 percent of the problems.

Table V.
Prioritization of causes and sub-causes

Factor	Weightage	Factor	Weightage
Man	0.55	Demotivated workmen	0.36
		Inter-incentive group rivalry	0.07
Material	0.13	In-sufficient input (ingot and block)	0.12
		Poor quality input (ingot and block)	0.09
Machine	0.29	Old and inadequate machinery	0.14
		Frequent break-down	0.14
Method	0.04	Excess material in semi-finished item	0.04
		High rejection	0.04

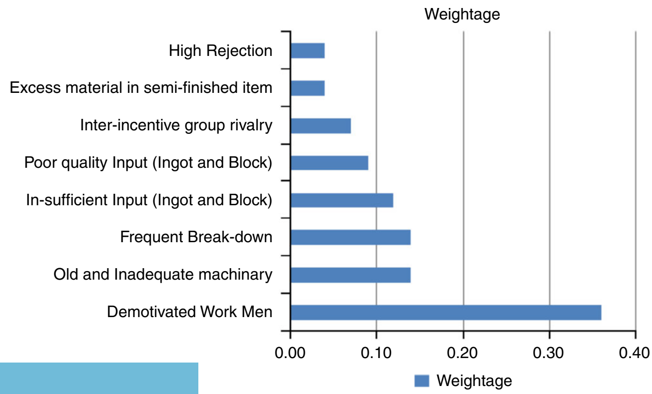

Figure 2.
Ranking chart of sub-causes

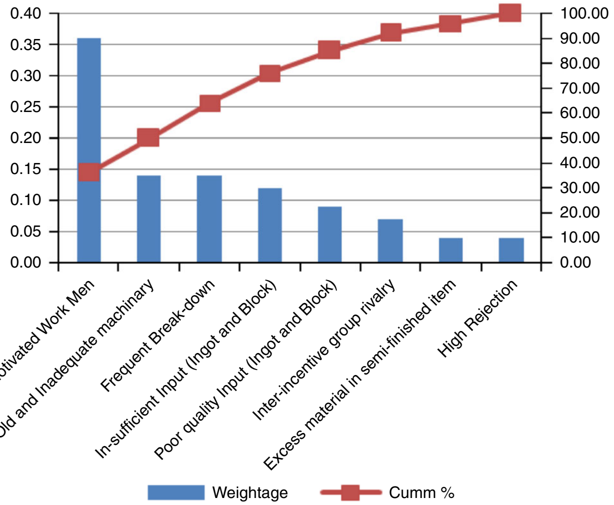

Figure 3.
Pareto analysis

3.3.2 Analysis of 20 percent causes. Guided by these valuable clues, the attention then was centered on the vital four causes, in particular on "demotivated workforce," which has the highest weightage of 36 percent. It is a well-known fact that the role of the human is important in a manufacturing plant, especially those where little automation is in place.

It is not only manufacturing operations, but other operations like materials movement, testing, inspection, dispatches, etc. which are highly labor intensive. In manufacturing industry, particularly in steel plants, the bulk of this manpower happens to be un-skilled/semi-skilled, making this problem more difficult. It was obvious that the role of workmen would certainly play a strong decisive factor in effecting the plant's productivity. During the measuring phase, it was also evident from the interactions with different cross-sections of employees, labor unions, and shop floor line managers as well as with top management that:

> The primary reason for employee grievance was their "low bonus or production incentive earnings" compared to their co-workers working in other adjacent manufacturing plants of the Company. They believed that their best efforts were not getting reflected in terms of incentive earnings due to the "defective incentive plan" and the "higher rejection" rate because of external testing and inspection. Mistrust between management and workers, and inter-group hatred and non-cooperation between different productions groups were prominent other reasons. For example, the Forging group blamed the CNC machining group for low incentives or the Type B group had complete disregard for the Type A group.

Accordingly, before considering the remaining causes of low productivity, it was first decided to relook at the existing incentive plan for possible solutions.

3.3.3 Examination of existing incentive/reward schemes. There were two motivational incentive plans for the employees:

(1) CU incentive scheme: this is the primary and permanent incentive plan, which is designed for long-term goal achievement. It is based on equipment capacity, since their rated outputs decide the plant's capacity.

(2) Reward scheme: this focuses on short-term gains. This scheme attempts to motivate employees to achieve monthly production targets set for the plant based on annual budgeted production target, commonly known as the annual production plan (APP).

These two areas are now looked at in more depth.

3.3.3.1 CU incentive scheme.

(1) Salient features of capacity utilization-based incentive scheme (plan):

- This incentive scheme has two incentive groups, Groups I and II, coinciding, respectively, with the production lines for Types A and B products. Group I was based on production norms at 100 percent of rated output of 15 CNC machines (i.e. 70,000 finished and OK output of Type A per annum) and Group II was based on 100 percent rated output of Forging Hammer w.r.t 16,000 finished Type B product annually.
- However, the same incentive amount is payable to all employees of this plant but at a linkage of 90:10, meaning that if Rs 100 is to be payable as total incentive, then Rs 90 is earned from Group I on account of the performance on Type A and Rs 10 is earned by Group II based on the performance on Type B product.
- The incentive earning starts at 60 percent of RC utilization and extends up to 110 percent of rated output with incremental steps of 1 percent.
- Because Type A product varied from simple to complex in shape, each category was assigned with a credit factor (CF) (decided on actual work contents of finished Type A products) and is multiplied with the physical number produced to give equivalent number for the purpose of incentive computation.
- The eligibility for incentive payment went up to second line executives and the maximum incentive potential was about 20 percent of basic pay for the respective grades (amounting to approximately Rs 2,000 to 3,500 for the lowest and the highest grade employees).

Points of grievances: *employees*. The actual incentive earnings were around Rs 500 to 1,200, and were only 30-35 percent of the total potential (Rs 1,500-3,000 per month). In other words, about 65 percent of the incentives, i.e. Rs 1,000-2,300, remained un-utilized. But their co-workers in other areas of the company were earning 85-100 percent of the maximum potential.

Management. The percent RC utilization was merely 65 and 56 percent w.r.t Types A and B, respectively, including substantial external machining support. Moreover, since almost all Type A products were complex in nature, they could not expect additional incentive.

(2) Examining the incentive plans:

- LSS's "Heijunka" principle was used to find a solution to this complex problem. In TPS, the principle was used for "Production Leveling" to smooth out or remove unevenness in the mass production system to improve flow by planning small batch sizes of products/processes and scheduling their manufacture. In this case study, this principle was used as far as possible to smooth out the unevenness/bottlenecks, if any, in the incentive plans which were restricting the natural flow of motivation and efforts in maximizing productivity *vis-à-vis* incentive earnings (i.e. workers and management) for customer's satisfaction. In this endeavor, a number of uneven aspects were observed in the exis2ting incentive plans as discussed next:

(3) Identification of unevenness/anomaly/bump observed in the existing incentive plans:

- One major "unevenness" was observed in the incentive criteria of Group I. The under-performance of the internal CNC machining group led to partial outsourcing of the semi-finished Type A products, which helped the plant to maintain the same productivity level. This was possible because of the unperturbed performance of all the units preceding CNC machining, in particular the "Forging Press" and "Block cutting by Sawing machining group." In other words, in the changing situation, the fulcrum of production performance had already shifted from the CNC machining group to the Forging Press, which was primarily responsible for semi-finished Type A products. But the incentive criteria of Group I continued to rely unduly on the performance of CNC machining group. Therefore, this aspect needed to be smoothed by giving similar or equal credit to the Forging Press, which would help boost its performance. Since virtually there was no restriction in the intake of semi-finished Type A products by outside machining agencies (since plenty of vendors were available), any enhanced production would easily be absorbed by them, which in turn would raise the productivity level of the plant.

- Further, the incentive norm of the Type A product was based on the cumulative rated capacity of 15 CNC machines, while in reality, only 14 machines remained manned round the clock. On an average, one machine always remained subject to a major breakdown, thereby reducing the actual output proportionately and adversely effecting incentive earning. This anomaly also needed to be taken care of for the smooth operation of the scheme.

Similarly, the incentive norm for Group II based on Type B product was also found to be too high and injudicious. As a result, it was restricting this group to qualify for any incentive and eventually proving to be demotivating for its employees. Examination revealed that the incentive norm was based on the original capacity of Type B product when the production line was fully equipped and operational. But when the line was trimmed off during the nineties, the norm had not been revised and therefore it needed to be done.

3.3.3.2 Reward plan.

(1) Salient features of capacity utilization-based incentive scheme (plan):

- This reward scheme was a hit or miss type based on APP of Types A and B products expressed in terms of combined tonnage (unlike CU the scheme which is based on numbers). The reward scheme offers five levels of monthly production targets (calculated from the annual plan). These levels start from 80 percent of the monthly APP and range to 100 percent in 5 percent increments.
- The reward amounts for achieving these levels were a lump sum amount (equal for all grades/sections) of Rs 1,000, 2,000 and 3,000.

Points of grievances: in spite of all out efforts, support, coordination and supervision, the plant had never achieved more than 65-70 percent of APP, and that too was very inconsistently achieved. Because of this poor performance, employees were highly demoralized. They felt the target set was unachievable in this old plant. Shop management was on the receiving end of regular criticism. Many executives were penalized either by non-promotion or lack of transfer.

(2) Identification of unevenness/anomaly/bump observed in the existing Reward Plan:

Two important uneven aspects were noticed in the existing Reward plan:

- Reward targets expressed in "tonnage": in the internal system of this plant, all aspects like customers" orders, equipment capacity, production reporting, incentive plan norms etc. were expressed in terms of "numbers" w.r.t. a type of product. The shop employees also talk and understand "numbers," but the "reward targets" of this plant were expressed in terms of the unfamiliar terms of "tonnage."

- Joint Targets for Type A and Type B: similarly, the second "unevenness" observed was regarding "joint reward targets for Types A and B." In this case also, this appeared to be very unusual, because apart from joint reward targets, nothing was found common for these two products. They greatly differ in all respects, such as: shape, size, work content, weight, price or even their manufacturing process.

3.4 Improve phase

3.4.1 Modification of CU scheme. Once uneven elements were identified, modification to create the new incentive scheme became much easier by simply smoothing them out. The salient features of the modified scheme are briefly outlined below.

Two incentive groups were retained but completely redefined as follows:

- Primary group: this comprises the employees responsible for manufacture of semi-finished Type A product and also the entire crane handling personnel. The performance of the group would be measured based on the rated capacity output of the Forging Press with an incentive norm of 310 equivalent numbers of OK semi-finished Type A products. All varieties of semi-finished Type A products were assigned respective credit factors (CFs) based on their work content taking one variety as standard. The physical numbers of units produced of any semi-finished product variety is multiplied with it's own CF to give equivalent numbers. All are than added together to total qualifying equivalent number of units of Type A product.
- Finishing group: this group was redefined to comprise all the remaining employees including employees working on Type B products. However, the norm and respective old weightage factors for all varieties were retained as the rated capacity output of 15 CNC machines as existing, but the qualifying production would be computed for performance measurement as below:

$$\text{Qualifying equivalent OK finished Type A}$$
$$= \text{Actual equivalent nos of OK finished units of Type A} \times \text{MF}-1 \times \text{MF}-2$$

  where MF-1 is a credit factor for operating with 14 machines and MF-2 is a credit factor for production of OK finished units of Type B[3]:
- Incentive linkage: another vital change proposed was in the computation of final incentive earnings with the aim of striking some balance as well as keeping competitive edge between the earnings of both the rival groups. The final incentive for a group would be calculated as follows:

$$60\% \text{ based on own performance} + 40\% \text{ on another group's performance}$$

3.4.2 Shadow calculation. Tests of the efficacy of the scheme in real-time situations as well as an "Extremities Test" were carried out. The projected results showed a marginal increase in incentive earning (only Rs 60-110) with the existing production level and gave handsome returns in extreme conditions, thereby assuring win-win situations for both the concerned groups, i.e. the employees and the management.

3.4.3 Resistance from top management. No incentive scheme or Six Sigma project could be implemented without approval of the top management. And as expected in this case study face resistance from the top management. This is because any management was normally averse to discussing incentives issues because of fear of encouraging negotiations with unions. However, after detailed discussion and projected working results being divulged, the project was passed and the incentive scheme was approved for implementation.

3.4.4 Negotiation with forum unions and implementation. The next important stage was a very difficult phase for any new incentive plan. But, in this case, the previous mutual work and discussion on the difficulties and strengths of existing and potential plans helped prepare the ground. Further, during the various rounds of meetings the scheme was thoroughly explained with all its modalities and calculations, advantage-disadvantages, scope and limitation. Projected results were also shown with various levels of productions *vis-à-vis* earnings. Finding that the scheme had equal opportunity and scope of earning, all factions of the labor unions, including the troublemaking CNC group, were happy and finally the scheme sailed through smoothly. The modified plan was implemented successfully during mid-2013.

3.4.5 Implications of the incentive plan. The implications of the incentive scheme were clearly visible from the time the scheme was set to "go live." In 2013, there was an increase in output of about 15 percent, which rose up to almost 39 percent in the next year compared to the base year of 2010 (refer to Table VI). The annual production of 58,000 units, or nearly 5,000 units a month, of Type A was a figure management had been wishing to see for a long time, but was always beyond reach. As the yield increased, the incentive earnings of the employees also enhanced substantially. Further, a great satisfying point for the workmen was that the earnings of the rival groups were more or less the same but, at the same time, the plan provided ample opportunity for a decent competitive edge for workers to maximize their own earnings with added efforts. The balanced and handsome incentive earnings for the first time made everybody happy and brought a positive harmony among all groups. A visible improvement was noticed in the employee morale, attitude and coordination. During the break-down of equipment, as a matter of self-interest, the operations people extended helping hands to the maintenance employees to restore operation quickly. Supervision was at its lowest. Restricted practices among workmen reduced considerably resulting enhancement of operation time.

3.4.6 Modification in the target-based reward plan. On seeing the unprecedented success in the incentive plan, the management then showed its extreme interest in bringing similar modifications into the target-based reward plan with the expectation of fulfilling customer demands. Based on the detected unevenness, the following modifications were proposed in the reward scheme:

(1) The monthly reward target levels to be expressed in terms of "numbers of products A or B" instead of the present practice of expressing targets in tonnage.

Year	Annual Production in Nos. Primary Group				Annual Production in Nos. Finishing Group				
				% Incr. w.r.t Base Yr	Internally Machined		Outside Machined (special)	Total	% Incr. w.r.t Base Yr
	Common	Special	Total		Common	Special			
2010	27300	23523	50823		16331	6186	19537	42054	-
2011	24102	32040	56142	10.5	15474	6736	28650	50860	21.0
2012	25130	27625	52755	3.8	13562	6302	24476	44341	5.44
2013	18700	41622	60322	18.7	11634	15792	20764	48189	14.6
2014	30141	39017	69158	36.0	19576	15019	23656	58251	38.5

Indicates Pre-implementation period

Indicates Post-implementation period

Table VI. Production performance analysis

(2) In place of "composite" single tonnage-based reward target for both products, there would be separate reward targets for Types A and B products in terms of numbers.

(3) The reward payable should be the same for all employees of the plant based on a weightage of 80: 20 for Type A: Type B, i.e. for a reward of Rs 100/-, the plant needs to earn Rs 80/- from attaining targets w.r.t. Type A and Rs 20/- on attaining targets w.r.t. Type B.

(4) The amount of reward money remained the same for achieving the three level reward targets at Rs 1,000, 2,000 and 3,000/.

3.4.7 Impact of APP reward scheme modification. Despite the simple modifications made in the plans (which few top managers opposed during implementation and expressed their serious doubts of any positive effect), the results were stunning. The impact of modifications on both the products in the financial year 2013-2014 is shown in Table VII for both pre- and post-implementations periods.

As can be seen from Table VII the average output of both types of products were enhanced significantly after implementation of the scheme (Type A output from 3,300 to 5,186 and Type B products from 470 to 800). Further, such an increase occurred consistently for two consecutive financial years, namely, 2013-2014 and 2014-2015. The increase in Type B was really worth drawing attention as in two months (January 14 and March 14) the production even exceeded the highest target levels. This increase was not special because of the first time since the plant's inception but for being achieved in a plant which had no matching facility. Similarly, in the case of Type A also, in two months, record production of 6,000 were achieved. These outputs were the outcome of sheer motivation of people to achieve rewards.

Month	Type A	Type B	Type A	Type B
	Production (Nos)	Production (Nos)	Qualifying level	Qualifying level
January'2013	3,100	487	**NQ**	**NQ**
February'2013	2,750	362	**NQ**	**NQ**
March'2013	3,710	576	**NQ**	**NQ**
April'2013	3,664	445	NQ	NQ
Monthly Avg	3,306	468		
May'2013	4,680	614	Level 2	**NQ**
June'2013	4,352	705	Level 1	**NQ**
July'2013	4,906	780	Level 3	Level 1
August'2013	4,748	850	Level 2	Level 2
……	……	……	……	……
January'2014	5,436	1,050	Level 5	Level 5
February'2014	5,056	970	Level 5	Level 5
March'2014	6,034	1,115	Level 5	Level 5
……	……	……	……	……
November'2015	5,689	797	Level 5	Level 4
December'2015	6,007	818	Level 5	Level 4
Monthly Avg.	**5,186**	**804**		

Period before implementation **Period after implementation**

Table VII.
Reward performance analysis

3.5 Financial impact

The average financial gain based on current market price of Type A and Type B products *vis-à-vis* extra expenditure on incentive/reward was worked out as under (Refer Table VIII):

(1) Considering the average unit selling cost of Types A and B as Rs 50,000/ and Rs 18,500/, respectively, the annual augmented revenue on increased output works out to:

$$= [(\text{Rs } 50{,}000 \times 1{,}880 \text{ nos}) + (\text{Rs. } 18{,}500 \times 336 \text{ nos})] \times 12 \text{ months}$$

$$= (\text{Rs } 94 \text{ million} + \text{Rs } 6.21 \text{ million}) \times 12$$

$$= 10 \text{ crores} \times 12$$

$$= \text{Rs.}120 \text{ crores (Rs. 1.2 billions)}$$

(2) Considering average extra incentive/reward earning @ Rs 3,230/ for all grades of employees (approx. 500 employees), the total annual extra expenditure works out to:

$$= \text{Rs. } 3{,}230 \times 500 \times 12 \text{ months}$$

$$= \text{Rs. } 1.93 \text{ crores}$$

$$= \text{Rs. 2 crores (Rs. 20 millions) (approx)}$$

(3) Thus, the apparent gain works out approximately to Rs 118 crores (Rs 1.18 billions) annually by a mere 1.6 percent additional expenditure toward incentive/reward.

3.6 Control phase

In order to sustain and further improve the performance, the following control plan was suggested for implementation as shown in Table IX.

4. Conclusion

Apart from becoming a great savior for a plant which was at the brink of closure, the actions described in this case study have many other significant contributions too:

(1) It is a testimony of the astonishing power of financial incentives in motivating employees for delivering excellence, in spite of the fact that they already enjoy a handsome salary. Thereby proving those critics wrong who always argue against the utility of financial incentives for salaried people.

(2) This work is also an excellent example of profit maximization by improving productivity to a great extent. The revenue gains that the plant achieved were a substantial figure of about Rs 1.2 billions per annum.

(3) Apart from financial gains, there were many intangible benefits also, like improvement in the workers' morale, reduction in restricted practices, increase in co-operation, behavior change, dedication, loyalty, etc.

Periods	Yearly avg. monthly finished production in nos Type A	Type B	Avg. monthly incentive and reward earning per employee for all grades (Rs)
Before modified incentive scheme	3,306	468	1,331
After new incentive scheme	5,186	804	4,561
Avg. monthly increase	1,880 (57%)	336 (72%)	3,230 (242%)

Table VIII. Financial impact of modification

Table IX.
Control plan communicated for implementation

Recommendation	Action plan	Frequency	Benefit
Inspection and testing of incoming ingots	To identify surface defects and discarding	As and when lot arrives	Unproductive sawing time to be avoided to improve yield of blocks
7×3 operation of block cutting section	Provision of suitable manpower	Regular	Enhanced yield of blocks
One sawing machine to be kept down a day	For preventive maintenance	All seven days	Reduction in slant cutting and improved yield of block
Visual display of production	Electronic display board at convenient place	Immediate	It will facilitate motivation for all out efforts
A suitable tongue type fixture be designed and attached in the EOT crane for lifting hot Type A product	Manual fixing be stopped	One time	Seven men ($2 \times 3+1$) released. They can be trained and redeployed in block cutting section for its 3 shift operation
Reward targets with its benefits to be published for employees	At various locations of shop floor	Every month	Help achieving levels
Monitoring of breakdown jobs	By senior supervisors	Regular	Help reducing frequency
Adoption of TPM	In HT furnaces and Forging Press	Regular	Help reducing breakdown

(4) It also signifies the importance of correct and suitable designed incentive plans for delivering the desired objectives. Alternately, it has also identified the extent of devastation and damage.

(5) This case study has shown the limitation and hesitancy on the part of top management in dealing with incentive issues. The fear and suspicion about the worker's unions must be the reason behind it, but the case has shown that if management comes out with transparency and clarity, negotiation with labor unions may not be difficult.

(6) This work is also an eye opener for top management about the importance and versatility of Six Sigma projects. It has once again established the utility and usefulness of the structured methodology of LSS for identifying and solving complex problems.

(7) Last but not least, this case study could be a showcase for the common belief that "Small and insignificant factors sometimes result in big achievements." In the case of the reward scheme, nobody had thought or believed, how simple and ordinary solutions of "converting monthly targets into numbers" or "Splitting the composite targets" could deliver so big contribution.

Acknowledgment

Statement of competing interests: the author has no competing interests.

The author expresses his sincere thanks and gratitude toward the plant authorities for extending their warm co-operation, access to all facilities and staffing, as well as funding of the carrying out and completing this project. The author also is indebted to the then ED (works) and IED colleagues for their valuable suggestions and technical assistance. The author expresses his gratitude to the workmen and management of the plant concerned for their co-operation and valuable feedback.

Notes

1. Due to performance limitation of the company's own CNC machining group, semi-finished products were decided to partially outsource to a number of agencies for outside machining.
2. Machining operation of Type B product was outsourced to external agencies a while ago.
3. Multiplying factors were credited to the final performance based on unevenness observed w.r.t. CNC machines and Type B products. MF-1 was an empirical formula so devised that it would enhance the final productivity so long as 14 or a lesser no. of machines are operational and becomes null and void if all 15 machines are available. Similarly, MF-2 also boosts up the final index based on the actual production of Type B up to a maximum of 10 percent.

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Corresponding author
Sasanka Sekhar Ghosh can be contacted at: ssghosh33@gmail.com