Chapter 3 – Lean System & Innovation

Case Study 7 – Overall Business Application

Bread and Butter Company (BBC) started its business a couple of years ago down when customers preferred bread to other food items in their breakfast. Today the market has seemingly turned narrow for bread or sandwiches. The high nutrient rich breakfast like corn meal, rice crisps and oats meal are taking over the market share as opposed to bread butter or a simple sandwich which appears to be aged old talks. BBC was about serving the kind of bread their customers wanted. The breads were custom made, ready in no time on order, and delicious, exactly how they need to be. The prices charged for the products offered were on high end since it was the only store of its kind in the area covering 50 kms of east Georgia. Georgians were fond of the unique service offered and the taste filled their morning experience with happiness.

The business prospered and profits increased phenomenally on a year-to-year basis. The prosperity called for additional space and resource requirement. BBC contemplated that since they would have to hire more staff to meet the increasing demand and the space, they were trying to lease was more than what they could use, they planned for add-ons to their current production line "breads and sandwiches". They started selling frozen food items, deserts, beverages, and meals for train passengers. The Bread and Butter Company was now known as "Just Taste It" (JTI). They started to hire new people with flawless cooking skills. There seemed to be more supply than the demand and it appeared that commoners had great cooking talent and were interested to learn more to take it to an altogether newer level. The staffs were welcomed to share their unique recipes and team gathered to prepare items based on the ones selected and approved. The employees started preparing meals on a prior anticipation of demand including excess meals for any stock outs. In a month or so, the warehouse seemed to be a chaos full of raw materials purchased from various suppliers based on suggestions of staffs and prepacked meals. The kitchen was out of space to accommodate the current staffs comfortably. The myriad ideas took JTI in a mirage creating problem in coordination among staffs since many of their ideas had to be dropped and others that were welcomed created a negative cost benefit equation.

The bread and sandwich business was hit by the negative publicity of the train meals business since JTI had to compromise on quality to earn enough profit to keep the meal business up and running. Gradually the loyal clients turned down on them and started to switch to other caterers. The management of JTI was wondering if at all the business should be continued since there were not enough orders and the pre prepared meals are getting wasted thereby burdening the firm with huge costs. The frozen items, desserts and beverage business were the only support they had. Clients continued to buy those items considering frozen items, desserts and beverages were just bought and served to them on a margin. JTI ended up losing customers trust and had no other option but to stop preparing anything for them. They thought of bringing a changeover and presenting themselves as retailers rather than preparers of meals, breads and sandwiches. The management of the company was in desperate need of a savior that could prevent the demise of JTI.

One of the management people, Mr. Juniorson contacted you and approached you for some valuable ADVICE in this regard. He also came up with their income and expenses (refer Annexure) so that you could provide some insights on how to overcome the loss-making situation and rebound back to a prosperous profit earning history.

Required

Consider yourself as a management accountant who was referred by one of the friends of Mr. Juniorson. He has following questions in his mind that clogged all doors of ideas to revive.

i. What are we doing wrong?
ii. Is there any way JTI could continue its current business?
iii. We need to save on costs and regain the lost trust of customers. How do we do this? You see there was no dearth of loyal foodies when we use to sell just breads and sandwiches. Even though we charged high prices back then we never had to confront such predicaments we currently are in.

ANNEXURE

"Just Taste It"

Statement of Income

(Amounts in ' 000)

	Year Ended December 31,		
	2019	**2018**	**2017**
Revenue			
Breads and sandwiches	41,000	45,000	49,000
Desserts and frozen food	92,000	79,000	68,000
Beverages	47,000	34,000	30,000
Meals	77,000	1,20,000	1,34,000
Total	**2,57,000**	**2,78,000**	**2,81,000**
Costs and Expenses			
Food items as raw materials	1,10,000	95,000	78,000
Ready-made frozen	33,455	28,727	24,727
Desserts purchased	46,920	40,290	34,680
Beverages purchased	39,048	42,857	46,667
Labor	40,000	35,000	31,000
Other operating expenses			
Rent	11,000	11,000	11,000
Insurance	5,000	5,000	5,000
Rewards to staffs	5,500	4,000	2,400
Packaging cost	4,000	3,400	2,800
Transportation cost for meal delivery	3,500	5,500	6,000
Total	**2,98,423**	**2,70,774**	**2,42,274**
Net Income	**-41,423**	**7,226**	**38,726**

1. Since beverage market was competitive commanding high profit was never an expectation.
2. Frozen items were sold at a markup of 10% on purchase cost Georgian preferred frozen foods and fresh foods equally.
3. Desserts are all time favorite irrespective of seasonal variations.
4. Of the deserts and frozen revenue, 60% sale was dedicated to desserts.

5. 50% labor was identified towards meal preparation,40% towards sandwich and breads and rest 10% for serving desserts. Beverages did not take labor hours since they could be refilled in self-serving dispensers through which clients were served. Once they served themselves with their choice of beverage, they stood in lines to complete the billing of the service.
6. Of the cost of food as raw materials, only 40% was dedicated to earning bread and sandwich revenue.
7. Rewards to staffs were paid on basis of their recipes being approved.

Product/ Service Wise Analysis (Rs.)			
	Year Ended December 31,		
	2019	**2018**	**2017**
Revenue from breads and sandwiches	41,000	45,000	49,000
Less: Cost of food items	44,000	38,000	31,200
Less: Labor	16,000	14,000	12,400
Gross Profit	**-19,000**	**-7,000**	**5,400**
Revenue from desserts	55,200	47,400	40,800
Less: Cost of desserts purchased	46,920	40,290	34,680
Less: Labor cost	4,000	3,500	3,100
Gross Profit	**4,280**	**3,610**	**3,020**
Revenue from frozen food items	36,800	31,600	27,200
Less: Cost of frozen food items	33,455	28,727	24,727
Gross Profit	**3,345**	**2,873**	**2,473**
Revenue from beverages	47,000	34,000	30,000
Less: Cost of beverage products	39,048	42,857	46,667
Gross Profit	**7,952**	**-8,857**	**-16,667**
Revenue from meals	77,000	1,20,000	1,34,000
Less: Cost of meals			
Food as raw material	66,000	57,000	46,800
Labor	20,000	17,500	15,500
Other operating cost directly identified	9,000	9,500	8,400
Profit	**-18,000**	**36,000**	**63,300**

Solution

i. The idea to expand the business by diversification of product line and adding new products/services like frozen items, train meals, and desserts, delivery of foods to passengers at train were all directed towards growth and a better future for business. This gave an additional edge over other bread manufacturers in the area since the more products offered the more awareness among the customers. However, the manner in which the business was executed seems to lack proper planning and organization which is very much needed for survival of any business. Further a business success depends on the execution of correct strategies meaning doing the right thing at the right time and in the right manner. So, let us see what were we doing and what should have been done.

Manufacturing process in any business is a combination of series of activities, where we need to identify which activities should be chosen and which should be excluded. This calls for application of lean thinking in the conduct of those activities. The concept was originally introduced by producers of a Japanese car manufacturer company named Toyota. They were of the view that to make a production process efficient waste of all forms must be eliminated from such process. They identified those activities as waste which consume resource but are of no value addition from an end consumer perspective, thereby increasing the overall production cost and time.

Basically, they meant that not only the design of the product or the utility of the product but the production process itself should be customer focused. This is possible when we can segregate each activity as value creating and non-value creating activity from customer's view. In order to do this, we need to list all our production/ service activities and then map each activity keeping customers' value in mind. During this mapping, we consider location of each machine, each human resource and the effort required to move resources in order to be at the production location. Then an attempt is made to eliminate all the non-value creating activities listed.

Having enumerated the idea of lean manufacturing, let us see how this could be applied in JTI's scenario. There are number of things that need attention. First of all, the lean thinking is based on just in time production whereas JTI is producing on prior unexpected demand basis for the fear of stock outs. We must remember that when operating in service industry and that too when dealing in food items, maintaining quality of the food items (considering the perishable nature of some items) becomes the top priority. We must design the production process in such a manner that safety and retaining the nutrition of the foods to be served remains ahead of everything. Customers always desire their foods to be fresh and to contain all the expected nutrition value. In such a situation, pre preparing the meals and storing them is not only a non-value-added activity but also a prolific challenge to the food safety requirement. Thus, going by the lean concept, JTI should prepare meals based on orders received or should pack meals just enough to serve the customers on the same day. This is one of the mechanisms not only to work smart but also to drive two forms of waste palpable in the production process, one is the cost of storing the pre prepared meals and the other is the wastage of prepared food that was prepared in anticipation of stock outs. Preparing fresh food will not only be a better value addition approach from customers' perspective, but it will also boost quality and reinforce customers' trust thereby adding a competitive edge over others.

Next change over required would be to switch the basis of commission paid to staffs. Currently staffs receive commission for the recipes approved irrespective of the cost incurred to JTI in implementing such recipes. Executing any recipes requires assembling of raw materials to prepare the food item, which bears a financial impact on the firm. Purchase of raw materials from various suppliers based on staff recipes and their suggestions have led to huge cost burden on the firm leading to a negative cost benefit ratio. Purchase activity is a significant puller of cost and therefore purchase department is considered as a cost center. Systematic operation of purchase department is highly imperative to control cost and achieve efficiency. Purchase activity should be related to production activity which is a direct factor of demand. Therefore, rather than acting on staff suggestions, purchases should be made based on requisitions from production department which has to operate based on just in time approach. Moreover, it is

also felt that staff participation has not been guided in the right manner since it has resulted in more disharmony than teamwork. Rewarding them based on their recipes rather than asking them to redirect their cooking efforts to the financial interest of the firm and to the satisfaction of the customers, sounds an incorrect encouragement. Working at below the optimum coordination levels result in under use of skill and cooking talent which is truly perceived in this situation.

The other issue perceived is the disorganized warehouse due to lack of systematic purchases and over involvement of staff in purchase activity. To achieve maximum production efficiency, building a favorable working environment is utmost necessary. This requires providing cooking staffs with organized clean kitchens and limited access to warehouse. Further limited access to warehouse will help to keep it more organized. Currently it seems storage facilities of raw materials and food items are totally messed up. We need to introduce an effective housekeeping system such that warehouses are organized systematically with all raw materials arranged employing specific techniques like 5S for storage and organization. This will lessen the time required to locate them when on demand thus removing the bottle neck developed due to time consumed for non-organization.

ii. The current business situation appears to lack planning and systematic approach. With a strategized planning focusing customer satisfaction in mind, JTI will be able to continue its current production activity instead of its planned switch over to just retailing activity. When looking at the financial figures, we have five products to focus on. Currently JTI only manufactures two of those and they are breads & sandwiches and train meals. The other three are just purchased and served at a margin.

It should be noted that sandwich business got a hit due to quality compromise in meals business and thus to revive this business, we must not only control quality of sandwiches but also re boost trust of customers in the train meals.
The beverage business is good and requires a little amendment since beverages will have to purchased and served for a margin. So, it is not a cause of much concern.
Now coming to frozen food items and desserts, it is recommended that JTI should make a detailed financial analysis of buy vs. manufacture option considering all the related costs and revenue. In some cases, in-house production of these items has proved more profitable to firms rather than just an outright purchase and service. Moreover, JTI would need to keep in mind the current resources available and the possible resources it could gather provided it decides to switch over to in-house production, given the financial positivity.
For the meal business, as suggested above, the production process needs a complete change over right from the just in time production to systematic purchases and implementing housekeeping system for achieving organized storage facilities. These strides will help to reinforce customer trust in the train meals and thereby rebound the entire JTI business. As we can see that meals business will have to be systematized first so that the sandwich business can see a positive business environment. The meal business is directly dependent on maintaining quality which can be perceived by it turning into a loss-making business of Rs 1.8 Cr. in year 2019 which used to produce profits of Rs 6.33 Cr. back in year 2017 and Rs 3.6 Cr. back in year 2018.

iii. Regaining customer confidence is no rocket science for JTI since it had successfully proved its success in past when it was known as the Bread and Butter Company. The company was

known for its quality and customers did not resist paying a higher price for celebrating their happiness in the food they want. Due to series of undesired happenings, the focus of JTI shifted from customer, which it needs to bring back. A correct focus can ensure its move in the guided direction.
So JTI needs to perform as per customers' expectation bringing to their table what they exactly want, also ensuring a positive cost benefit ratio for the firm. It requires reengineering of the way they currently work. This is the key to turn things favorable and ensure business success irrespective of what industry we choose to operate in.

For cost saving strategies, JTI needs to associate some direct cost to the revenue it earns. For example, commission paid to cooking staff should be based on the customer satisfaction which is key to increased revenue in service industry. We can keep a control mechanism for this. Asking the customers to rate their experience with the food and the staff service would help the firm to improve with the changing needs of customer and rate and reward their staffs. This will ensure that the firm incurs costs towards generation of revenue. We also need to know what kind of transport mechanism is used to deliver the meals to customers on train. To save transportation cost, it is better to use in-house transportation vehicles rather than outsourcing the activity. This will ensure timely and responsible delivery of meals at reasonable cost to the firm. Further we must not forget that redesigning the meal preparation process will call for less storage and therefore less packing. This will save significant packing costs.

Case Study 8 – 6 Sigma & 5S

Welcome Foodies (WF) was a small restaurant in and around the busy city of Newtown. The city was located in the banks of river Terresa and was known for its tourism value. The visitors often passed days visiting the prominent natural attractions and the scenic beauty brought them back again. They also treasured the culture of the town and adolescence of the local surroundings. It was simple down to earth. It was untouched by man-made interventions like infrastructures and celestial buildings. The people down there had the culture of visiting bars and restaurants at the evening time to undo the monotony of the day. They liked sitting with their friends, close relatives and chit chatting their busy schedules and what special they did throughout the day, how things went fuzzy, which ought to have been straightforward. The not so civilized 'life' went calm until the development of a highway that connected Newton city to the "infrastructural sound" city called Angel. In no time, the Newtown found itself crowded and overburdened to accommodate the daily passengers from highway and near surroundings. This made the State government consider the development of infrastructure in the Newton and additional hotels to welcome the growing tourism business. This led to a drastic changeover in the restaurant business of Welcome Foodies.

It started getting busier and was brimming with food lovers all over the day. WF being a family owned and self-funded business took this ambience as a door of opportunities to recover the previous losses it had to book long back at its outset. It was thinking to expand its business and open new restaurants in the town, but the funding was yet a trouble since its credibility was questionable to lenders. WF could borrow just enough funds from its familiars to hire additional staffs to serve the growing crowd. Albeit the new staffs were recruited, they lacked proper skill and knowledge of the service industry that WF was into. Most of the staffs were the local people of the city who knew no fancies of alluring the customers with their smiles

and warm heartedness. They had to work overtime for low pays since WF was in debt, paying the peaking expenses of production and processing of food items. Given the rising bills and heightening cost of raw materials, it had to escalate the prices of the items served in the menu card. Notwithstanding the rise, the WF chain was easy on their guests' pockets compared to other posh dine place out in the city and so the customers resisted subtly and then continued to walk in as before.

The operating efficiency of the restaurant began to decline with the increasing numbers, also somewhat perceived by the incoming customers. The owner heard his customers' conversation:

Customer Mike: Hey there how are you doing? Well! I wonder why we have to wait so long when many tables are lying empty. Doesn't the restaurant feel like harassing their customers without any cause? My mood gets ruined for the wait and I plan to seek other nearby places to dine. What about you?

Customer Davin: Yes, you are right. I also feel like claustrophobic having to dine among the proliferating crowd. Hey, guess what, I heard the owner is short on finances and he could hardly do anything to get himself out of this hell, at least not in the near future.

Customer John: The waiting time is ridiculously long. I mean I had to wait 20 minutes on a peak Friday, which I do not mind but here I believe they hardly care to manage this.

The lines got bigger on the Fridays and weekends since the cleaning boy and his partner used old cleaning techniques and were reasonably slow. Several people went ahead and decided to leave rather than wait any further.

The hospitality business demanded unwavering flawless customer service which started to shake. Because of dearth in finances, enough staff could not be placed at required locations which turned things chaotic.

The kitchen environment was not sound either. They used outdated equipment to prepare the food stuff and the manual cleaning of dishes was a big trouble altogether. With the increasing demand for service, no adjustment was made to the number of kitchen equipment. The short number of kitchen staff tried their best to manage things in order, but they could not help to deliver with required speed since they had to clean the equipment manually before every use. The ingredients of the items were not well arranged adding to stress and the wait time of service. Some items like onion garlic paste, boiling of vegetables, chilies, sauces and pickles ought to have been prepared before the restaurant opened for guests. No such arrangement was in place. Some raw materials were in short supply while some were more than the demand, which perished. There were three chefs in the kitchen each specialized in a given cuisine. However, they were not groomed to switch efforts in times of necessity, they but were asked to do this anyways and the results were atrocious.

Sometimes the guests found their tomato soup containing odd ingredients like mushrooms or potatoes and sometimes the guests so claimed 100 % vegetarian dish was found to comprise fish or chicken remnants. This situation called for significant quality issues on the processing of food in the most unexpected manner one could think of.

Moreover, the lax kitchen staff had the customer request on their table, which they did not accede in the order received. Some orders were served early while some customers kept seating for long time, waiting for their food to show up on the plates.

The billing machine was not modern and cashier had to manually enter price and other specifications of each item ordered and served.

Most of the times, the only supervisor was found snuggling in his chair. He did not care to advice the waiters and other assistant staffs to improve. As a result, staffs persistently made same mistakes and guests were forced to report the complaints to the restaurant manager, who was also the owner. No leadership role was identified among the staffs.

Some staff took leave on weekends and returned on Tuesdays. They lacked motivation to stay during the peak weekends. When any staff was missing from his respective role, the manager replaced the position since he wanted to save on currency.

The hygiene of the place was also questionable. The floors were watery and smelt nasty, the tables seemed to have contained foods, oils and spilled over sauces. The guests carrying their kids were nervous about their small ones slipping over the floor. On a total, it raised concerns about cooking and cleaning habits of the staffs working there, thereby escalating the health risk of the guests.

The business saw its doom and the customers began looking for dining options in the surrounding area.

Consider yourself as the family advisor of Mr. Bean, the owner and successor of his father's business. He is aware that you have a cost management degree and are working in one of the multinational firm's accounting department. Luckily, he has had the chance to hear about your achievements of successfully implementing strategies to assist the firm in rejuvenating its struggling business and now he wants you to work on turning things around for his restaurant business. He had tears in his eyes while narrating the entire story.

Required

i. DISCUSS which managerial technique could be used to "turn things around" as Mr. Bean wants?
ii. How could this be done? RECOMMEND improvement techniques in each area of disparity.

Solution

The current situation of Welcome Foodies, a small family-owned restaurant, resembles lot like that of dissociation of staff efforts, unplanned activities and need for reengineering of business activities. The processes there contain lot of known defects that are being continuously overlooked. There are several quality issues as well, not just in some phases of the service but holistically in series of activities. So, when defect is the prime issue to focus upon, we look for total quality management to render the product/ service defect free to ensure the long run success of the business, but here we need to take a step further discussing the roots of the issue rather than just simply working on the symptoms. For example, long wait time of guests is considered as symptom, while the root cause is disorganized staff team and non-strategic output towards a

destined focus, i.e., customers. Frankly, we are talking about Six Sigma strategy to get the changeover done.

While people often relate six sigma methods to manufacturing firms and the industry itself, service industry could very well adapt it pragmatically. The forerunners of the technology were Motorola and General Electric who gave a scientific solution to the all-pervasive quality issue evidenced in the day today businesses. Quality issue in physical product means compromise in the shape, size, color, design, taste, or any other form that reduces its true expected utility. Quality issue in service on the other hand means variation in the customer's standard experience set as per industry norms. Defect therefore means a quality issue that leads to the failure of any product or process. Six Sigma entices one not just to deliver defect free product/ services but also to reduce waste by eliminating errors. The steps involved to improve existing business processes are define phase, measure phase, analyze phase, improve phase, control phase. Now let us see how we can implement each phase to improve the WF's business situation.

Define Phase

This is the foundation of other phases of the methodology on which they rest. Under this phase, we identify the processes that need improvement, the goals and scope of improvement. In WF's case, the goals of improving the service process are below:

a. Exuberating the customers' overall dining experience including reduction of total wait time.
b. Achieving enhanced staff communication and coordination ensuring unclogged flow of information.
c. Ensuring the rendering of ordered food items as per description in the menu card.
d. Kitchen chefs to prepare and process food items as per their skill set.
e. Reduction of the overall processing time of food items once orders are received.
f. Resolving hygiene concerns.

Measure Phase

Under this phase, we are primarily concerned with gauging the problem, meaning seeking a quantitative tool to define the problem so that it can be used to measure the current performance.

Moreover, we also need to employ effective data collection techniques to obtain data about the current performance. The success of this phase depends on the validity of the data collected.

We must keep in mind that only when the current performance is quantifiable, we could compare it against the standards to identify the variation. These are the traditional steps to bring about an improvement in any process.

We catalogue numerous basis to measure each issue to be improved as indicated in the goals above.

a. Number of customers leaving the restaurant for having to wait too long.
b. Number of unhappy customers not returning back.
c. Number of complaints reported against staff misbehavior.
d. Average wait time per customer.
e. Average food processing time per simple item and per complex item.
f. Number of accidents due to nasty floors.
g. Number of complaints against food quality and order mismatch to description in the menu card.

Analyze Phase

This phase involves establishing the root cause of the symptoms palpable in the deficient service process.

a. In WF, it would be vital to itemize the entire restaurant service processes in the order of their occurrence. This can help firm to look at things in a serial manner rather than taking plethora of activities all at once.
b. Customers enter the restaurant.
c. Receptionist greets and asks them to wait in the waiting area until their names are called upon.
d. Cleaning team clean the tables once the guests are done eating.
e. Receptionist calls the guests in the order of their arrival.
f. They enter the dining area, seat on the indicated table, place order of the food items of their choice from the menu card.
g. The waiters take the order to the chefs in the kitchen for preparing the ordered stuff.
h. Kitchen chefs prepare and process the food ordered, served on plate, to be taken up by waiters.
i. Waiters serve the food to the guests and check with them for coming requests.
j. Waiters keep visiting kitchen and serving stations to get the requested stuff on the table.
k. Finally, guests finish their dine; request the staffs to furnish the bill of the service.
l. The cashier prepares the bill, taken to the guests for payment.
m. Guests pay the bill and leave the restaurant.
n. Cleaning team again starts the cleaning process to make room for other guests in the waiting area.

In this way, the whole process gets broken down into small sub processes. This is the true effort involved in analyze phase. Once all the activities carried out are identified we need to bifurcate them into value added and non-value-added activities, basically we need to pull the bottlenecks out of the entire process to bring efficiency.

Improve Phase

This phase is all about recommending alternatives and implementing them to resolve the established issues. For example, if the issue at hand is about two cars falling short for picking up the employees to render an effective pick drop facility, the alternative is to employ more buses or cars to do the same. Where the firm is unable to do so, it can resort to third party services who deliver this form of service. It will end up in choosing the alternative that is financially more feasible.

In our case, we can clearly perceive humungous scope of improvement. First of all, we must keep in mind that the effective wait time of customers in the service business is a critical factor for success. The long wait time of customers in the waiting area can be directly ascribed to age old cleaning techniques of the staff. The idea here is to introduce innovative techniques of cleaning the tables such that it takes hardly any time to get the table ready for oncoming guests.

Next it is also evident that staffs of WF are not well groomed and lack appealing strategies to enhance the dining experience of their guests. Organizing frequent training sessions to boost their marketing skills like placid smile and greeting the guests with warm- heartedness; keeping up a continuous check of their requests and fulfilling them on timely basis; making them aware of any special coupon or discount that the restaurant puts up; can all bring a drastic change in the

customer's apprehension of the WF's services. Hiring people with supervisory acumen will help staffs to be aware of their scope for improvement and rule out their possibility of repeating same mistakes.

Now let us see what could be done on improving staff coordination. Staffs should be motivated to work as a team rather than on stand-alone basis since it is the combined effort that is representative of WF identity. Any bottleneck in unbound communication should be outrightly removed so that things flow in a streamlined fashion. It is also necessary that WF hire additional staff to meet the growing need of the city such that manager can dedicate himself to the top priority matters rather than playing multiple roles. An efficient reward system should be put in place to ensure each staff's effort in the process is recognized and rewarded for. This will motivate them and push their determination to work productively rather than missing on peak weekends and returning on Tuesdays. If they work with efficacy during their normal hours, the need of overtime would also reduce.

Finance requirements can be fulfilled by building up good creditability among customers such that an effective business plan itself can propel the lender to provide the required finances.

Further, more kitchen equipment will have to be purchased and cleaning techniques have to be explored such that kitchen staff work productively rather than working laboriously. Just three chefs sound like a real short supply of cooks, driving them to prepare things they are not trained for. The WF should adopt strict food processing policies such that chefs are allowed to prepare only cuisines for which they are groomed. This will ensure complying with strict food quality standards to accentuate no compromise in food quality. Moreover, a fixed processing time of both simple and complex items should be specified and it should be the policy of the restaurant to abide by the same.

Organizing kitchen equipment and food ingredients would eliminate the additional time required to locate them. WF can apply 5S methodology here to cleaning out the working area and maintaining the cleanliness to improve process quality. 5S means sort, set in order, shine, standardize, and sustain. WF needs to ensure that no unnecessary items like perished ingredients/food items, old equipment, and old cleaning tools are seating in the kitchen (Sort).

To bring in more efficiency, we must place frequently used items in easily accessible locations and place occasionally used items at bay (Set in order). For example, a veggie sandwich making store can organize its veggie counters near to its ordering and processing center, so that it takes them less time to prepare sandwiches once order is received. Scientific arrangement helps not just in saving time, it also boosts workplace cleaning. With order comes cleanliness in the workplace (Shine). WF should adopt best practices of the industry or make one to be adopted as the constitution (Standardize). For example, in present case, we need chefs to prepare food items only for they are specialized. Monitoring the adopted practices under 5S model is also no less important. This ensures that we can upgrade those practices if situation demands (Sustain).

Prefixing startup items like sauces, pickles and serving them with starters will help eradicate the wait time once guests are ready with their orders. Employing advanced food processing machineries will drive efficiencies and help meet new standards of WF.

The hygiene concerns can be easily dealt with by applying planned and innovative cleaning ideas to clean the dining and waiting area and using sign boards to warn the subsisting guests of the ongoing cleaning process.

Bringing in automatic scanners and advanced technology will eradicate the manual entry of order details and their prices to prepare the bills, thereby ruling out the possibility of manual errors and thefts.

The Control Phase

This phase deals with adequate determination to put into practice the policies developed under the "Improve Phase" and ensure its persistent compliance in the rendering of the service. Once the policies become culture of the people, it would be hard to be discern them without such policies. As part of control phase, the changed performance is measured at regular intervals to establish any variances from the expected standards.

Case Study 11 – Business Process Innovation

DIC is one of several insurance companies which offer insurance policies covering general risks relating to individuals and his/her family members. Since past three years DIC has seen the volume of business increase, but profits have remained static due to declining margins. Cost efficiency is a major factor in the success of the companies in this industry, because competition within the industry is high.

Some of the processes within DIC are computerised. However, many of the processes which involve communication with customers are still paper based. Responses to telephonic queries from customers involve paper-based communications. Additionally, sales staff visits potential customers in their homes to try to sell them insurance policies for their homes and their possessions. These transactions are again paper based. This process is often slow and has led to complaints from both customers and the company's sales staff. DIC has also been receiving regular complaints from current and potential customers about errors in the paperwork that they receive. The number of complaints is increasing day by day.

The Board is worried about growing popularity of new style of business using the Information Technology. The Board intends to streamline the business model as much as possible, re- engineer the business processes and to increase the profitability of the company. It was finally decided that there is a need for a Business Process Re-engineering (BPR) programme to be conducted and the Board has asked the management accounting department to help with the planning and implementation of the programme.

DIC intends to computerise fully, all of the work done. However, while some members of the staff are welcoming the BPR programme, others have expressed concern about business process reengineering and its implications for them.

Required

i. How BPR can be implemented? ADVISE.
ii. DISCUSS the improvements that might be expected from introducing BPR.
iii. RECOMMEND, performance targets which DIC could introduce to ensure that the re-engineered processes enable it to achieve its key business objectives.
iv. Why DIC's staff might be concerned about BPR and its implications for them? EXPLAIN.

Solution

i. To implement BPR, firstly, each business process of DIC needs to be divided into a series of processes. Then each business process requires to be documented and analysed to find out whether it is essential, whether it provides support to other valuable processes and whether it is adding value. Any process which does not add value or does not provide essential support to the value adding activities must be removed. Those processes remain; require to be re-engineered/re-structured, so that can be as efficient as possible. For DIC, technology should be introduced to improve these processes. However, DIC must ensure that the statutory compliances regarding these processes are not undermined.

DIC is facing a hyper-competitive marketplace where customers expect superior benefits. BPR activities would help DIC in understanding those processes which DIC's customers value the most and remove those that are not valued. It is likely that BPR may increase costs in short-term as investment in technology. However, this would also reduce substantial levels of manual activities and processes, thereby providing speedy services to customers. In long term, this would result in high levels of efficiency, profitability and better levels of customer satisfaction and retention.

ii. Improvements expected by implementation of BPR

Fast information processing and error reduction – The processes at DIC have not been updated to take advantage of the Information Technology systems that are widely available today. In particular, relying on a predominantly paper-based system makes DIC's processes much slower than they need to be and it also increases the chances for errors as information is manually recorded and then transferred between departments. A new electronic database-led system is the need of the hour, where any information can be entered into the central database on a real time basis, and the system can then be continually updated for other staff to use. Therefore, no paper-based transfers of information will reduce delays in systems and reduce the risk of errors occurring.

For example, if an enquiry is received over a telephone, staff can access the database and gather all the relevant information of that particular customer. This faster response time and error free feedback should lead to improved customer satisfaction.

Better facilities for salesperson – Having an online real time database and improved technology might also help the sales staff when they visit potential customers. If the salesperson can access the database remotely from their laptops, they can get every minute detail of policies and premiums and so could potentially make a decision about a policy application then and there. Thus, speeding up the process should directly address the complaints of slow processing of files.

For example, If a sales person goes to sell the X policy to the potential customer, however if the customer is interested in Y policy, the same can accessed immediately online.

Motivating staff leading to overall improvement – The advance technology provided to the salesperson will not only encourage them to do their job more effectively, but it will also motivate them. Moreover, customers are likely to have a more favourable impression of the salesperson if they provide a quick and efficient service more importantly which is error free.

This, in turn, will lead to the salesperson making more sales and likely to increase their motivation still further. Therefore, leading an overall improvement.

Parallel processing – The paper-based nature of DIC's current system means that tasks have to be done sequentially. However, one of the principles of BPR is that linked activities should be conducted in parallel rather than sequentially. In this case, if DIC improves its Information technology systems and stores customer details digitally, staff may be able to deal with different aspects of a customer transaction in parallel, thereby speeding up the transaction process.

For example, if a customer wants to pay premium for its existing policy at the same time wants to enquire about a new policy, both can be done.

iii. Key business objectives

The areas of concern of DIC are reducing the time taken to process transactions and improving the quality of the paperwork and so it is likely that it will have business objectives relating to these areas.

DIC should have performance measures looking at these areas, in order to assess how well the re-engineered processes have helped to improve performance in relation to them.

Performance targets

Speeding up the process

The slow speed of the current process is a major source of complaints; therefore, DIC desires to speed up the process. Slow work pace can be among the most difficult problems to resolve unless organisation/(s) have standards or goals against which to compare actual performance. 'Number of transactions completed within a given time needs to be measured'. For example, Data entry people may be expected to process so many entries each day from the paper-based data however on real time data entry this task will be done immediately without any delay. In changed environment, performance can be measured by computing various metric such as number of policies issued on time, number of transactions completed successfully, number of claims settled on time.

Error free Work

The impact of errors may be in increased cancellations or lapses, financial compensation payments to customers, and a poor market image leading to reduced sales and market share. Reducing the number of complaints about errors in paperwork should be the main motive. One of the key aims behind the BPR exercise is to help DIC reduce the number of errors in the paperwork which a customer receives. Setting a target to reduce the number of complaints about errors will help to achieve its key objective. Target could include a percentage decrease in complaints, lapse rates, or cancellations, an increase in business growth.

iv. Perception of BPR programmes

Generally, people are not susceptible to change. Although the main aim of BPR programmes is to increase business efficiency, there is often a general perception that organisation just wants

to do some cost-cutting exercises and this could lead to redundancies or could threaten jobs and prospects. It is likely that this is a major reason in DIC behind the staff's concern.

Resistance may be encountered from the staff as they are concerned about the change and are uncertain about their jobs in near future.

Even if the programme does not actually lead to redundancy, the fact that it will result in the fundamental redesign of business processes is still likely to lead to significant changes which affect staff. For instance, BPR may lead to new patterns of work, changes in people's roles or changes in the composition of work teams or may bring changes in the pattern of working. This uncertainty about how the programme could affect them is likely to make staff concerned about it and may lead them to resist it. Resistance may be exacerbated because the out-of-date processes are likely to have been in place for quite some time and have therefore become ingrained in the staff. This ingrained habit needs a change, which is not acceptable by the staff.

Case Scenario 2 – Kanban Card

Surmount Cable Cars (SCC) engaged in assembly of cabin used on ropeways. In order to assemble cabin, 3 major parts of different shapes and sizes are used. These parts are assembled with help of specially designed dome nut and bolt made of brass (Product Code – Brass DIN 85), which are manufactured by Reliable Hardware and Metal Works. Plant layout design of SCC comprises assembly line, where multiple products are assembled at one point of time. Hence there are multiple workers, who are using such nut and bolts simultaneously. Such nut and bolts come in set along with washer and all three spares collectively consider as set.

Since the plant facility of SCC is situated in remote area hence majority of worker are either unskilled or semi-skilled and literacy rate is also low among workers. This causes variety of problems including not informing production supervisor, about the re-ordering of such (Brass DIN 85), a class of store and spares items. Due to ignorance in workers towards understanding of the stock levels and their relevance, many a times stock of such spares ordered later then it should be, hence got out of stock. This further leads to stock out situation in some of the cases, which result in contribution loss.

Reliable Hardware and Metal Works (RHMW) is long standing supplier of Brass DIN 85 to SCC, hence reliable in term of both quality and delivery time. RHMW took single day as lead- time to deliver the re-ordered quantity. Despite the reliability of supplier SCC wish to maintain safety stock equivalent to 3 (three) days consumption for production facility. SCC is using latest version of SAP as enterprise resource planning, which is installed just 3-4 month back. Employees are being trained to use the respective modules of SAP and integration among various function/modules is ongoing.

Plant of SCC works for 6 days in a week and during a week period 1,200 units of Brass DIN 85 is required for production. Consumption of Brass DIN 85 in order to assemble the cabin cars are constant through-out the year. SCC during first phase of its drive to implement lean

manufacturing, is working on its operational efficiency and tries to reduce inventory by introducing a Kanban system.

Required

(i) EXPLAIN the Kanban in inventory management for entity like SCC? Also, EXPLAIN Kanban be applied to non- manufacturing entities?

(ii) CALCULATE is Kanban size and number of Kanban required in case of SCC?

(iii) LIST the factors to be considered and specific precautions/pre-requisites, prior to SSC took task of applying Kanban system.

Solution

(i) Kanban system is a visual signal-based workflow management technique. Taiichi Ohno an industrial engineer, developed the first Kanban system for Toyota automotive in Japan.

Kanban in inventory management

Kanban can be used in pull system of inventory, where supplier supplies the material based upon consumption. Kanban (a yellow line, originally used in Toyota) is visual cue to worker (may be unskilled or even illiterate) to understand that further material is required. Kanban reduce the cycle time and enhance the predictability, in order to promote value to customer. Kanban system hold specific amount of material (divided in Kanban Size). Kanban system also maintain information regarding quantity, storage location, vendor and details on product/part.

While calculating Kanban size and number of Kanban required following assumption need to be taken–

- Consumption is constant throughout the period; else smoothing factor need to be used in calculation of Kanban size.
- The supplier will deliver material directly to the point of use area (assembly line) and
- Requirement in term of space to store number of Kanban is met.

Kanban in non-manufacturing facilities

Kanban originally designed for manufacturing entities but can be applied to non- manufacturing concern as well, for smoothening of workflow rather inventory management. In Kanban, signal based dashboard is used to manage and improve the flow of work to be followed and also categories the work into to do, on-going and done (in some of cases backlog category also be added).

(ii) **Kanban Size and Number of Kanban**

Kanban Size can be calculated using formula i.e. **(C) x (LT) x (L) x (SF)**

Whereas C stands for consumption,

LT stands for lead time (Note – Lead Time should be in terms of consumption pattern means if consumption is considered for week/s time then lead time shall also be considered in term of week/s)

L stands for location of Kanban (Note - When so even any entity implement the Kanban then keep one container of material at both the location (entity it-self and supplier), hence L is 2 unless otherwise provided)

SF stands for smoothing factor, which is used to set-off seasonal variations in consumption; obviously if consumption and level of stock throughout the period remain same then smoothing factor can be one.

Calculation of Kanban Size

C – Consumption per day is 200 i.e., 1,200/6

LT – Lead time is 1 days

L – Locations are 2 (RHMW and SCC) and

SF – Smoothing Factor is 1

Therefore, the Kanban Size is 200×1×2×1 = 400 Units in each Kanban. Note – EOQ can also be practice as Kanban size

Number of Kanban depends upon the maximum quantity of inventory which comprises of demand/consumption during lead period and quantity of safety stock. It can be determined using following formula–

$$\text{Number of Kanban} = \frac{\text{Quantity of safety stock+consumption during lead period}}{\text{Kanban Size}}$$

Calculation of numbers of Kanban

Quantity of safety stock in given case is 3 days × 200 (daily consumption) i.e., 600 Consumption/demand during lead period is 1 days × 200 (daily consumption) i.e., 200 Therefore, maximum inventory under Kanban system is 800 i.e. (600+200)

Number of Kanban is 2 i.e., 800/400

(iii) Factors to be considered and specific precautions/pre-requisite to Kanban system

Kanban try to smoothen the workflow process by 'visualise the flow of the work, reducing WIP, managing process, making process policies explicit, incorporate feedback and using scientific techniques'. In order to do so, while applying Kanban system SCC need to consider following factors–

1. Will supplier ready to supply material in the lot size equal to Kanban Size?
2. Will supplier participate in pull system of inventory and agree upon Kanban Stocking program? – reliability on supplier.
3. Will supplier agree to supply material directly at point of use i.e., assembly line?
4. Is the consumption pattern comprising significant variations or constant throughout?
5. What is requirement regarding handling and storage of material?
6. Contribution margin on sale of product in which raw material is used.

Note – these factors have major impact on calculation of Kanban size as well.

Some specific precautions for SCC

1. Since the worker are unskilled and literacy rate is low among them hence it is needed to be assured that worker must understand the visual cue. Training can be provided to them.

2. Demand/Consumption need to be predicted with reasonable assurance in order to implement Kanban, although one thing, which is in favour to SCC is that it knows the consumption of Brass DIN 85 is constant throughout the period.
3. SAP which is used as ERP system in SCC, need to be integrated with suppliers system in order to practice pull system of inventory and various modules of SAP need to be tightly integrated.

Case Scenario 3

Shakti Automobiles Limited (SAL) is a leading battery-based e-rickshaw manufacturing firm, under brand 'Shah Swaari' in three models – Super, Star, and Speed. SAL started this business around 5 years back when it was only manufacturer of such e-rickshaw. SAL manufactures all assembly components themselves, irrespective of fact that these components can be acquired from market at a cheaper rate. Major component of total costs in manufacturing of such e-rickshaw is variable in nature. Company was performing well, earning reasonable and enjoyed large market share up-till two year ago majorly due to first mover advantage. But due to increasing competition as new entrant coming into market and rough macro-economic conditions, market share starts shrinking; resultantly profit starts declining. If no major steps taken, then company may run into red in year to come.

Mr. Pillai, CEO attended some workshop last week, where he learned about the lean management and techniques of cost management. He asked Mr. Reddy, Chief Management Accountant to report on underlying reasons behind current performance with available set of possible solution. Mr. Reddy immediately convened a meeting of top ranked officers, which is chaired by CEO, at meeting.

Mr. Swami, VP Marketing mentioned that it is difficult to maintain same level of sales in upcoming years because price of Shah Swaari is much higher than price offered by all the competitors in market. Quality and features of other are also similar.

Mr. Dutta, Customer Relation Officer also supported Mr. Swami and said that the popularity of their product is declining, he quoted that he receives lot of complaints from buyers in e-mails and tele-calls due to manufacturing defects, which arise in product within a month period of purchase and frequency of such calls and emails have increased in recent years. He also mentioned that in some cases, customer reported that assembled part did not belong to model they purchased, and some customers say, assembly is not as per specification provided.

Mr. Sodhi, Head Workshop & Repairs agrees that the repair issues in case of recently sold vehicle have been increased.

Mr. Murthy, VP Production & Operations who recently joined the SAL replied, firstly large percentage of worker are unskilled; secondly due to large amount and categories of raw materials, dumped by store at production floor; that's too well prior to need. These two reasons cause worker fails to differentiate among parts which appear similar. He also mentioned entire business process, especially production process is quite old and contains certain activities which are purely unnecessary, he also highlight importance of industry 4.0 and give stress on business re-engineering through artificial intelligence, machine learning, etc.

Mr. Naidu, VP Purchases immediately responded about economics of discount involved behind purchase of large quantity and also mentioned buying too less may lead to stock-out situation.

Required

You were also presented at meeting as deputy to Mr. Reddy. Post meeting you came back to your desk and start working. Mr. Reddy called to you to his cabin, on reach to his cabin; he asked you to prepare draft of report (ADVISE) seek by CEO; and meet him with copy of draft after half an hour from now.

Solution

Report

Addressed to:

Office of CEO,

Shakti Automobiles Limited (SAL).

Dated – 19th Jan 2021

Report on underlying reasons behind current performance and Lean Management, Cost Management tools

(i) First reason behind weak financial performance is highlighted by Mr. Swami i.e., Price of SAL's Product Shah Swaari is much higher than price offered by all the competitors in market. Quality and features of other products are also similar.

Target Costing as cost management technique can be applied. Since market condition are stiff and bargaining power of customers is high due to multiple competitors, and these competitors are selling the product at price lesser then price offered by SAL. Hence, price offered by such vendors should be considered as 'Target Price' and after reducing 'Target Profit' from same 'Target Cost' can be identified. Production, operations facilities along with product need to be reengineered to achieve such 'Target Cost'.

(ii) Second reason is that SAL manufactures all assembly components themselves, irrespective of fact that these components can be acquired from market at a cheaper rate.

Relevant cost of both, 'Make or Buy' needs to be compared. As mentioned, that major component of total costs in manufacturing of such e-rickshaw is variable in nature, hence, such major component of costs can be controlled if SAL buy the all the components instead of Making them.

Only those products need to be made in house whose variable cost of manufacturing is less then market price and vice versa.

(iv) Third and major reason is popularity of their product is declining, this is evident from declining in market share and lot of complaints from buyers in e-mails and tele-calls for manufacturing defects.

Since these defects arise in product within month period of purchase. Hence, product needs to be looked at. Further, some of cases customer reported that assembled part is not belonging to model they purchased and some customers say assembly is not as per specification provided. Hence, quality is needed to be ensured in the product delivered.

One of way to look at 'Quality' is conformance to need of customer, to ensure same Total Productivity Management/ Total Quality Management supported by Six Sigma need to be applied as part of Lean System Management.

(v) Fourth reason being large percentage of worker are unskilled. Each worker should be provided with requisite training. Though Kaizen, workers should be involved into improvement of existing process so that they become able to address small problems or improve a process.

(vi) Fifth and second major reason is large amount and categories of raw materials, dumped by store at production floor; that's too well prior to need. This reason may be root cause of one of complaint by customer that assembled part is not belong to model they purchased.

JIT can be implemented as part of lean system. JIT is pull system of production, with single piece flow after considering takt time. In JIT, production facility needs to be integrated with vendor system for signal (Kanban) based automatic supply which depends upon demand-based consumption. Under JIT system of inventory storage cost is at lowest level due to direct issue of material to production department as and when required and resultantly less/no material lying over in store or production floor.

Note - Takt time is the maximum time to meet the demands of the customer, this will help to decide the speed of/at manufacturing facility. Heijunka can be applied in order to reduce variation between takt times over the production.

Cost benefit analysis of 'reduction in storage cost along with opportunity cost saved' and 'increase in ordering cost, purchase cost along with stock-out cost' need to be made.

(vii) Sixth reason for low performance is old established businesses processes, especially production processes and contains certain activities which are purely unnecessary.

Value Analysis needs to be applied in order to ensure maximum value to customer by eliminating activities which are not value generating, this will control cost also, that's too strategically.

Process Innovation and Business Process Re-engineering can also be applied. Re- engineering is rethinking and radical design of business process in order to achieve improvement. It will help the SAL to keep them at par with changing technology by synchronization along with redesign, retool the business process.

Further details can be tabled on requisition basis. Closure of Report
Mr. Reddy,
Chief Management Accountant
(For Management Accounting Division)
Shakti Automobiles Limited

Case Scenario 4 – Kaizen Costing

A-One Automobile is manufacturer of Motor Bikes. A-one is based in a country which recently became liberal and global economy. Hence till the time, when businesses in country was controlled by government and the government, in order to maintain price and domestic demand, regulates the market to maintain the uniformity in the prices determined by the entities.

The country is large enough with widespread populations with high density; there is high demand for motor bike as large population of country is in the age group of 18-24 years. A-one automobile enjoys reasonable market share. The new government in country believes in deregulating markets and allows the imports of foreign motor bikes.

Management team at A-One acknowledge that it utmost needs to make changes to its process in order to respond the competition from foreign manufacturers. Further, A-One's Motor Bikes are now being seen as expensive product in comparison to the foreign competition, because A-One motor bikes are costly. Currently, finance department uses traditional standard costing and budgetary variance analysis on the basis of standards set semi-annually in order to monitor and control production activities. Management at A-One plans to improve its performance through the use of Kaizen costing.

Required

(i) RECOMMEND key changes significant to A-One's traditional costing system to support the adoption of 'Kaizen Costing Concept'.

(ii) LIST the impact of implementation of the Kaizen costing approach on the employee management at A-One

Solution

(i) Key changes to support the adoption of 'Kaizen Costing Concept'–

Kaizen Costing implies that small, incremental changes routinely applied and sustained over a long period, results in significant improvements. It aims to involve workers from multiple functions/ levels in the organization to work together to address a problem or improve a particular process. In other words, it is a costing technique to reflect continuous efforts to reduce product costs, improve product quality, and/or improve the production process after manufacturing activities have begun.

Adopting Kaizen costing requires a change in the method of setting standards. Kaizen costing focuses on "cost reduction" rather than "cost control". It emphasizes on small but continuous improvement. Targets are updated continuously to reflect the improvement that has already been achieved and that are yet to be achieved.

The suggestive changes which are required to adopt Kaizen Costing concepts in A-One are as follows:

Cost Control System to Cost Reduction System: Traditionally Standard Costing system assumes stability in the current manufacturing process and standards are set keeping the normal manufacturing process into account thus the whole effort is on to meet performance cost standard. On the other hand, Kaizen Costing believes in continuous improvements in manufacturing processes and hence, the goal is to achieve cost reduction target. The first change required is the standard setting methodology i.e., from earlier Cost Control System to Cost Reduction System.

Reduction in the Periodicity of Setting Standards: Under the existing control system followed by the A-One, standards are set semi-annually and based on these standards monthly variance reports are generated for analysis. But under Kaizen Costing system cost reduction targets are set for small periods say for a week or a month. So, the period covered under a standard should be reduced from semi-annually to monthly and the current practice of generating variance reports should be reduced to a month or a week.

Participation of Executives or Workers in Standard Setting: Under the Kaizen Costing system, participation of workers or executives who are actually involved in the manufacturing process are highly appreciated while setting standards. So, the current system of setting budgets and standards by the finance department should be changed.

(ii) Impact of implementation of the Kaizen costing approach on the employee management–

- **Role of Employees** – The relation between management and employees, apart from role of employees will change drastically, because under any system of costing, employees are seen as cost centre and real cause of problem, but in kaizen costing employees are seen as solution provider.
- **Implementation aspects of Kaizen** – It may be possible that at time of implementation of Kaizen due to change in role of employees, they may be not self- motivated to command, control and suggest possible improvement themselves. But this is sure that after reasonable time Kaizen system will increase staff motivation through empowerment.
- **Changes in Culture** – From government regulated culture to employee self- empowered work-culture, will be dramatic change for A-One. Under Kaizen employee group will be assigned with power to make continuous changes rather than just executing the changes approved from management.

Case Scenario 5 – 6 Sigma

Smooth Connect Telecom (SCT) is the private sector telecom company. SCT is second largest player in telecom sector of country, with subscriber base of more than 10 million. SCT achieved this magnificent growth by acquiring competitor in recent years. SCT deals in fixed line telephone services, corporate services and mobile (cellular) services. SCT is meeting all the requirements from regulator in efficient and timely manner.

SCT is known for continuous innovation in its services, with changing pace of technology and business need like wise use of Optical Fiber Wire and VoLTE (Voice over Long-Term Evolution) etc. This helps the SCT in acquisition of many corporate clients.

The largest player in telecom industry is Voice Telecom, which is resulting company out of corporate restructuring of state-owned telecom corporation. Voice Telecom still own largest market share due infrastructural advantage over other players in the market. SCT is also facing tough competition from Voice Telecom on pricing and customer volume.

Majority of telecom operators, including SCT and Voice Telecom, usually criticized by customers for poor customer services, misallocation of call duration and call drop; but majority of complaints are on account of–

a. Calculating wrong tariff, and

b. Dull and delayed response from customer care executives.

Hence by focusing on customer services, if SCT improves its billing process and handles the customer complaints wisely; then SCT can gain competitive advantage over other players including Voice Telecom. In order to improve the quality of customer services, SCT decide to practice Six Sigma initiative.

Required

Enumerate the modus operandi that 'how SCT can APPLY DMAIC method to implement Six Sigma'.

Solution

Six Sigma was first used by Mr. Bill Smith of Motorola Corporation in 1986 for improvement of manufacturing process & elimination of defects. Six-Sigma seeks to improve the quality of process by identifying and removing the cause of defects (defect can be anything, which lead to customer dissatisfaction). Six Sigma uses quality management and statistical methods with special infrastructure of people. Six-Sigma can be implemented through two methodologies–

1. DMAIC (Define, Measure, Analyse, Improve and Control) - Improve existing business process (remove defect).
2. DMADV (Define, Measure, Analyse, Design and Verify) - Create new business process (defect free).

DMAIC methodology of Six Sigma implementation at SCT Define –

Define the improvement area

Define include definition of customer requirement or problem faced by customer

First and foremost, requirement of is to ensure customer must be billed correctly, because wrong billing may lead to either of–

a) Delayed revenue – due to litigation for wrong billing
b) Loss of revenue – due to porting to alternate telecom operator by customer

Customer care executives need to be trained, so that they can guide the customer in most appropriate way and ensure lowest possible wait time to solve customer complaint.

Measure – Existing process for comparison

Existing performance need to be measured

Since performance need to be measured specially in two domains 'billing processes' and 'customer complaint handling', hence SCT needs to have a system through which it can collect reliable information (likewise number of complaints as percentage of total customers, similarly wrongly billed customers against total customers; is there any process of reissue the correct bill? – if yes – than in how many cases it is issued? and average time to solve complaints) in order to measure existing performance.

Performance is required to be measured against each of critical success factors (which will create value for customer).

Analyse – Cause effect relationship between factors of process

Existing process needs to be mapped in order to determine the root cause of problem

SCT should further analyse the information collected in second point (measure) above for determining the performance, in order to reach to root cause of customer complaints and wrong billing; So that necessary preventive and corrective steps then can be taken.

Improve – Plan improvement on basis of analysis

Existing process need to be improved in order to mitigate the root cause threats

Once the SCT done with the analysis, it has to identify the possible solution to root causes, in order to improve the performance.

Any improvement, which is so ever is suggested; needs to be both feasible from SCT prospective and valuable from customers' perspective.

Improvement can be done by reissue of bill where it was wrongly issued earlier, if already process of revision of bill is in existence than wait time for reissue need to be curtailed.

Control – Continuous control to identify and correct the process variance

Improved processes need to be controlled continually in order to assure enhanced performance shall be maintained

Post improvement in process (issue of bill and handling of customer complaints), the manager who is responsible for such process at SCT need to assure continuous control over the process, so that customer services should create same value for customer and keep them satisfied.

For monitoring, KPI against CSFs can be established and reported on daily basis, likewise number of complaints (especially which remain unresolved at day end) and wrong billing cases. These KPI will also act as early signal to Line Manager or Senior Management.

In order to implement Six Sigma as per DMAIC method, SCT need to form a team of line managers from different processes which need to be improved (or critical from prospective of customer services). Team and implementation project should lead by some senior management person (may be CEO him-self).

Case Scenario 9 – 5S

Toys Limited manufactures toys and games for the children in the age group 6 to 14 years. They have recently shifted to STEM i.e., Science, Technology, Engineering and Mathematics learning approach. The major games under this category are DO IT YOURSELF (DIY) Kits. Each kit is designed with a specific learning objective. This kit comprises of all the elements which are essential to build the specific project. The number of elements in a kit range from

200 to 350 elements. There is an instruction booklet in the kit which guides the user throughout the project. The users can also use the video support which is provided with specific user login.

In last two months, the customer support division has reported a major increase in the consumer complaints. A critical study revealed that the major complaints were under the category "missing elements" in the kits. Further study revealed that most of these complaints were for the products which had some common elements in the kits. On the other hand, the customer feedback and reviews have been very positive on the "quality of the elements" provided with the kits.

Since innovation is the core competency for this game industry, the company has a dedicated Research and Development team which focuses on three areas-

a) Identification of new learning techniques
b) Development of new games
c) Upgradation of existing games

Under the current system, the games are sold online. The final product is delivered from the central warehouse located in Bangalore. The company holds a minimum inventory of the games at the central warehouse.

The manufacturing facility is located in the industrial area which is around 50 kms from the Central Warehouse. The production plan is based on the demand as per the instructions from the Central Warehouse. The Chief Quality Officer is responsible for the quality of the product right from the procurement of the raw material till the final product is delivered to the customer.

The CEO has called a meeting of the heads of all the departments and suggested them to implement of Lean Management and integrated the same with the innovation in the organisation. After a series of brainstorming sessions, they have agreed to implement 5S lean management system.

Required

ADVISE on implementation of 5S in Toys Limited.

Solution

The current problem emphasises on “missing elements” in the kits as one of the major reasons of customer complaints. This highlights that there are issues related with workspace organisation. The positive feedback on the “quality of the elements” reflects that the production related process is robust. Considering the above two factors, Toys Limited is required is to maintain high quality work environment. Therefore, the 5S concept should be used. 5S explains how a workspace should be organized for efficiency and effectiveness by identifying and storing the items used, maintaining the area items, and sustaining the new order. The 5S lean management system comprises of the five S's Sort, Set in Order, Shine, Standardize, and Sustain.

Sort

This will focus on identifying necessary elements of the kit, remove the unwanted items and ensure that all the elements of a particular kit are available. The unwanted items can be provided with RED FLAG so that these can be removed at the earliest.

Set in Order

It will ensure that the elements of the kit are placed at the properly allocated space for the kit. It will also help in assigning fixed places and fixed quantity of elements at each space. It is always recommended to have it compact so that it is easy to access.

Shine

One of the reasons why elements might be missing would be mismanaged and untidy workplace. Shine aspect of 5S focuses on keeping the workplace clean on regular basis, and also ensuring it is easy to work at the particular workplace. It focuses on keeping tools and equipment clean and in top condition, ready for use at any time.

Standardise

The best practices of the particular work area are standardised. The focus is on maintaining high standards through orderliness and as per the required quality and quantity. This includes steps which make it easy for everyone to identify the state of normal or abnormal conditions. This can be achieved by placing photos on the walls, to provide visual reminder about the elements properly placed in the kits.

Sustain

For a long-term success, it is important to sustain the set standards and processes. This involves establishing and maintaining responsibilities amongst the team leaders and members. Ensure that members follow the rules and it becomes a part of their work habit. There should be periodic audit and review of the process for early identification of any issues.

Considering the above aspects of 5S lean management system, its proper implementation will strengthen the way the kits are being packaged and will ensure that the issue of missing elements can be brought down significantly.

Skill Based – Q3 – Cellular Manufacturing

Micro Lite Limited engaged in manufacturing of casting and capping of PVC pipes used for electronic fittings, which they supplied to various part of country using a well-diversified network of distributors. MLL was established by Mr. Rejul Raheja around 10 year back, since then competition is continually increasing in market as new players entered in market who are ready to sell similar product at relatively lower prices. Mr. Raheja is actively participating in business and hold position of CEO and being a CA by profession; he conducts regular meetings with management accounting department.

In order to beat the competition, MLL decided to reduce the cost and enhance the efficiency by implementing the strategic cost management techniques, such as cellular manufacturing using lean manufacturing.

Mr. Rastogi who joined the company recently as management accountant, is very enthusiastic about cellular manufacturing and consider same as scientific way of production. He added it will enhance the value creation over value chain. According to him, cellular manufacturing is significant tool to achieve process cycle efficiency.

Mr. Rastogi makes a plan of rearranging the existing machine and human resources who are working on these machines. He tenders such plan (of implementing cellular manufacturing) to Mr. Raheja. Process is also reengineered along with restructuring of production layout. Mr. Rastogi is of belief that with minimal cost (including loss of contribution on account of down time) on rearranging existing resources processing cycle efficiency can be enhanced.

Mr. Raheja is skeptical in respect of expected benefit, so in his reply to Mr. Rastogi agreed to rearrangement plan, but in phased manner rather than pilot implementation. Mr. Rastogi asked to implement his plan (on test run basis) to the one of production engineering department, which is tiny in comparison to other 3 production engineering department. Such selected department is contributing around 12% of total production capacity of MLL. Mr. Raheja in his reply also quoted that go green for next phase will be granted only if during testing phase processing cycle efficiency improved by minimum of 15%.

Mr. Rastogi and his team implement the rearrangement plan on such selected department and practice the reengineered process and rearrangement of machines along with men for 30 days. Recordkeeper provide following PCE data before and after rearrangement.

Activity (part of process)	Before (in minutes)	After (in minutes)
Moving	70	25
Inspection	40	15
Storage	60	10
Processing	80	40

Required

(i) EXPLAIN why Mr. Rastogi considers cellular manufacturing as scientific way of production?

(ii) ASSESS, whether out-come of testing phase at MLL is sufficient or not as to expectation of Mr. Raheja, for implementation similar rearrangement (cellular manufacturing) to remaining production departments.

Solution

(i) Cellular manufacturing as scientific way of production

In cellular manufacturing, production workstations and machines are queued in specified sequence to ensure seem-less flow of material over entire production line (Straight Line, U-Shaped or Inverted U-Shaped etc.) to eliminate delay (Time) in production and also to eliminate the transportation (Motion) of various parts of single product from one production facility to another.

Hence Mr. Rastogi is right in equating 'cellular manufacturing' as a 'scientific way of production' because, it largely rests upon principles of scientific management, suggested by Fredric Winslow Taylor based upon 'Time Study' and 'Motion Study'.

Since in cellular manufacturing one-piece at a time moves across production line, hence provide the scope for customisation to product features on the production line in view of specific customer demands. Hence in this cellular manufacturing add value to customer over value chain.

(ii) Assessment of Mr. Rastogi's plan (cellular manufacturing) for further implementation (to remaining production departments)

Mr. Raheja seeks 15% improvement in PCE during testing phase, in order to implement the same for remaining production department. Means if PCE is 10% in existing layout, it shall increase to 11.5% or beyond in cellular manufacturing environment.

There is improvement in Process Cycle Efficiency by shifting to cellular manufacturing system from existing system by 12.44% in absolute term. If we measure percentage increase (relative measure), it will be 38.87% (i.e., 12.44%/32.00%).

Since relative improvement in PCE is by 38.87% against the yardstick of 15% hence it is advantaged to implement cellular manufacturing to remaining production department also.

Workings

Computation of the PCE (Time in minutes)

Sr. No.	Activity Category	Before Rearrangement	After Rearrangement
A.	Moving	70	25
B.	Inspection	40	15
C.	Storage	60	10
D.	Processing	80	40
E.	Value added time ...(D)	80	40
F.	Cycle time ...(A+B+C+D)	250	90
G.	Process Cycle Efficiency ...(E/F)	**32%**	**44.44%**

Skill Based – Q5 – Just In Time

Delight Engineering Solutions (DES) (a hypothetical company) is manufacturing product CAF-5 from use of single raw material CAI-100. The two major departments operational in Delight Engineering Solution are purchase and production. DES is facing high competition due to large number of competitors in market. Demand of CAF-5 is fluctuating, therefore high storage cost is prime cause of low financial performance. DES Company decided to move from traditional system to JIT system.

From purchase and store following data is collected. Annual consumption is of 1,800 units of CAI-100. List Price of each unit of CAI-100 is Rs 4,000. The cost of placing order is Rs 2,000 and cost of carrying one unit of CAI-100 for a year is 2%. Company presently use EOQ model of ordering.

Purchase Manager further estimated that, if JIT system of inventory is implemented, ordering cost will increase by 50% from current level, whereas carrying cost can be avoided up-to 90%. But there is prospective order of 5 units of CAF-5 which can't be served, due to non- availability of stock and failure of delivery by supplier. Contribution from each unit of CAF-5 is Rs 1,200. Stock insurance cost will reduce by Rs 400 on annual basis. There will also be reduction in working capital requirement, which will result in interest saving of Rs 500 on annual basis.

Further, Production and Engineering department supported by marketing department provide details that presently average production of CAF-5 is 150 units of per month, although for next 4 months expected demand will be 120, 160, 140, 180 units. Maximum capacity from man- hours perspective is 150 units. 20 man-hours required for producing each unit and labour rate per hour is Rs 3. Casual labour is not available in market. Overtime rate will be 200%. Average monthly cost of storage of each item of CAF-5 is Rs 65.

Required

(i) EXPLAIN the JIT purchasing and JIT production and the effect of its introduction.
(ii) COMPUTE cost savings if it moves to JIT Purchasing.
(iii) COMPUTE cost savings if it moves to JIT Production.

Solution

(i) Just-in-time (JIT) is a collection of ideas that streamline a company's production process activities to such an extent that wastage of all kind viz., of time, material and labour systematically driven out of the process.

JIT purchasing suggests that materials should only be purchased as and when required. While JIT production shows that finished products should only be produced as and when required by customers. Whereas in traditional manufacturing system, to smooth out production and to meet forecasted demand, materials and finished goods are stored in advance.

JIT Purchasing reduces the inventory level which will result in reduction of carrying cost of inventory, as well as reduces the level of working capital which will save the opportunity cost in form of interest expenditure. On the other hand, JIT Production gives opportunity to customize the product as per customers' needs, conformance to customers' need is essential to quality. It also reduces the level of working capital which save the opportunity cost in form of interest expenditure.

Prerequisite of JIT purchasing or production is integration with vendor, if vendor is not integrated properly or less reliable, then situation of stock out can arise and which can result into loss of contribution.

Multitasking by employee is another key feature of JIT, group of employees should be made based upon product instead based upon function. Hence, functional allocations of cost become less appropriate.

Overall, JIT enhance the quality into the product by eliminating the waste and continuous improvement of productivity.

(ii) Cost Savings in JIT Purchasing

Reorder Size under present regime:

Under current scenario reorder size of CAI-100 will be EOQ. Formula for EOQ is mentioned below –

= 2 x A x O / C

Where:

A = Annual Consumption i.e., 1,800 units of CAI-100

O = Ordering Cost per order i.e., 2,000 per order

C = Carrying Cost per unit per annum i.e., 80 (2% of 4,000) per unit per annum

= 2 × 1,800 × 2,000 / 80

EOQ (reorder size under present regime) of CAI-100 is 300 Units

Cost Comparison under present and JIT regime (annual basis)

Particulars	**Present System** ₹	**JIT System** ₹
Ordering Cost (1,800 units/ 300 units) × 2,000 JIT-150% of present cost	12,000	18,000
Carrying Cost (300 units/2 × 80) JIT- Reduced by 90% in comparison to present cost	12,000	1,200
Stock-out Cost (5 units × 1,200)	-	6,000
JIT- Reduction in Stock Insurance Cost on annual basis	-	(400)

Opportunity Cost (saved) on reduced amount of working capital on annual basis	-	(500)
Net Cost of Inventory Management	24,000	24,300
Incremental Cost in shifting to JIT	(300)	

Since implementation of JIT Purchasing results in incremental cost of 300 per annum basis, hence it is not economically worth to move to JIT system of inventory purchase.

(iii) Cost Savings in JIT Production

Carrying Cost in Present Scenario (for next four months)

Month	**I**	**II**	**III**	**IV**
Opening Stock	-	30	20	30
Add: Production	150	150	150	150
Less: Demand	120	160	140	180
Closing Stock	30	20	30	-
Average Stock*	15	25	25	15
Carrying Cost (65 per unit)	975	1,625	1,625	975
Total Carrying Cost for 4 months	**5,200**			

*Average Stock = Opening Stock + Closing stock/2

Overtime Cost in JIT Scenario (for next four months)

Month	**I**	**II**	**III**	**IV**
Demand	120	160	140	180
Production	120	160	140	180
Bottleneck	150	150	150	150
Shortfall*	-	10	-	30
Labour hrs. as overtime required (20 hours for each unit of CAF-5)	-	200	-	600
Overtime Cost (Payment at rate of 6 per hour)	-	1,200	-	3,600
Total Overtime Cost for 4 months	**4,800**			

Based upon comparative cost for upcoming four month under present and JIT scenario, there is cost saving of RS 400 (Rs 5,200 vs. Rs 4,800) in move to JIT system production. Hence, it is economically worth to move to JIT Production.

Skill Based – Q 13 – Just In time

Innovation Ltd. has entered into a contract to supply a component to a company which manufactures electronic equipment.

Expected demand for the component will be 70,000 units totally for all the periods. Expected sales and production cost will be

Period	1	2	3	4
Sales (units)	9,500	17,000	18,500	25,000
Variable cost per unit	30	30	32.50	35

Total fixed overheads are expected to be Rs 14 lakhs for all the periods. The production manager has to decide about the production plan.

The choices are:

Plan 1: Produce at a constant rate of 17,500 units per period. Inventory holding costs will be

Rs 6.50 per unit of average inventory per period.

Plan 2: Use a just-in-Time (JIT) system

Maximum capacity per period normally…… 18,000 units

It can produce further up to 10,000 units per period in overtime.

Each unit produced in overtime would incur additional cost equal to 30% of the expected variable cost per unit of that period.

Assume zero opening inventory.

Required

(i) CALCULATE the incremental production cost and the savings in inventory holding cost by JIT production system.

(ii) ADVISE the company on the choice of a plan.

Solution

Statement Showing 'Inventory Holding Cost' under Plan 1

Particulars	Pd. 1	Pd. 2	Pd. 3	Pd.4
Opening Inventory …(A)	---	8,000	8,500	7,500
Add: Production	17,500	17,500	17,500	17,500
Less: Demand/ Sales	9,500	17,000	18,500	25,000
Closing Inventory …(B)	8,000	8,500	7,500	---
Average Inventory (A+B)/2	4,000	8,250	8,000	3,750
Inventory Holding Cost @ Rs 6.50	26,000	53,625	52,000	24,375

Inventory Holding Cost for the four periods = Rs 1,56,000 (26,000 + 53,625 + 52,000 + 24,375)

Statement Showing 'Additional Cost-Overtime' under Plan 2 (JIT System)

Particulars	Pd. 1	Pd. 2	Pd. 3	Pd.4
Demand/ Sales	9,500	17,000	18,500	25,000
Production in Normal Time	9,500	17,000	18,000	18,000

Production in Over Time …(A)	---	---	500	7,000
Variable Cost per unit	30.00	30.00	32.50	35.00
Additional Cost – Overtime per unit (B) (@ 30% of Variable Cost)	9.00	9.00	9.75	10.50
Additional Cost – Overtime …(A) × (B)	---	---	4,875	73,500

Total Additional Payment (Overtime) = Rs 78,375

(4,875 + 73,500)

Statement Showing 'Additional Variable Cost*' under Plan 2 (JIT System)

Particulars	Pd. 1	Pd. 2	Pd. 3	Pd.4	Total
Production (Plan 1)	17,500	17,500	17,500	17,500	70,000
Variable Cost …(A)	5,25,000	5,25,000	5,68,750	6,12,500	22,31,250
Production (Plan 2, JIT)	9,500	17,000	18,500	25,000	70,000
Variable Cost …(B)	2,85,000	5,10,000	6,01,250	8,75,000	22,71,250
Total				…(B) – (A)	40,000

*** excluding overtime cost**

Incremental Production Cost in JIT System = 78,375 + 40,000 = Rs 1,18,375

Therefore, Saving in JIT System (Net) = 1,56,000 – 1,18,375

= Rs 37,625

Advise

Though Innovation Ltd is saving Rs 37,625 by changing its production system to Just-in- time but it has to consider other factors as well before taking any final call which are as follows:

- Innovation Ltd has to ensure that it receives materials from its suppliers on the exact date and at the exact time when they are needed. Credentials and reliability of supplier must be thoroughly checked.

- To remove any quality issues, the engineering staff must visit supplier's sites and examine their processes, not only to see if they can reliably ship high-quality parts but also to provide them with engineering assistance to bring them up to a higher standard of product.

- Innovation Ltd should also aim to improve quality at its process and design levels with the purpose of achieving "Zero Defects" in the production process.

- Innovation Ltd should also keep in mind the efficiency of its work force. Innovation Ltd must ensure that labour's learning curve has reached at steady rate so that they are capable of performing a variety of operations at effective and efficient manner. The workforce must be completely retrained and focused on a wide range of activities.

Skill Based – Q15 – Just In Time

Impax Electronic Limited (IEL) is manufacturing wide verities of torches operated on power batteries, specially designed for trekking and travelers, apart from domestic use. For which they purchase bulbs from Glow Lights and Bulbs (GLB), mostly G3 1M Screw 7.5V bulb is used in torches. Due to lockdown and outbreak of COVID the demand of torch falls significantly, and factories allowed to work at 1/3rd of capacity. Considering the same production department slows down the production, causing a huge piled-up inventory of raw material. This will be expected to result in high storage costs. Hence to attain cost- effectiveness; IEL decided to move from tradition system to Just-in-Time (JIT) system in a phased manner. There are two major departments operating in IEL, purchase, and production. In the first phase, the purchase department is considering the adoption of JIT purchasing.

The annual demand for G3 1M Screw 7.5V bulb (bulb) is 24,000 units at IEL. Presently, the purchase price is Rs 80 per bulb. Currently, the annual demand is ordered in 24 orders of equal size, and the cost of placing an order is Rs 10 which is expected to remain same in JIT regime too. Material handling, insurance, and other carrying cost is Rs 2, Rs 1, and Rs 1.5 respectively per unit per annum.

Under the JIT system, the price expected to increase to Rs 80.05 per bulb. GLB is a reputed company for the quality of its products and timely delivery. As a result of frequent orders, the number of orders increased to 120 under the JIT regime, and order size decrease proportionally. Material handling cost is expected to reduce to Rs 1.2, whereas other carrying costs will reduce by Rs 0.5 and insurance costs remain at the same level. Lower inventory level will cause a stock-out cost of Rs 5 per unit on 0.25% of annual demand.

The required rate return for IEL is 16%.

Required

(i) (a) Is the JIT process is different for the purchase and production department? STATE the reason to support your opinion.

(b) STATE any three areas in which JIT purchasing may reduce cost significantly to bring the cost efficiency.

(ii) COMMENT, whether purchase department of IEL should move to JIT Purchasing, presuming the same annual demand.

Solution

(i) (**a) Just-in-time (JIT)** is the management philosophy based upon demand pull system (rather than supply-push) throughout the plant in order to reduce cost, with a single piece flow after considering takt time.

JIT process is different for purchase and production department, due inherent nature of the function they render; despite the purpose of both is to de-clutter store/assembly line at the production floor and reduce the cost.

JIT if applied in purchases by purchase department then known as JIT purchasing, which meant materials should only be purchased, when required for production.

Whereas if JIT applied by the production department, it will be termed as JIT production and meant that finished products should only be produced, as needed to meet actual customer demand.

(b) The areas, where JIT purchasing expected to reduce cost significantly are:

1. Interest cost of working capital – JIT purchasing will reduce the level of raw materials, which cause a reduction in the amount blocked as working capital; hence interest cost (either actual or opportunity) will reduce too.

2. **Reduction in storage cost** – As we know JIT purchasing reduce the level of raw material stored, hence storage cost is expected to reduce.

3. Since JIT purchasing reduced the inventory level of raw material, hence sorting (first S out of 5S) become easy and motions (as per motion study) also reduced, which reduce labour and overhead cost as well.

4. Material is purchase as and when required hence wastage and scarp will be less due to a relative reduction in evaporation and tendency to obsolete.

(ii) Chart of cost comparison under present and JIT regime (annual basis)

Particulars	Present	JIT system
Purchase Costs = 24,000 units × 80 = 24,000 units × 80.05	19,20,000	19,21,200
Ordering Costs (number of orders × ordering cost per order) = 24 orders × 10 = 120 orders × 10	240	1,200
Opportunity Carrying Costs = order quantity/2 × (purchasing cost per unit × 0.16 per year) = 1,000 units/2 × 80 × 0.16 = 200 units/2 × 80.05 × 0.16	6,400	1,280.80
Other Carrying Costs (insurance, material handling etc.) = order quantity/2 × carrying costs per unit = 1,000 units/2 × 4.50 = 200 units/2 × 3.20	2,250	320
Stockout Costs = contribution lost × units not delivered/ produced = 5 × (0.25% of 24,000)	-	300
Total Cost of Inventory Management	19,28,890	19,24,300.80
Incremental savings in shifting to JIT	4,589.20	

Decision

Since the implementation of JIT Purchasing results in an **incremental savings of Rs 4,589.20** on a per annum basis, hence it is economically viable to move to JIT system of inventory purchase.

Working Note 1 - Average Inventory

Particulars		Present	JIT system
Annual Consumption	…(A)	24,000	24,000
Number of orders	…(B)	24	120
Order Size	…(C = A/B)	1,000	200
Average Inventory	…(D = C/2)	500	100

Working Note 2 - Carrying Cost per unit

Particulars	Present	JIT System
Material handling (reduction of 0.8)	2	1.2
Insurance	1	1
Other carrying cost (reduction of 0.5)	1.5	1
Carrying Cost per unit per annum	**4.5**	**3.2**

Skill Based Q 30 – OEE – Jan'21 ICAI Exam

(i) Based on the following data CALCULATE 'Overall Equipment Effectiveness':

Particulars	Data
Shift length	9 hours
Short breaks	3 of 10 minutes each
Meal break	45 min
Equipment down time	30 min
No. of units produced per hour (Standard)	30 per min
Total units produced per shift	12,240
Rejected units out of the above	240

(ii) (A) Based on the answer derived from the above can you DEMONSTRATE that the machine is working at world class performance as suggested by 'Nakajima' ideal values for the 'OEE'.

(B) "OEE is an aggregate measure. Its components will compensate for each other or, on the contrary, will aggravate a failing situation and attract further attention to it". EXPLAIN.

Solution

(i) Seiichi Nakajima led the introduction of TPM, OEE and the Six Big Losses in the early 1970s while at the Japanese Institute of Plant Maintenance. OEE is a quantitative metric for measuring productivity of individual equipment in a manufacturing plant. OEE identifies and measures losses of crucial parts in a manufacturing process namely availability rate, performance rate and quality rate.

OEE = Availability × Performance × Quality OEE

Factors are calculated as follows–

1. Availability: NOT / NAT = (435 / 465) × 100 = 93.55 %

2. Performance: IOT / NOT = (408 / 435) × 100 = 93.79%

3. Quality: (IOT – LOT) / IOT = (408 – 8) / 408 × 100 = 98.04%

OEE = A × P × Q = 93.55% × 93.79% × 98.04% **= 86.02%**

Alternative Presentation-I

Good Counts = 12,240 – 240 = 12,000 units

Planned Production Time= 540 mins - 75 mins. = 465 mins.

OEE= (Good Counts × Ideal Cycle Time)/ Planned Production Time

= {(12,000 / 30 units (per min.)} / 465) x 100 = **86.02%**

Alternative Presentation-II

OEE = (Ideal operating time – loss operating time)/ Net Available Time

{(408 – 8)/ 465} × 100 = **86.02%**

Workings

1. Scheduled Time (total time) = 540 Minutes (9 hrs. × 60 mins.)

2. Planned Down Time = 3 short breaks × 10 minutes +meal break 45 minutes = 75 minutes

3. Net Available Time (NAT) = 540 – 75 = 465 minutes

4. Unplanned Downtime = 30 minutes

5. Net Operating Time (NOT) = Net Available Time – Unplanned Downtime NOT = 465 – 30 = 435 minutes

6. Ideal Operating Time (IOT): 12,240 total units / 30 (units per min.) = 12,240 / 30 = 408 minutes

7. Lost Operating Time (LOT): 240 units / 30 (units per min.) = 240 / 30 = 8 minutes

(ii) (A) Seiichi Nakajima in his book, Introduction to TPM (originally published in 1984 and later in 1988 translated into English) suggested that ideal values (World-Class OEE) for the OEE component measures are:

(a) Availability rate in excess of 90 percent

(b) Performance efficiency rate in excess of 95 percent

(c) Quality rate in excess of 99 percent

Such levels of Availability, Performance and Quality would result an ideal OEE scores of approximately 85 percent.

Seiichi Nakajima defined these numbers, based on his practical experience, as minimums for which companies should strive. He also noted that all of the companies winning the Distinguished Plant Prize, awarded annually in Japan to plants that had successfully implemented TPM, had OEE scores in excess of 85%.

In the instant case OEE is 86.02%, which is beyond the ideal rate of 85% suggested by Seiichi Nakajima. Availability, Performance, and Quality rate is 93.55%, 93.79%, and 98.04% respectively against the ideal rate of 90%, 95% and 99% respectively. Hence, considering OEE only (rather its individual components) it can be said that machine demonstrate the world class performance. Both performance and quality rate are slightly lower than the ideal rate (world class performance), whereas availability rate is beyond the ideal rate to help the OEE to stand beyond ideal rate of 85%.

(ii) (B) Yes, OEE is an aggregate measure of productivity; comprising the sub-metrics (components) of Availability, Performance and Quality.

When the sub-metrics (components) are multiplied by each other, the resulting OEE number may end up hiding the areas that have the most problems, because these sub-metrics (components) compensate for each other. For example, low quality may be compensated by high availability and performance. OEE has another limitation being aggregate measure, it assumes that each of the sub-metrics have equal importance; 1% quality loss will be more dangerous than 1% availability loss.

Here is worth noting that calculation of OEE involves multiplication of sub-metrics of Availability, Performance and Quality, which aggravate a failing situation and attract further attention to it. For example, if all the sub-metrics has rate of 85% then OEE will be only 61.41%, if all the sub-metrics has rate of 90% then OEE will be 72.90%.

As an aggregate quantitative metric OEE can obfuscate by hiding underlying issues, instead of clarifying areas for improvement, hence in-depth study of each sub-metrics is essential.

Skill Based Q32 – Reverse OEE

Sheetal Bearing Balls Limited (SBBL) is the famous name for bearing balls of different sizes. Mr. Syal recently joined as Manager Production and Operations at Unit 3 of Ludhiana (in Punjab) plant of the SBBL, wherein 10mm diameter steel ball bearings for bicycles are manufactured. The plant is largely automated and lashed with the latest technology machines.

From Mr. Singh, Plant Accountant Mr. Syal come to know that since machines are of the latest technology and workers are motivated due to the liberal workman policy of SBBL, hence productivity and quality is and was never an issue, but availability is. Over lunch, when Mr. Syal greets Mr. Kumar, Plant Head, he also expresses his worry over excessive downtime and optimal use of limiting factors.

Mr. Syal, while navigating the ERP and reviewing the files & other documents handed over to him, which was prepared and maintained by his predecessor; come across the OEE rate of 93.555% measured during last week for machine '107-10M-Bearing' (which is limiting factor – caused bottleneck activity) during a normal shift. Since the said machine has a high- performance rate of 105%; hence Mr. Syal decided to dig deep into the composite OEE.

In the normal shift of 9 hours workers are allowed to take 2 short breaks of 15 minutes each and a lunch break of 30 minutes. During such a normal shift, out of the total manufactured 27,216 bearing balls by said machine, only 272 balls are found defective.

Required

(i) DETERMINE the unplanned downtime witnessed by machine 107-10M-Bearing and advise Mr. Syal, the best way-out to reduce the same (in brief).

(ii) MEASURE the Ideal Cycle Time to manufacture a single bearing ball.

(iii) APPLY, Goldratt's five steps that can be applied to remove the bottleneck at the Ludhiana plant of SBBL.

Solution

(i) Unplanned downtime of machine 107-10M-Bearing

Overall equipment effectiveness (OEE) is a quantitative metric for measuring the productivity of individual equipment in a manufacturing plant. According to Seiichi Nakajima who introduced OEE, it is capable to identify and measure the losses in a manufacturing process through availability rate, performance rate, and quality rate.

OEE = Availability Rate × Performance Rate × Quality Rate

Quality Rate

Particulars	Units
Output units – total count	27,216
Rejected units out of the above	272
Good units – good count (which met the quality criteria) (27,216 - 272)	26,944
Quality Rate (Good Counts / Total Counts) (26,944 units / 27,216 units) 99.00%	

Since the quality rate is 99.00% and performance rate (105%), as well as overall equipment effectiveness (93.555%), is also given in the case; hence availability rate can be measure–

Availability Rate × 105.00% × 99.00% = 93.555%

The Availability rate is 90% i.e., run time [or net operating time (NOT)] / planned production time [or net available time (NAT)]

Planned Production Time

Particulars	Time in minutes
Total possible time (9 hours × 60 minutes) [scheduled time]	540
Less: Planned down time [scheduled loss]	
Short breaks (2 breaks × 15 minutes)	30
Meal break (30 minutes)	30
Planned production time	480

Since the Availability rate is 90% and planned production time is 480 minutes, hence run time shall be 432 minutes (run time / 480 minutes = 90.00%).

Since unplanned downtime is the difference between run time and planned production time, hence unplanned downtime of machine 107-10M-Bearing is 48 minutes.

Particulars	Time in minutes
Planned production time	480
Less: Run time (actual time taken)	432
Unplanned Downtime	48

Note

Alternate Working

Unplanned downtime = Planned production time (1 – availability rate)

= 480 minutes (1 - 90%) = 48 minutes

Advise

In order to reduce the unplanned downtime, preventive maintenance shall be practiced either before or after each shift; and the shine (out of 5S) principle shall be adopted by the workman as part of the TPM initiative. It is expected that the time spends on preventive maintenance will be less than the current unplanned downtime of 48 minutes.

(Alternate advice is also possible, provided shall be valid and reasonably relevant.)

(ii) Ideal Cycle Time to manufacture a single bearing ball

Performance rate can be computed by dividing standard time required [or ideal operating time] with run time. Since performance rate (105%) is given in the case and run time (432 minutes) computed above; hence the standard time required to manufacture 27,216 bearing balls is 453.6 minutes (standard time required / 432 minutes = 105.00%)

So, standard time required to manufacture a single bearing ball (i.e., ideal cycle time) is

1 (one) second (453.6 minutes × 60 / 27,216 balls) i.e., 60 bearing balls per minute.

Alternate Working

OEE = (Good count × Ideal cycle time) / Planned production time 93.555%

= (26,944 × Ideal cycle time) / 480 minutes

(iii) Goldratt's five steps to remove the bottleneck at Ludhiana plant of SBBL

Goldratt's theory of constraints describes the following mentioned five steps process of identifying and taking steps to remove the bottlenecks that restrict output.

1. Identifying the System Bottlenecks, likewise, at unit 3 of Ludhiana plant of SBBL, 107-10M-Bearing is limiting factor hence activity performed through/using this equipment is bottleneck activity.

2. Exploit the Bottlenecks – Limiting factor (Bottleneck's activity capacity) must be fully utilised and that too optimally. Currently the overall equipment effectiveness is already 93.555%, attention on the possibility to enhance the same is needful. (Like preventive maintenance shall be practiced to avoid unplanned downtime. Similarly for each production units, way-out depends upon the limiting factor of that unit.)

3. Non-bottleneck activities are subordinate – Bottleneck activity should set up the pace for non-bottleneck activities. Production units shall plan their production keeping respective limiting factors at the centre point, because even if the efficiency of non- bottleneck enhanced; same may be worthless due to scarcity of limiting factor (bottleneck activity).

4. Elevate the bottleneck – Eliminate the bottleneck by enhancing the capacity and efficiency. Major change (business reengineering) or continuous minor change (kaizen) may do.

Note – There will always be one bottleneck in the system, if such bottleneck is eliminated then a new constraint emerges as a bottleneck. Hence this process continuous. Ultimately improvement is a never-ending continues process.

5. Repeat the process – Apply step 1 to new bottleneck activity which emerges at different production units of Ludhiana plant of SBBL and repeat the process.

For Your Understanding

Seiichi Nakajima led the introduction of TPM, OEE and the Six Big Losses in the early 1970s while at the Japanese Institute of Plant Maintenance. OEE is a quantitative metric for measuring productivity of individual equipment in a manufacturing plant. OEE identifies and measures losses of crucial parts in a manufacturing process namely availability rate, performance rate and quality rate.

OEE = Availability × Performance × Quality OEE

Factors are calculated as follows–

1. Availability: NOT / NAT = (432 / 480) × 100 = 90.00%
2. Performance: IOT / NOT = (453.60 / 432) × 100 = 105.00%
3. Quality: (IOT – LOT) / IOT = (453.60 – 4.533….) / 453.60 × 100 = 99.00…%

Or

$$\left\{\frac{\text{27,216 units - 272 units}}{\text{27,216 units}} \times 100\right\}$$

OEE = A × P × Q = 90.00% × 105.00% × 99.00…% = **93.555…%**

Alternative Presentation-I

Good Counts = 27,216-272 = 26,944 units

Planned Production Time= 540 mins. – 60 mins. = 480 mins. (or NAT) OEE = (Good Counts × Ideal Cycle Time)/ Planned Production Time
{(26,944 / 60 units (per min.)} / 480) x 100 = **93.555…% Alternative**

Presentation-II

OEE = (Ideal operating time –loss operating time)/ Net Available Time
{(453.60 – 4.533….)/ 480} × 100 = **93.555…%**

Workings

1. Scheduled Time (total time) = 540 Minutes (9hrs. × 60 mins.)
2. Planned Down Time = 2 short breaks × 15 minutes +meal break 30 minutes = 60 minutes
3. Net Available Time (NAT) = 540 – 60 = 480 minutes
4. Unplanned Downtime = 48 minutes
5. Net Operating Time (NOT) = Net Available Time – Unplanned Downtime NOT = 480 – 48 = 432 minutes
6. Ideal Operating Time (IOT): 27,216 total units / 60 (units per min.) = 27,216 / 60 = 453.60 minutes
7. Lost Operating Time (LOT): 272 units / 60 (units per min.) = 272 / 60 = 4.533… minutes

Skill Based Q34 – Cellular Manufacturing

You are newly appointed management consultant with experience in Lean System. During discussion at meeting, managing partner (Mr. Gupta) explain the assembly line workflow process at RIO along with the machine part incident matrix. You quoted about your past experience of implementing Cellular Manufacturing system.

Required

Mr. Gupta asks you to:

(i) FIND appropriate cells using suitable method. (ii) COMMENT on the results, if any.

Note- Use "Rank Order Clustering method".

Machine Shop RIO-042

Machine Part Incident Matrix

Part / Machine	P_1	P_2	P_3	P_4	P_5	P_6
M_b			1		1	
M_c				1	1	1
M_d	1	1				
M_e			1		1	1
M_f	1	1		1		

Solution

Assign **Binary Weight** ($BW_j = 2^{n-j}$) to each column j of the matrix, where n =6 (the number/ types of parts). Calculate the **Decimal Equivalent** (DE_i) of the binary values of each row i using the formula:

$$DE_i = \sum_{j=1}^{n} (BW_j)(a_{ij})$$

Rank the rows in decreasing order of their DE_i values i.e., the largest value is ranked as 1.

i \ j	P_1	P_2	P_3	P_4	P_5	P_6	DE_i	Rank
M_b			1		1		10	4
M_c				1	1	1	7	5
M_d	1	1					48	2
M_e			1		1	1	11	3
M_f	1	1		1			52	1
BW_j	2^{6-1} =	2^{6-2} =	2^{6-3} =	2^{6-4} =	2^{6-5} =	2^{6-6} =		
	32	16	8	4	2	1		

Now, **Re-arrange** the rows in the running order of the rankings.

Since further rearrangement is necessary, assign **Binary Weight** ($BW_i = 2^{m-i}$) to each row i of the matrix, where m =5 (the number of machines). Calculate the **Decimal Equivalent** (DE_j) of the binary values of each column j using the formula:

$$DE_j = \sum_{i=1}^{m} (BW_i)(a_{ij})$$

Rank the columns in decreasing order of their DE_j values i.e., the largest value is ranked as 1. [Break ties arbitrarily]

j / i	P_1	P_2	P_3	P_4	P_5	P_6	BW_i	
M_f	1	1		1			2^{5-1}=	16
M_d	1	1					2^{5-2}=	8
M_e			1		1	1	2^{5-3}=	4
M_b			1		1		2^{5-4}=	2
M_c				1	1	1	2^{5-5}=	1
DE_j	24	24	6	17	7	5		
Rank	1	2	5	3	4	6		

Now, **Re-arrange** the columns in the running order of the rankings.

Since further rearrangement is necessary, assign **Binary Weight** ($BW_j = 2^{n-j}$) to each column *j* of the matrix, where *n* =6. Calculate the **Decimal Equivalent** (DE_i) of the binary values of each row *i* using the formula:

$$DE_i = \sum_{j=1}^{n} (BW_j)(a_{ij})$$

Rank the rows in decreasing order of their DE_i values.

j / i	P_1	P_2	P_4	P_5	P_3	P_6	DE_i	Rank
M_f	1	1	1				56	1
M_d	1	1					48	2
M_e				1	1	1	7	4
M_b				1	1		6	5
M_c			1	1		1	13	3
BW_j	2^{6-1} =	2^{6-2} =	2^{6-3} =	2^{6-4} =	2^{6-5} =	2^{6-6} =		
	32	16	8	4	2	1		

Now, **Re-arrange** the rows in the running order of the rankings.

Since further rearrangement is necessary, assign **Binary Weight** ($BW_i = 2^{m-i}$) to each row *i* of the matrix, where m =5. Calculate the **Decimal Equivalent** (DE_j) of the binary values of each column *j* using the formula:

$$DE_j = \sum_{i=1}^{m} (BW_i)(a_{ij})$$

Rank the rows in decreasing order of their DE_j values. [Break ties arbitrarily]

j / i	P_1	P_2	P_4	P_5	P_3	P_6	BW_i	
M_f	1	1	1				2^{5-1}=	16
M_d	1	1					2^{5-2}=	8
M_c			1	1		1	2^{5-3}=	4
M_e				1	1	1	2^{5-4}=	2
M_b				1	1		2^{5-5}=	1
DE_j	24	24	20	7	3	6		
Rank	1	2	3	4	6	5		

Now, **Re-arrange** the columns in the running order of the rankings.

Since further rearrangement is necessary, assign **Binary Weight** ($BW_j = 2^{n-j}$) to each column *j* of the matrix, where *n* =6. Calculate the **Decimal Equivalent** (DE_i) of the binary values of each row *i* using the formula:

$$DE_i = \sum_{j=1}^{n} (BW_j)(a_{ij})$$

Rank the rows in decreasing order of their DE_i values.

i \ j	P_1	P_2	P_4	P_5	P_6	P_3	DE_i	Rank
M_f	1	1	1				56	1
M_d	1	1					48	2
M_c			1	1	1		14	3
M_e				1	1	1	7	4
M_b				1		1	5	5
BW_j	2^{6-1}=	2^{6-2}=	2^{6-3}=	2^{6-4}=	2^{6-5}=	2^{6-6}=		
	32	16	8	4	2	1		

Since the ranking is now neatly arranged in order, stop the process. We can now identify the cells.

Cell1	P_1, P_2, P_4	M_f, M_d
Cell2	P_5, P_6, P_3	M_c, M_e, M_b

The following cells, as derived from the Rank Order Clustering Algorithm, shall be presented to Mr. Gupta for consideration along with the below comments.

Cell 1		Cell 2	
Part Family 1	**Machine Group 1**	**Part Family 2**	**Machine Group 2**
P_1	M_f	P_5	M_c
P_2	M_d	P_6	M_e
P_4		P_3	M_b

Comments

It is essential to understand that the cells are not totally independent. Since P4, which is member of cell1, needs processing in Mc. But machine Mc belongs to cell 2. So, some amount of intercell movement/ change will take place in this situation. In general, these moves may become unavoidable in real life circumstances. There are various alternative ways of eliminating intercell moves in a cellular manufacturing system like– redesigning the part so that the machine belongs to other cell is no longer required for processing, subcontracting the part/ adding the necessary machines in the cell. The cell designer should evaluate the consequences of each of these ways and take suitable measures/ ways to minimise these moves.

Case Scenario 6 – Value Engineering

Star Tiles Production Limited (STPL) is large manufacturer of floor tiles and interlocking tiles. STPL enjoyed reasonable market share and brand reputation up till couple of year ago. Since then, STPL is facing problem of decline in productivity. STPL deals in variety of tiles with different brand-name, some of their brands are in development stage and some in maturity. Majority of customer are from middle class, who are price sensitive; hence cost of production is critical aspect for STPL and resultantly productivity too become critical factor.

Workers at STPL are allocated with specific roles and responsibilities. Workers are supposed to work strictly according to specific set of guidelines provided by superior. Workers used to complain about job role allocations, because allocations are not as per skill set of workers. In some of case task become monotonous; as learning curve exhausted. Management and operational decision are centralised in nature, participation of workers is limited up-to day end report only.

Remunerations at STPL are paid based on hourly rate. Hourly rate is fixed based upon number of years of working in STPL, irrespective of importance of task allocated to such worker. Since payment are fixed in nature hence workers at STPL are hardly concern about quality. Some of skilled workers are getting less pay in comparison to other staff. STPL recently retrench some of senior workers, who possess reasonable operational skills; but not good in technology part which is essential to operate machines; recently installed at STPL plant.

Since there are varieties of tiles available in stock that's too with different design, hence in past there are handful instances where material delivered to customer was different from what being ordered. Due to large volume of inventory at store, some category of tiles is further manufactured even lying available in store and stock of some remains always short.

Required

You are newly appointed to Management Accounting Department of STPL, Management Accountant asked you to draft a report for CEO, containing brief explanation to–

a. Productivity, stating in context of what it should be measured?
b. Productivity enhancement techniques, which can be applied at STPL in order to enhance productivity?

Solution

Report

Addressed to:

Office of CEO,

Star Tiles Production Limited (STPL). Dated –11th Apr 2020

Report on Productivity Enhancement Techniques

(i) **Productivity -** Productivity is all about efficient and effective use of all resources. Resources can be time, people, knowledge, information, finance, equipment, space, energy and material.

Productivity is usually linked to 'time and motion', in order to

- Put pressure on worker to perform faster.
- Increase the productivity either by increasing the value or reducing the time required to create that value.

Note - Responsibility of productivity is largely on the person who organising the work rather individual worker.

(ii) Productivity Improvement Techniques

a) Value Analysis/ Engineering – Value engineering improve value of product at every state of product life cycle; Since products of STPL is lying either in development stage or in maturity stage, hence
   - **At development stage** – STPL can reduce cost without reducing quality by establishing design and processes accordingly.
   - **At maturity stage** – STPL can reduce cost by replacing costly component with cheaper one. But may result in reduction in quality to some extent, hence consumer behaviour is important. Since customer base is price sensitive hence this strategy may work.

b) **Quality Circles** – Quality circle is small group of employees, usually in size of 5-6 members in order to–
   - Meet regularly to identify, analysis and solve problem of their departments.
   - Advice the management to implement new methods to solve work-related problems.

Since STPL facing criticism from worker class and method of working is selected by superior hence quality circle can be solution to these problematic aspects.

Note – This technique originated in Japan in 1960s

c) **Financial & Non-Financial incentives** – Incentives are real cause of motivation to worker and may be financial and non-financial in nature.
   - Financial incentive includes better wages and salaries, bonus etc.
   - Non-financial incentive includes better working condition, welfare facilities, worker participation in management.

Since the incentive scheme is not linked to employees' productivity and skill hence redrafting of incentive schemes incorporating financial and non-financial incentives can promote productivity.

d) **Operations Research** – Management at STPL need to incorporate operation research and technique thereof in the decision-making process. Use mathematical & scientific methods may solve the problems of productivity (by using techniques such as LPP etc).
e) **Training** – Rather than retrenching the employees who are operationally sound and weak in using the technology, they must be trained on technological part. Training is process of knowledge & skill enhancement of employee and will result in increased efficiency of employee.
f) **Job Enlargement & Job Enrichment** – Job Enlargement is horizontal expansion of job which increase the varieties of job & work knowledge (make job interesting and satisfying), whereas Job Enrichment is vertical expansion of job which makes routine job more meaningful and satisfying. With this STPL can solve the problem of monotonous nature of task and can enhance the productivity.
g) **Job Evaluation** – In order to enhance the productivity, STPL should do job evaluation. Fixing value of each job in the organisation. This is essential for moral boosting for employees.
h) **Inventory Control & Material Management** – Optimum usage of material in manufacturing process need to be ensured by STPL, whereas overstocking and under-stocking should be avoided, through–
    - Scientific Purchase
    - Systematic Store Keeping
    - Proper Inventory Control, etc.

    Because overstocking may result in blockage of fund, chance of misuse/ mishandling & spoilage of material and under-stocking results in shortage or sale out situation which result in loss of contribution.
i) **Quality Control** – STPL should ensure identification of causes of quality deviation & correction thereof, in order to produce goods with quality at lowest prices & to reduce wastage.
j) **Human Factor Engineering** – Understanding of technology and human requirement (psychological & physiological character), of task and worker both; in order to ensure fitment of job to men; to increase human efficiency & wellbeing. STPL can do skill mapping as part of this technique.

Further details can be tabled on requisition basis.

Closure of Report

Signature

(For Management Accounting Division)

Star Tiles Production Limited.