

REDUCTION OF DEFECTS AND LEAD TIME OF THE ORDER TO DELIVERY (OTD) PROCESS IN A GLOVE MANUFACTURING FIRM

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Abstract — This paper is to analyze and reduce the defects and lead time in XYZ firm in kottayam. XYZ is a small scale industry, who manufacturers sterile latex surgical gloves and examination gloves. Presently the firm has 41 permanent staffs in the company in regular with total production of 100000 pieces per day. This study is specifically to reduce the lead time for production and defective gloves inorder to improve the customer satisfaction A combination of site observation, personnel interview, literature survey is to be used for data collection for assessing the current situation and future improvements. Currently 4% of the total production is defective gloves and five days time is taken to make the product get ready for dispatch. The lead time is reduced to 3 days by adding more shifts in inspection and introducing a wallet packing unit. The defects can be reduced by implementing the suggestions provided along with the economic justification. Every suggestions provided have an economic justification.

Keywords- defective gloves,order to delivery time,customer satisfaction

I. INTRODUCTION

Increase in the competition and demands of the customers forced the entire industries to continuously improve their quality in terms of products and Services for obtaining a strategic competitive advantage. The organization studied in this document should maintain the quality of their products in order to delight customers and thereby compete in the market effectively. A glove manufacturing unit aims to meet the demand of the customer by providing a good quality product. The glove is rejected by the customer due to the fact that the product is not upto their requirements. Nowadays it is common practice to review rejected pieces for a day, but the retouching leads to losses in the final result of the company, if it is a continuous mass production, in which the products go through a series of processes, leading to the product final. The Order To Delivery process is part of every business process. The performance of the OTD process is very important for most companies because it Determines the capacity of companies produce a certain amount of merchandise at a given time. The fastest OTD process is The fastest company is able to meet the requirements of customers. The firm discussed in this study is facing a problem with the number of defective gloves and the increase in the order to delivery time. The primary objectives of this study was to determine the causes for the rejection of gloves and to reduce the time taken for order to delivery. For academic purposes, limited studies are done in this area, so this paper can be a base for further studies.

II. METHODOLOGY

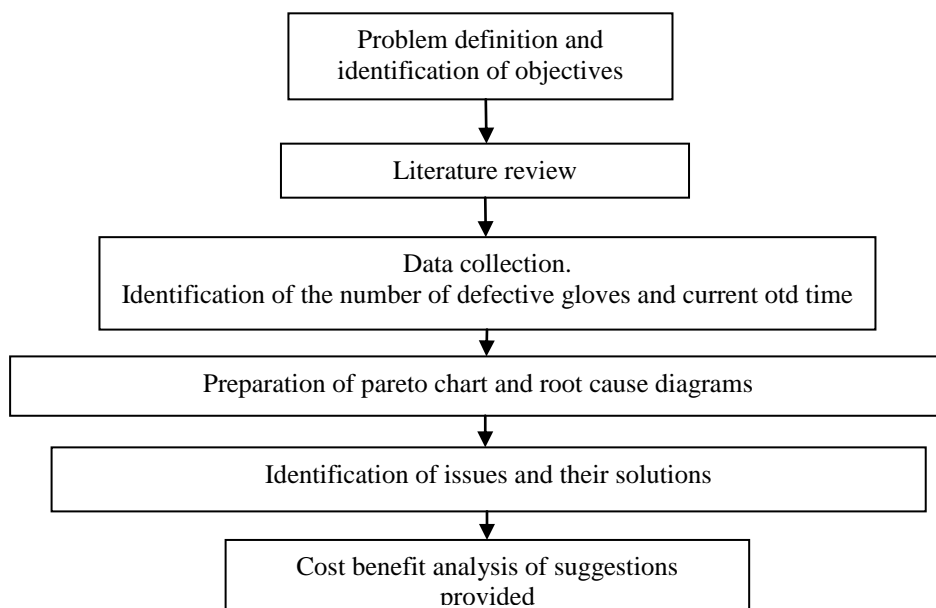


Figure 1. Methodology

III. DATA COLLECTION

The preliminary data collection was done from the company records and from detailed literature review. Thus the current status of the firm was analysed from company records and annual report of XYZ and thereby formulated action plans for the stabilization of the company. The secondary data is collected through onsite observation, employee surveys and literature review. The current layout design and process flow diagram is framed.

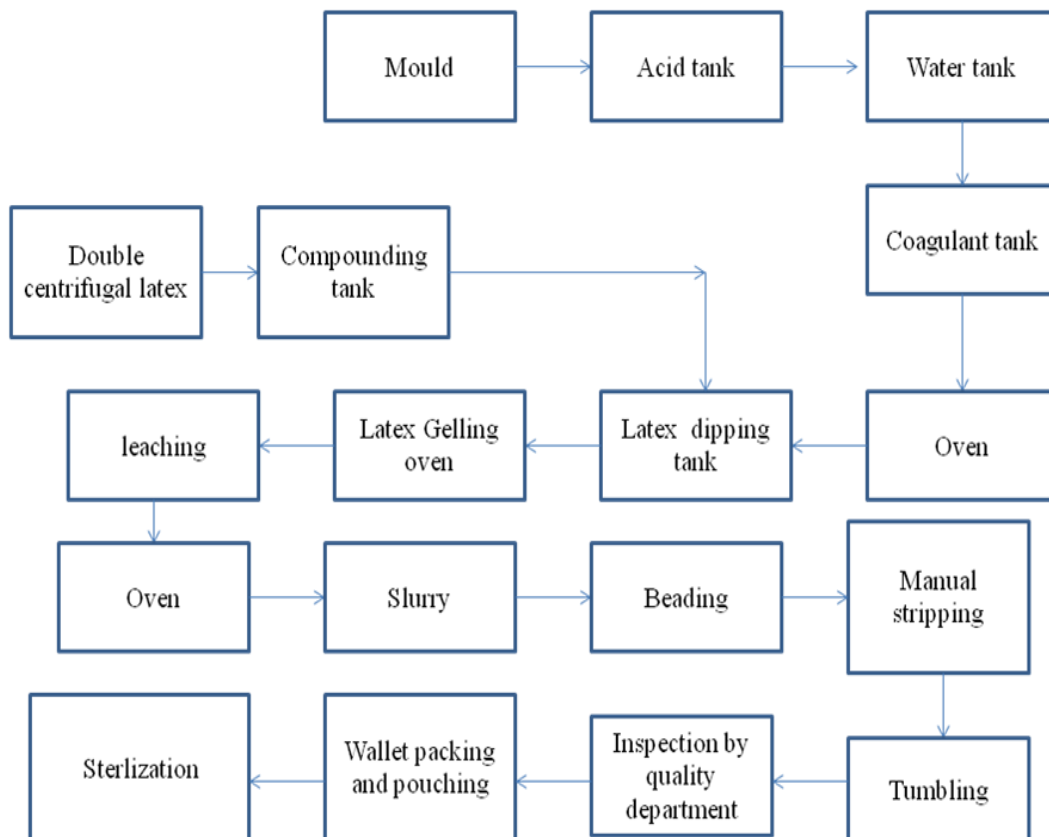


Fig2: Current process flow diagram

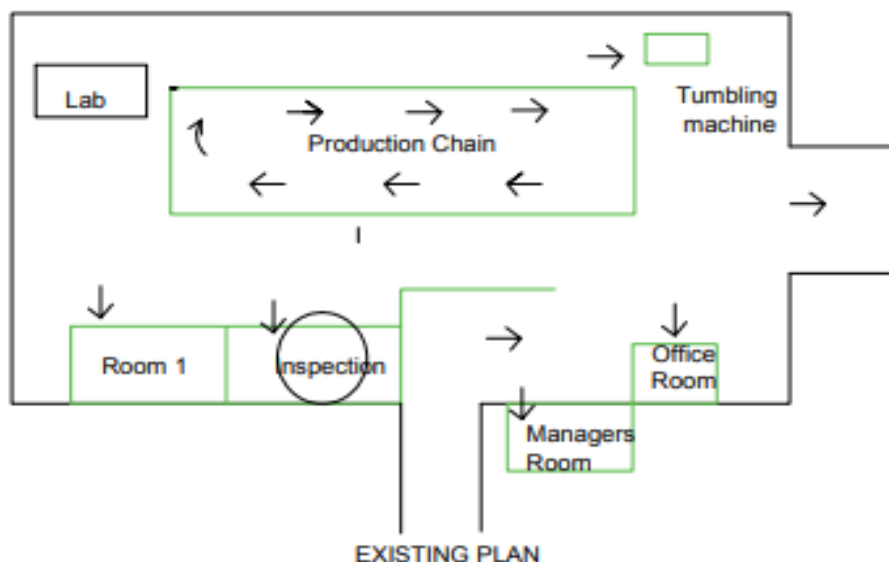


Fig3: Current layout

The current layout consist of a production chain, office room, managers room, a tumbling machine, tensile testing and chemical testing lab, inspection room and unused room where scraps are kept. The data is collected to identify the percentage of defectives, the number of defects and the current order to delivery time. The daily production of the firm is 100000 pieces. The number of permanent staffs is 41. The number of gloves checked per day is 82450.

| No of days | Total gloves checked | Leak/ Pin hole defect | Dirt | Beading | Torn tearing | Weak spots | lumps | No of defectives |
|------------|----------------------|-----------------------|------|---------|--------------|------------|-------|------------------|
| Day 1 | 22450 | 780 | 690 | 650 | 240 | 220 | 170 | 888 |
| Day 2 | 22450 | 785 | 645 | 647 | 210 | 200 | 150 | 895 |
| Day 3 | 22450 | 741 | 640 | 630 | 230 | 170 | 130 | 881 |
| Day 4 | 22450 | 780 | 650 | 660 | 220 | 120 | 130 | 910 |
| Day 5 | 22450 | 745 | 630 | 540 | 240 | 140 | 0 | 860 |
| Day 6 | 22450 | 700 | 670 | 530 | 230 | 120 | 110 | 910 |
| Day 7 | 22450 | 768 | 620 | 550 | 230 | 0 | 0 | 890 |
| Day 8 | 22450 | 763 | 650 | 530 | 0 | 0 | 0 | 950 |
| Total | 179600 | 6062 | 5195 | 4737 | 1600 | 970 | 104 | 7184 |

Table 1: No of gloves checked, individual defects and no of defectives

The critical defect is identified using a pareto chart and the causes for each defect is identified using a root cause diagram. Both are done using a mini tab software. The current order to delivery process is framed and the current manufacturing process time is obtained through on site observation and personnel interview. The current time taken to deliver the order is 5 days.

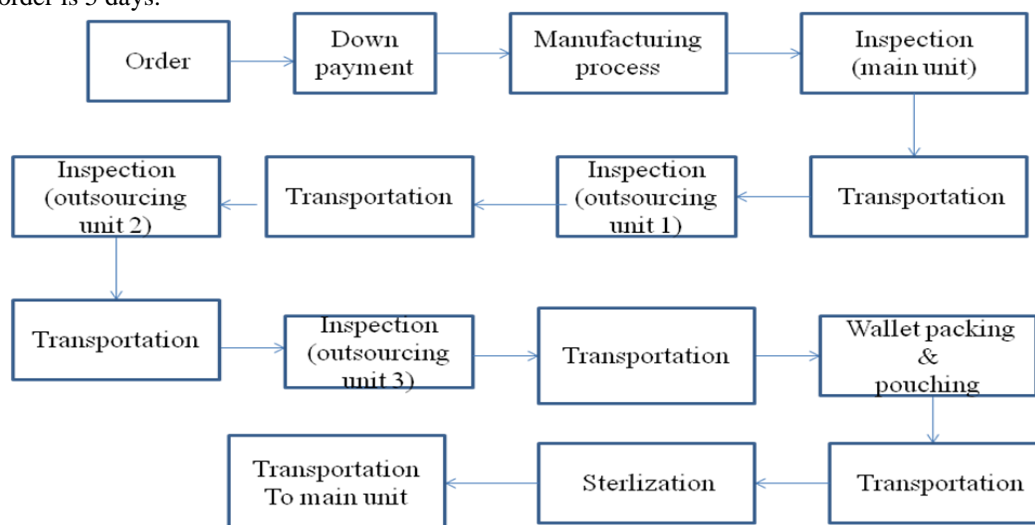


Fig4: Current order to delivery model

| Days | Process | No of items | Shifts | Labor | Machine | Time for one batch |
|-------|-------------------------------------|--|--|-------|--|--|
| Day 1 | Production | 1668/batch 100000 pieces | 3 shift(24 hrs) | 12 | Production line 1668 mould | 24 min/batch for rest |
| Day 1 | Tumbling | 1668/batch 100000 pieces | 3 shifts (24hrs) | 3 | 1 Tumbling machine | |
| Day 1 | Tensile test | 20/batch 1200 items | 3 shift(24hrs) | 3 | Tensile testing machine 96sec for one glove | 32 min/batch |
| Day 2 | Inspection@ 4 units Main unit | 82450 pieces 22450 pieces | 1shift (440 min) | 17 | 20 sec/glove | 54/7 batch 62/1 batch (approximate time) |
| Day 2 | Unit 1 Unit 2 Unit 3 | 20000 pieces 20000 pieces 20000 pieces | 2 hrs 30 min 2hrs 30 min 2hrs 30 min | | | |

Table2: Current manufacturing process

IV. RESULTS

The data is analysed using a minitab software .The most critical defects among the six type of defects is obtained using the pareto tool.

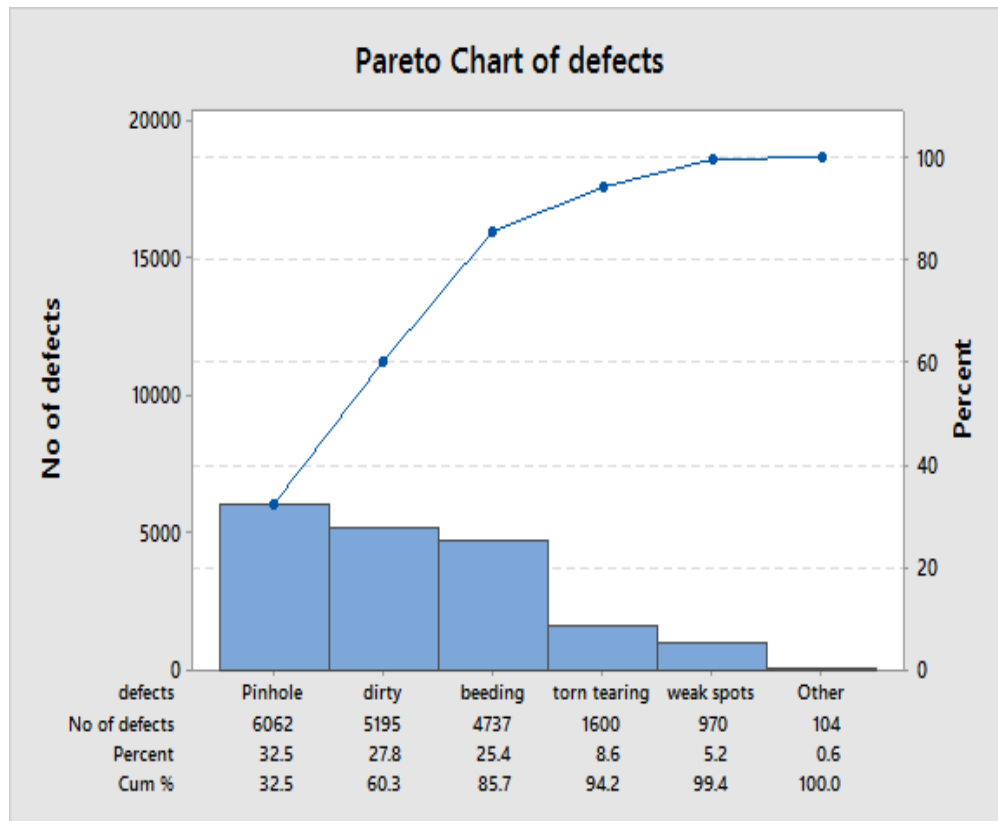


Fig5:The pareto chart of defects

From the chart it can be interpreted that 32.5% of the total defects is the pinhole defects ,27.8% of the total defects is the dirtiness of the glove,25.4% of the total defects is beeding defect ,8.6% of the total defects is torn tearing defect,5.2% of the total defects is weak spots and the other defects include the remaining percentage. The major defect which is identified is the pinhole defect.

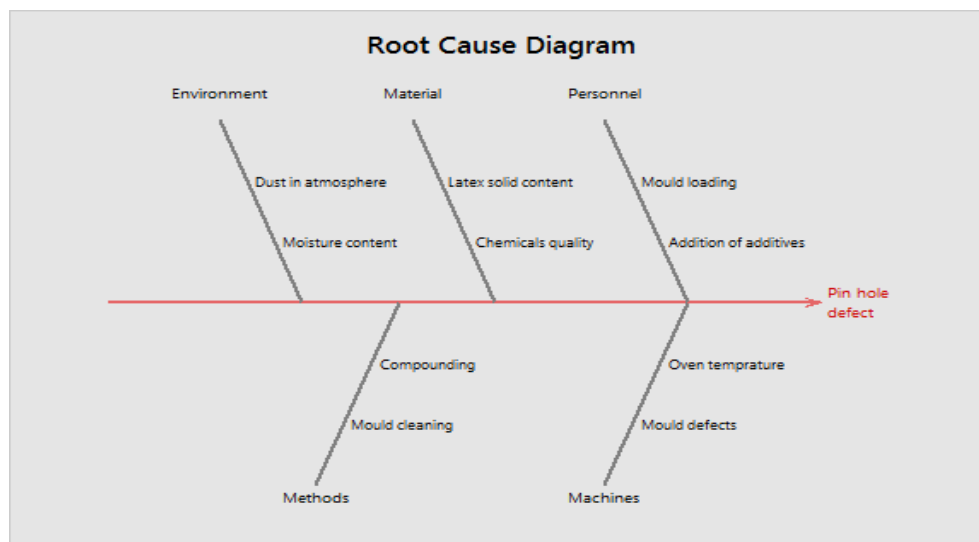


Fig6:root cause diagram of pinhole defect

Using root cause diagram the causes for each defect is identified and plotted.The causes were obtained using a onsite observation, literature survey and personnel interview.

4.1 Suggestions and economic justifications

Objective1: To identify defects and the causes behind the rejection of gloves and provide necessary suggestions.

| Suggestions | Costs | Benefits |
|--|--|--|
| Cleaning of the mould using an alkaline tank and 2 hot water tanks | 3 tanks made of Stainless steel -Item cost-26000x3= 78000 -Capacity -1000l -Steel grade SS316 -Labor cost -7000 | 32.5% of defects is leak/pinhole defect. The amount of defect can be reduced. The loss 4.3rs /glove can be saved along with the amount of rework |
| <ul style="list-style-type: none"> Provision of a material handling unit in the plant along with a bulk storage rack. An additional staff for cutting the piece in dumbbell shape as per ASTM D412 standard | A material handling unit-BC=Rs 20230+26000(ac,1 ton) Bulk storage rack-Rs 25000 -Storage capacity-6 ton -Height -9 m <ul style="list-style-type: none"> Rs 8000 per staff 3 staff/3 shifts 8000*3=Rs 24000 | 27.8% of the gloves get rejected due to dirt. The amount of defects can be reduced. reduced. The loss 4.3 rs /glove can be saved along with the amount of rework |
| <ul style="list-style-type: none"> Provision of a storage unit in the plant which includes a bulk storage racks Trolleys should be provided for transporting the crate. -Four crate per trolley The gloves should not be handled by the workers with bare hands | <ul style="list-style-type: none"> Bulk storage rack-Rs25000 -Storage capacity-6 ton -Height -upto9m Luggage Trolley Rs.15000(SS,4ft*2ft*250mm,15kg-1 ton),*2=Rs30000 3 staff/shift=12 staffs 12*100=1200 | 68.9% of the defects consist of pin hole, dirty and Tearing. this can be reduced. reduced. The loss 4.3 rs /glove can be saved along with the amount of rework |
| Regular maintenance of the beading brush by a line qc | 12000/staff, 2 staffs 1 staff/shift 12000*2=24000 | 25.4% of gloves get rejected due to beading defect. This can be reduced |

Table 5:Economic justification of objective 1

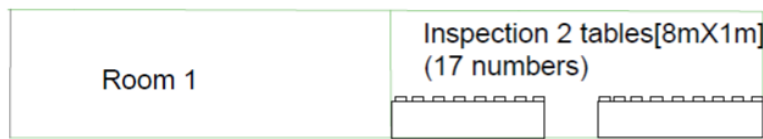
objective 2: To reduce the lead time for the current OTD process.

- Proposed a new manufacturing process.

| Days | Process | No of items | Shifts | Labor | Machine | Time for one batch |
|---------------------|------------------------------------|-------------------------------|------------------|----------|--|------------------------|
| Day 1 | Production | 1668/batch 100000 pieces | 3 shift(24 hrs) | 4/shift | Production line 1668 mould 2 sec | 24 min/batch |
| Day1 | Tumbling | 1668/batch 100000 pieces | 3 shift(24 hrs) | 3 | 1 tumbling machine | |
| Day 1 | Tensile test | 20/batch 1200items | 2 shift(24hrs) | 2/shift | Tensile testing machine 90sec for one glove,65 sec/19 | 24min/batch |
| Day 1 | Inspection | 90720 Pieces | 3shifts | 21/shift | 20 sec/glove | 24 min/ batch(1512) |
| Day 1 | Wallet packing & material handling | 50000 pair | 3 shifts(440min) | 7/shift | 12 sec/glove | 24 min/batch(834 pair) |
| Day2 (outsourcing) | Pouching | 50000 pair | 3 shifts | 3/shift | 40 pair/min, 3machines | 1.5sec/pair |
| Day 2 (outsourcing) | Sterilization | 50000 pair 550 pair/carton | 360 min | 5/shift | 20 min/carton 5 machines | |

Table 6:proposed manufacturing process

- Changed the shift of inspection unit from one to three. 21 staffs are allowed work in each shift so that the inspection gets completed in one day along with production



EXISTING PLAN



REVISED PLAN

Fig8:Redesigned plant layout

- A new wallet packing unit is introduced into the firm with 7 staffs to work for three shifts day. This will make the inspection and production to get complete along with production of gloves and thus the pouching and sterilization can be outsourced to one unit. Thus the time for order to delivery can be reduced into 3 days.
- Proposed a new model of OTD process. The inspection is done in the main unit itself instead of outsourcing it, thus it gets completed in one day. The wallet packing is also done in the main unit with 7 staffs for each shift

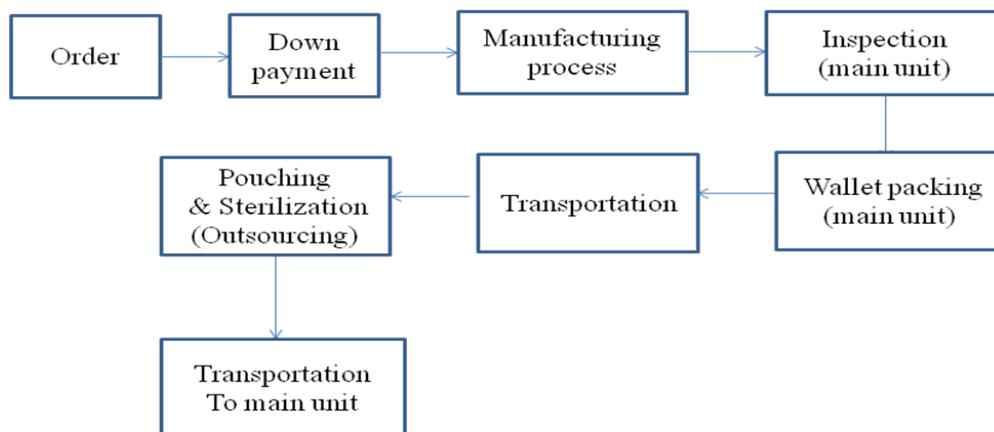


Fig9:Proposed order to delivery process

| COSTS | BENEFITS |
|--|--|
| Inspection Unit: -46 additional staff required to complete 3 shift $-46 \times 8000 = 368000$ - Design cost(27230)+ - Table cost(25000)+ - Installation cost(5000)+ - AC(32000) -Total cost = $368000 + 83230 = 457230$ | Outsourcing cost: -.3/piece $-.3 \times 60000 = 18000/\text{day}$ $-18000 \times 29 = 522000$ *Profit /month = 64770 |
| Wallet Packing: -21 staff required for 3 shifts $-21 \times 8000 = 168000$ -Table cost=5000 -Total cost= $168000 + 5000 = 173000$ | Outsourcing cost: -.25/pair $-.25 \times 50000 = 12500/\text{day}$ $-12500 \times 29 = 362500$ *Profit/month=189500 |

V. CONCLUSIONS

XYZ is a private company which was once a leading manufacturer of surgical gloves. Due to certain defective planning, the company was pushed backward from the competitive market. Hence there was a need that the company must have a proper marketing strategy for pooling themselves again into the market. The main problems faced by the firm is the increase in the number of defectives and the increase in the order to delivery time. Since the market is very competitive, delay in the delivery time and increase in the defective percentage can reduce their value in the market. This will restrict them from gaining new customers also. Currently 4% of the total production is defectives and the order to delivery time is 5 days. The critical defect identified is pinhole defect. In order to reduce the number of defectives proper suggestions were provided with economic justifications. By reducing the number of defects the amount for rework can be reduced. The main factors causing lead time for OTD (5 days) have been identified and this is due to the outsourcing of gloves. The outsourcing can be reduced by increasing the shift of inspection from one shift to three by adding 46 additional employees and by introducing a wallet packing unit. The wallet packing unit consists of 7 members in each shift. The inspection and wallet packing of the gloves can be done in one day along with the production process. The outsourcing is done only for pouching of gloves and sterilization of gloves, thus the time for order to delivery can be reduced to three days. By reducing the delivery time they can gain more customers and can survive the competition in the market.

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