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Investigation on the Capacity Utilization Issues in a Cattle Feed Plant

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Abstract

Every organization needs to balance their production capacities with demand. This paper focus on the capacity utilization issues using the company's true capacity utilization, efficiency, and Overall Equipment Effectiveness (OEE). The use of the company's Enterprise Resource Planning (ERP) system assists in defining the present production utilization, efficiency, and history of the customer sales needs. The company's yearly production data for the year 2012-13 taken as a model to define and allow the company to better understand its true calculated capacity versus its sales and develop a plan to correct the constraints. One of the objective is to compare the data from the company's ERP system to define the company's present rated capacity level with efficiency, utilization, and work schedules and another objective is to define the company's capacity according to OEE. The paper contributed the company to identify what constraints are truly causing issues in the company's capacity and suggests alternatives for improving the Capacity Utilization

Keywords: Capacity Utilization, Overall Equipment Effectiveness, Pareto Diagram, Capacity expansion Strategies.

1. INTRODUCTION

Capacity planning and its management is a very important field of operations management. Capacity management means how the existing system is used. A company has an existing configuration of people, resources and equipments. The efficient use of these resources is very much essential for the existence of the firm. Capacity management becomes a vital issue under this perspective. The existing system needs to be analyzed thoroughly and it is important to look forward for superior alternatives. Bottlenecks and delays restrict the capacity and elimination of these is an important aspect of capacity management.

The ready mixed cattle feed manufacturing firm company is now faces stiff competition from other established firms. The cost of raw materials used in the cattle feed production are increasing at a rapid rate and on the other side availability of raw materials are decreasing resulting in increasing cost of production. At the same time, the company struggles to keep in pace with the demand for its products. It has been identified that the company is not managing its production capacity properly. In other words, the company is facing serious capacity management issues. A thorough understanding of the operations management concept is necessary to tackle this problem. In this project, an emerging theory of operations management ,Overall Equipment Analysis, Pareto Charts are used as a tool to solve the capacity management issues faced by the company.

2.LITERATURE REVIEW

Capacity management means how the existing system is used (Gregory A. Howell1, Glenn Ballard2, and Jerome Hall3 (2012)). A company has an existing configuration of people, resources and equipments. The efficient use of these resources is very much essential for the existence of the firm. Capacity management becomes a vital issue under this perspective. The existing system needs to be analyzed thoroughly and it is important to look forward for superior alternatives. Bottlenecks and delays restrict the capacity and elimination of these is an important aspect of capacity management. Capacity management requires knowledge of what percentage of available capacity is actually utilized currently. Capacity Utilization (CU) is ratio of observed output over expected output (Kirkley et al.2002). Utilization is the degree to which equipment, space, or labour is currently being used and is expressed as a percentage (Krajewski et al. 2002).

According to Reyes et al.(1989), overall equipment effectiveness (OEE) is a quantitative metric That has been increasingly used in industry not only for controlling and monitoring the productivity of production equipment but also as an indicator and driver of process and performance improvements. In this context, OEE is Able to measure performance, identify development opportunities and direct the focus of improvement Efforts in areas related to equipment or process utilization (availability), the operational rate (performance) and quality.

According to Dal *et* al. and Ljungberg (2009), OEE is calculated by obtaining the product of availability of the equipment ratio, the performance efficiency of the process ratio and rate ratio of quality products.

1. Availability Ratio, according to Jonsson and Lesshammar (1980) "the availability factor measures the total time That the system is not operating Because of breakdowns, set-up, adjustment, and other stoppages."
2. Performance Ratio, according to Jonsson and Lesshammar (1980) "performance measures the ratio of the actual operating speed of the equipment (eg the ideal speed minus speed losses, minor stoppages and idling) to its ideal speed". Performance ratio describes the ability of equipment to produce goods.
3. Rate of Quality Products, is a ratio that describes the ability of equipment to produce products that comply with standards.

3.RESEARCH METHODOLOGY

For identifying the issues faced by capacity utilization, both primary and secondary data are used. Primary data was collected through semi structured interviews with management and employees. Secondary data collection was collected from annual reports, Production reports, ERP Data etc. Stages in conducting research on increasing the productivity of the cattle feed plant required several stages of research, namely:

1. Initial research to get the whole picture of the issues to be examined (either the data or information from interviews with relevant parties).
2. Stage of data processing, where data collected is processed to be used in the study. Stages of data processing performed in this study include availability ratio calculation, the calculation of performance efficiency, the calculation of rate of product quality, overall equipment effectiveness calculations and calculations six big losses.

3. Problem analysis, conducted by the OEE calculation has been done before. Of the three components of OEE calculation, the value of OEE is known and can be further analyzed to evaluate, whether it is good enough or needs to be applied to models of a better machine maintenance, such as an integrated maintenance for example. In addition, the analysis is also performed on the six big losses, to know how big contribution of each of the six factors affecting the effectiveness of the machine losses.
4. Identify the problem by using a Pareto diagram of the factors of the six big losses, to determine what should be done so that the implementation of integrated care for the effectiveness of the utilization of facilities that can enhance the productivity of the company.

Calculating OEE

As described in World Class OEE, the OEE calculation is based on the three OEE Factors, Availability, Performance, and Quality. Here's how each of these factors is calculated.

OEE = Availability x Performance x Quality

Metric 1: Availability

Availability = Run Time / Total Time

By Definition: Percentage of the actual amount of production time the machine is running to the production time the machine is available.

Simple OEE: The total run time of the machine subtracting all unplanned downtime.

Metric 2: Performance

Performance = Total Count / Target Counter

By Definition: Percentage of total parts produced on the machine to the production rate of machine.

Simple OEE: How well a machine is running when it is running.

Metric 3: Quality

Quality = Good Count / Total Count

By Definition: Percentage of good parts out of the total parts produced on the machine.

Simple OEE: How many good parts versus bad parts a machine has produced.

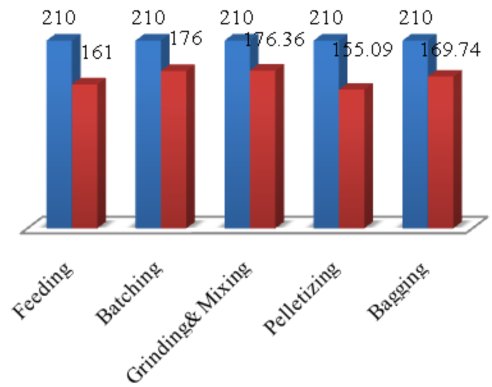
4. RESULTS AND DISCUSSIONS

The production details of major sections were noted for a continuous period of one month (1/05/2013–31/05/2013). It is presented in tabular form. From the production data, the average daily output of each of the sections during the specified period was determined. The result is shown below.

TABLE I
CAPACITY UTILIZATION OF MAJOR SECTIONS IN THE PLANT

Sections	Designed Capacity (Tones/day)	Expected Capacity (Tones/day)	Average Daily Output (Tones /day)	Capacity Utilization (%)
Feeding	240	210	161	76.66
Batching	240	210	176	83.81
Grinding	288	210	176.36	83.98
Pelletizing	288	210	165.06	78.57
Bagging	240	210	169.74	80.83

The following graph shows a comparison between effective capacity and actual capacity



The figure1 reveals that there is a large gap between the effective capacity and actual output. This indicated company is not utilizing its production capacity properly.

Details of stoppage time were taken and these are presented in Table 1.The data is taken for a continuous period of one year. Fig.2 shows the Pareto analysis of Production stoppages

TABLE II
PRODUCTION STOPPAGE DETAILS

Sl.No.	Reasons	Time Taken in Hrs	% of Total Time	Cumulative%
1	Target Achieved	712.25	70.10	70.10
2	Preventive Maintenance	232	22.83	92.93
3	Workers Shortage	44	4.35	97.28
4	Production change	19.76	1.94	99.22
5	Raw material shortage	8	0.78	100

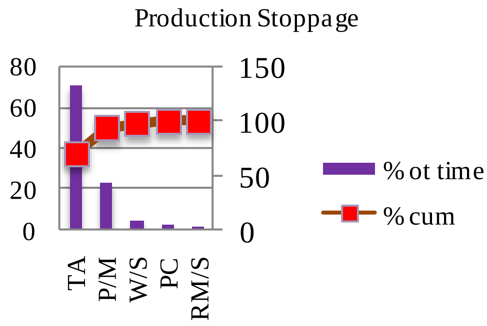


Fig.2 Pareto Diagram Stoppage details

From the data collected, it is very clear that the major contributors of to the production stoppages is Target Achieved.

TABLE III
PRODUCTION IDLE TIME DETAILS

Sl.no	Reasons	Time Taken Hrs	% of Total Time	Cum.%
1	Bin Empty	102.3	46.08	46.08
2	Bagging Out Put delay	46.25	20.84	66.92
3	Mechanical BDN	27.41	12.35	79.27
4	Electrical BDN	19.25	8.67	87.94
5	Shift Change	15.8	7.12	95.06
6	Others	10.98	4.94	100

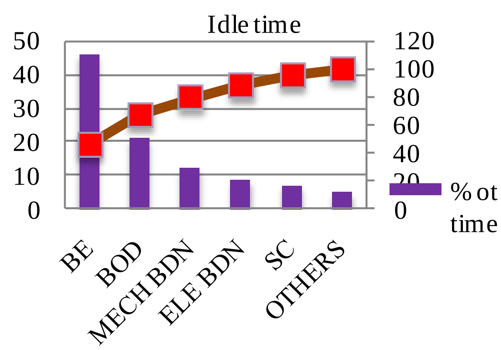


Fig.3 Pareto Diagram production Idle Time

From the **Table 3& Fig 3:** it is clear that About 67% idle time is due to bin empty and bagging delay. Lower output rate of Feeding and bagging section reduce the capacity utilization.

OEE calculation

As described in World Class OEE, the OEE calculation is based on the three OEE Factors, Availability, Performance, and Quality.

Data Analysis

- No. of shifts in a year = 1095
- Shift length = 8 hours = 8760
- Short break = 0 mins (machine will not stop)
- Meal break = 0 mins

A. AVALIBILITY

Availability = Operating Time / Planned Production Time

Planned Production Time = Shift Length – Breaks

= 8760 - 0

= 8760 Hrs

Operating Time = Planned Production Time - Down Time

= 8760-1238

= 7522 hrs

Availability = 7522/8760 = 0.8587*100

Availability = 85.87%

B. PERFORMANCE

Performance = (Total Production / Operating Time) /Ideal Run Rate

= (59409.5 / 7522) / 10 MT per minute

= 0.7898 or 78.98%

Performance = 78.89%

C. QUALITY

Quality = Good Production/ Total Production

Good length = Total production - Reject Products

= 59409.9-17.805

= 59391.7

Quality = 0.9997 or 99.97%

Quality = 99.97%

D. OVERALL EQUIPMENT EFFECTIVENESS

OEE = Availability x Performance x Quality

= 0.8587x 0.7898x 0.9997

= 0.6779

OEE = 67.79%

Table 4 shows the result of Overall equipment analysis

TABLE IV
OEE ANALYSIS

OEE Factors	World Class	Manufacturing Process
Availability	90%	85.87%
Performance	95%	68.67%
Quality	99.9%	99.9%
OEE	85%	67.79%

According to performed studies on OEE factors in the unit, the Availability is 85.87%, Performance is 68.67%, and Quality is 99.97%. The achieved result show distance between OEE in this process and World Class Level. Therefore the world class level OEE for continuous production process is 85%. The major reason for the distance is performance factor level in this process. In order to reach to world class level, process Performance level has to enhance to 95%.

Alternate capacity expansion strategies

Capacity expansion is the process of adding facilities over time in order to satisfy rising demand (Manne, 1961; Freidenfelds, 1980, 1981). Capacity expansion decisions in the business sector generally add up to a massive commitment of capital. The efficient investment of capital depends on making appropriate decisions in individual expansion undertakings. On the other hand, capacity expansion decisions can be improved through the use of Operations Research models. Today, large global corporations are increasingly adopting more flexible supply chain and production strategies based on real compound options. Dynamic investment strategies generally include options to wait, to exit, to expand, to switch, and to improve, among others.

Basic Strategies for Timing Capacity CRP provides information to determine the timing of capacity expansion. The basic strategies in relation to a steady growth in demand are:

1. Capacity Lead Strategy
   - In anticipation of demand, capacity is increased.
   - This is an aggressive strategy and is used to lure customers away from competitors.
2. Capacity Lag Strategy
   - Increase capacity after demand has increased.
   - This is a conservative strategy and may result in lose of customers.
   - You assume customers will return after capacity has been met.
3. Average Capacity Strategy
   - Average expected demand is calculated and capacity is increased accordingly.
   - This is the most moderate strategy.

Proposed Capacity Expansion Strategies

Plan 1- Increase Workforce Size
Plan 2-Install Storage silos
Plan 3-Automatic Bagging System

<u>Plan 1- Increase Workforce Size</u>

Advantages

-Increase Feed Rate
-Can be reduce Idle time
-Save Energy cost
-Save additional Cost of Product transfer

Major Constraints

-Lack of availability
- Increase Production cost
-Low output of Bagging

Plan 2-Install Storage Silos

Advantages

-Increase Feed Rate
-Can be reduce Idle time
-Save Energy cost
-Save additional Cost of Product transfer
-Additional workers are not needed

Major Constraints

-Investment cost is high
-Additional equipments needed
- large space required
-Low out put of Bagging

Plan 3-Automatic Bagging System

Advantages

-Increase Feed Rate
-Can be reduce Idle time
-Save Energy cost
-Save additional Cost of Product transfer
-Additional workers are not needed

Major Constraints

-Need training for operation and maintenance of Machine
-Need initial investment

Table 5 shows cost required for implementation of capacity expansion plans. From the Table 6 it has been found that payback period of plan two is more compared to plan three and also company can obtain maximum profit with implementation of automatic Bagging Machine. Fig 4 shows the Break Even Analysis of Plan1 and Plan 3.From the Fig.3 it has been found that when improved production rate reached in 24320 MT benefits from both plans becomes equal and further improvement in production rate plan 3 obtained more benefit than plan 2.

TABLE V
COST ANALYSIS OF CAPACITY EXPANSION STRATEGIES

Month	Production	Cost of Transfe	Plan 1 Additi	Plan 2 Storage	Plan 3 Baggi
2	2700	15.12	1.764	85	15
4	5400	30.24	3.528	85	15
6	8100	45.36	5.292	85	15
8	10800	60.48	7.056	85	15
10	13500	75.6	8.82	85	15
12	16200	90.72	10.584	85	15
14	18900	105.84	12.34	85	15
16	21600	120.96	14.11	85	15
18	24300	136.08	15.87	85	15
20	27000	151.2	17.64	85	15
22	29700	166.32	19.4	85	15
24	32400	181.44	21.168	85	15

TABLE VI
BENEFITS ANALYSIS OF CAPACITY EXPANSION STRATEGIES

Month	Production Improvement (MT)	Benefits From		
		Plan 1 (Lakhs)	*Plan 2 (Lakhs)*	*Plan 3 (Lakhs)*
2	2700	13.356	-69.88	-.12000
4	5400	26.71	-54.76	15.24
6	8100	40.068	-39.64	30.36
8	10800	53.42	-24.52	45.48
10	13500	66.78	-9.4	60.6
12	16200	80.14	5.72	75.7
14	18900	93.49	20.84	90.8
16	21600	106.84	35.96	105.96
18	24300	120.21	51.08	121.08
20	27000	133.56	66.02	136.42
22	29700	146.92	81.32	151.32
24	32400	160.272	96.44	166.44

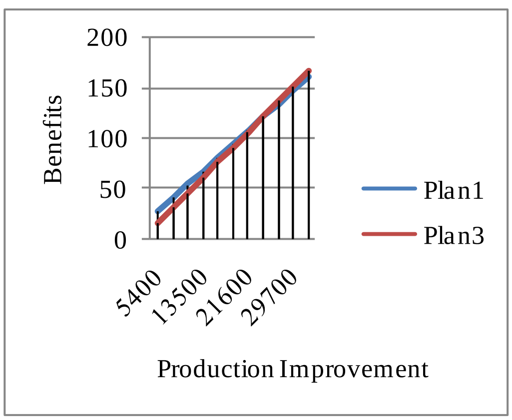


Fig 4:- Break Even Analysis

5. CONCLUSION

Today, India is the largest milk country in the world and has one of the largest population of cattle in the world.The demand for usage of cattle feed will grow if the feed is economically viable. Thus cattle feed industry has very high growth potential in India. Those companies that tap this potential will eventually become the market leaders. There is very high competition in this field and in today's global scenario, quality, customer satisfaction, competitive pricing and better capacity utilization are very important. The under utilization of available production capacity has been recognized as a problem faced by the company and this paper attempt to understand the causes of low capacity utilization and to provide recommendations for implementation so that much better capacity utilization can be achieved.

Lower output rate of Feeding and bagging section and insufficient work force in the Feeding section reduce the capacity utilization Overall Equipment Effectiveness of the plant (67.79%) is low compare to world class level (85%).Low performance rate (68.67%) leads to reduction of Overall Equipment effectiveness. Automate Bagging system to improve the capacity utilization without additional Labors

Real time study of the present scheduling method is not carried out. There may be flaws in the production planning and control activity that contribute to low utilization.

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