

Improving Production Efficiency by Modifying Employee Scheduling System at a Palm Oil Industry

Subin B Markose

PG Scholar

*Department of Industrial Engineering & Management
Mangalam college of Engineering Ettumanoor*

Subin George Mathew

Assistant Professor

*Department of Mechanical Engineering
Mangalam college of Engineering Ettumanoor*

Abstract

Employee scheduling is a common problem in most organizations, either from the service sector or industrial plants. It seeks to assign employees to tasks, work shifts or rest periods, taking into account organizational and legal rules, employees' skills and preferences, demand needs, and other applicable requirements. So it is a complex problem and a top concern for human resource management. Mostly it is done manually in several activity sectors, consuming time and resources. This paper compares the methodology followed in a palm oil industry in scheduling the employees and suggests an improved way based on the suitability of the employees towards specific tasks. The quality of work done is analyzed by calculating the quality metric value. The employees needed for each task are analyzed by the method of linear programming.

Keywords: Quality metric, absolute allocation, AHP, LPP

I. INTRODUCTION

The staff scheduling problem has been intensively explored in the literature; studies usually focus on solving very particular problems that derive from practical needs. Models are usually developed for specific applications and their adaptation to other cases implies significative reformulation. Researchers consider that cyclic scheduling approaches are inflexible because they impose a rigid schedule, not adjustable to unpredictable changes. Workload balance is usually tackled as a non-mandatory or soft constraint of the problem. While dealing with real-life problems, the trend followed is to use approximate solution approaches rather than optimization methods. This is mainly due to their high complexity and size. Such approximate procedures are, by nature, tailored for specific problems. This research has a twofold motivation; from a business perspective, it aims to contribute to the increase in both productivity and profitability of a company.

II. NEED FOR QUALITY METRIC ANALYSIS

Quality in its most simple terms may be defined as "Conformance to requirements". A product is said to be of good quality if it works well in the equipment it was meant for. Quality of work accomplished in a company depends upon the way in which the task is done, by whom, with what level of suitability that fits the employee to the task. The company irrespective of having all the requirements for meeting the target, struggles to attain the production capacity due to the errors in estimating employee allocation that detrimentally affects the quality of work performed in the firm. Quality metric will analyse the quality of work done and allocates the apt person for the task.

III. PROBLEM IDENTIFICATION AND PROBLEM STATEMENT

The work was studied in palm oil manufacturing company. Currently the company is using availability of employees as the primary basis for allocation of employees to each task. The main problems identified in the company are:

- Targeted production volume is not attaining.
- Raw materials, workers and all amenities are available but the target still remains unattained.
- Decreasing trend in annual production.
- Errors in estimating employee schedules.

The problem statement is 'Decreasing rate of production due to the errors in estimation of employee schedules at Palm oil Industry.'

IV. PROBLEM DEFINITION

The major problem faced by the company is the decreasing rate of annual production. The set target of production level is still not reached even after implementing various improvements in production methodology.

Table - 1
Annual Production in MT

| Year | Annual production in MT |
|---------|-------------------------|
| 2010-11 | 5770.28 |
| 2011-12 | 5770.11 |
| 2012-13 | 5769.22 |
| 2013-14 | 5769.33 |
| 2014-15 | 5769.29 |

The table shows the trend in production rate annually. The quantity produced in metric tonnes is shown. Slight fluctuations are the result every year and the production rate almost remains constant. Fresh fruit bunch is the major raw material for production of palm oil. From 100kg of fruit bunch, it will be getting roughly 20 kg of palm oil, i.e. one fifth amounts.

Table - 2
Company Profile

| | |
|--------------------------------------|------------|
| Total area of plantation | 9000 acres |
| Total number of non-technical staffs | 480 |
| Expected Annual yield of palm oil | 7500 MT |
| Average annual yield of palm oil | 5770 MT |
| Targeted weekly production (7500 MT) | 160 MT |
| Actual weekly production | 120 MT |

Table - 3
Loss in Production

| | |
|------------------------------|-----------|
| Targeted FFB Annually | 37,500 MT |
| Actual FFB produced Annually | 29,000 MT |
| Daily Targeted FFB | 120 MT |
| Actual FFB produced daily | 95 MT |
| Loss | 25 MT |

V. PROCEDURE

A. Stage 1

The existing quality metric value of the tasks performed are analyzed in the company. He analysis takes into consideration four variables namely, suitability, availability, conformance and urgency. Suitability is the major factor considered in the research because the existing trend is to allocate employees based on their availability. All other variables are remained constant since the urgency of operation is not fluctuating, availability of employees is assumed to be constant and the conformance factor which is a factor of penalty value. Penalty value of a task is the one which decides whether the work could be done by another employee or not. Probability of the employees allotted from the total strength gives the suitability value. Plucking, Packing, Loading and Cleaning are the tasks performed in the company.

Table - 4
Existing Quality Metric

| Work Item | Suitability | | Conformance | | Product | |
|-----------|-------------|------|-------------|-----|---------|------|
| Plucking | 0.28 | 0.28 | 1.0 | 1.0 | 0.28 | 0.28 |
| Packing | 0.51 | 0.51 | 1.0 | 1.0 | 0.51 | 0.51 |
| Loading | 0.22 | 0.22 | 1.0 | 1.0 | 0.22 | 0.22 |
| Cleaning | 0.09 | 0.46 | 1.0 | 1.0 | 0.09 | 0.46 |

$$\text{Quality} = 1.1/1.43 = 0.77$$

B. Stage 2

The qualities needed for each task to be completed are analysed by Analytical Hierarchy Process. Questionnaire based on saaty's fundamental scale was formed and it formed the basis for finding the suitability value of the employees to do specific tasks in the company.

Steps of AHP approach for employee quality selection are:

- Form a committee of experts.
- Construct a hierarchical model for the selected criteria's, and use the AHP method to calculate, aggregated weights of criteria's.
- Use pair-wise comparison to find out the degree of importance of each criterion.
- All experts' opinion will be integrated to obtain a weight for every aggregative criterion, by using geometric average.
- By using a heuristic method, arithmetic average, the weight of each criterion is calculated. For that Firstly, sum the arrays in each column. Then, each array in each column is divided by its respective column sum in order to get a normalized matrix. Finally find out average of each raw to get all criteria weights.

Employees in the company are divided into four different criteria based on experience, age, physique and gender. The task that could be done with optimum efficiency is founded by AHP process and the result is tabulated below.

Table - 5
Results of AHP Process

| Job | Experience | Age | Physique | Gender |
|----------|------------|-----|----------|--------|
| Plucking | √ | | | M |
| Packing | | √ | | M |
| Loading | | | √ | M |
| Cleaning | | | | F |

C. Stage 3

The result suggests the value of quality for each class of employees in doing specific tasks of the company. From this the modified value of suitability is founded and the quality metric value of the suggested method is calculated.

Table - 6
Suggested quality metric

| Work Item | Employee | Suitability | | Conformance | |
|-----------|----------|-------------|-------|-------------|-----|
| Plucking | R1 | 0.585 | 0.585 | 1.0 | 1.0 |
| Packing | R2 | 0.4 | 0.4 | 1.0 | 1.0 |
| Loading | R3 | 0.6 | 0.6 | 1.0 | 1.0 |
| Cleaning | R4 | 0.58 | 0.58 | 1.0 | 1.0 |

$$\text{Quality} = 1.0/1.0 = 1.0$$

D. Stage 4

From the results of suggested quality metric, it is founded that the quality of performance will be improved if employees are allocated based on their suitability to do specific tasks. Based on this the number of employees needed to perform each task are founded from LPP methodology. The total staff strength is 4810 and 80 employees is needed for the tasks of plucking and packing, 160 for loading and cleaning. The objective function is formulated based on the penalty value of each group. Penalty value is assigned from the results of AHP and values are 0, 5, 10, 15 etc which means that employees are willing to work if value is 0 and decreases as value goes on.

Employees are divided into 4 groups based on the qualities to do the tasks. Group 1 consist of the most energetic, healthy employees aim to do the task of plucking; group consist of the next suitable ones for packing; group 3 consists of female and less physique workers for cleaning, and group 4 with employees for loading.

Objective function is to minimize employee penalty condition.

$$\text{Min } Z = 0x_{1A} + 5x_{2A} + 20x_{3A} + 10x_{4A} + 5x_{1B} + 0x_{2B} + 20x_{3B} + 10x_{4B} + 40x_{1C} + 10x_{2C} + 0x_{3C} + 20x_{4C} + 0x_{1D} + 10x_{2D} + 40x_{3D} + 20x_{4D}$$

Where x_{1A} = no. of employees from group 1 for plucking

x_{2A} = no. of employees from group 1 for packing

x_{2B} = no. of employees from group 2 for packing

Similarly for other variables. Constraints are selected based on employee strength and minimum requirement for each task.

Table - 7
Results of LPP

| | | | |
|------------------|----|------------------|------|
| <i>Plucking:</i> | | <i>Packing:</i> | |
| X _{1A} | 60 | X _{2A} | 50 |
| X _{3A} | 20 | | (30) |
| <i>Loading:</i> | | <i>Cleaning:</i> | |
| X _{1D} | 50 | X _{3C} | 160 |
| X _{4D} | 60 | | |

Employees not coming under any of the group are unallocated.

VI. RESULTS

The existing quality metric value provides the basis for the decrease in the production rate. The qualities needed for the tasks to be done are founded by the method of AHP and the suggested quality metric value is formulated. This gave the modified quality metric value which improved the quality of work performed. The minimum number of employees needed for each task based on the suggested quality metric value is formulated by the method of LPP.

VII. CONCLUSION

The suggested quality metric provides the base for modifying the employee allocation methodology existing in the company. The value suggests a modification in the current methodology and also provides the minimum number of employees needed for each task to be done optimally.

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