Abstract 015 – 0695

Labor Scheduling in a health care company considering the welfare of its employees

Juan Pablo Orejuela, Diana Andrea Peña, Neptali Bustamante

Escuela de Ingeniería Industrial y Estadística, Facultad de Ingeniería, Edificio 357, Universidad del Valle, Calle 13 No. 100-00, Ciudad Universitaria Meléndez, Cali, Colombia.

Telephone number: + 57 +2 + 3334903 ext.220, fax: + 57 +2 + 339 84 62

E-mail: juanp77@pino.univalle.edu.co (J. Orejuela), dapena@fanalca.com.co (D. Peña), neptalibustamante@hotmail.com (N. Bustamante).

POMS 21st Annual Conference

Vancouver, Canada

May 7 to May 10, 2010

Abstract

The Labor Scheduling Problem consists of planning the shifts for the employees, and minimizing costs associated to the workforce. This paper presents a mixed integer linear programming model that minimizes labor costs, satisfies the requirements of demand, establishes adequate working conditions for employees by incorporating constraints that ensure well-being to generate an optimal assignment of physiotherapist shifts in the intensive and intermediate care areas in a Clinic and maintains an adequate level of service to optimize available capacity usage. For this, we considered that the Labor Scheduling Problem involves various factors such as the company, employees, demand requirements and Legislation, so it is necessary to achieve a balance between these factors. The model was implemented in the AMPL programming language and the computational tool was CPLEX® 11.1.

Keywords: Labor scheduling problem, shift assignment, workforce scheduling

Introduction.

When companies put service first to its employees and customers, radical change occurs in the way in which manage and measure success by relating the utility, customer satisfaction and loyalty to the value of the services created by employees satisfied, loyal and productive.When employers decide to invest in people, technology support to contact employees, the renewal of hiring practices and training and compensation related to employee performance at all levels and well being of the same is reflected in factors that drive profits.

William Pollard, chairman of ServiceMaster provides that "Anyone who sees things in terms of factors that can be quantified easily, is ignoring the essence of business, people", an example of

this lies in the traditional measures of losses were incurred due to employee turnover, focus on the cost of recruiting, hiring and training of employees, which in most service industries the true cost of turnover lies in the loss of productivity and reduced customer satisfaction as the low turnover is closely linked with a high level of customer satisfaction. Employee loyalty by [1] lies in the same job satisfaction, well-being provided by the company, training, payment and with respect and dignity.

The practice of Physiotherapist involves interaction with patients or clients, families, caregivers and health communities, in the process of assessing movement potential and establishing agreed goals and objectives for the use of knowledge and skills unique to physiotherapists. This process involves a duty cycle which begins with the point of initial contact with the client and proceeds through steps or stages until completion of all the service, along this cycle presents many moments of truth that define the service provided. A bad moment of truth can cancel many positives, even when given a service recovery.

The administration of the moments of truth in such a way as to ensure a positive experience for the customer, is the essence of service process design, thus ensuring that professional services are the highest quality, taking into account the resources available to you and constraints of various kinds exist in the medium within which to develop its activity, as demanded by the law 598 of 1999 which regulates the activity of the physiotherapists in the country. This requires providing the resources and conditions for the development of their activities.

In this paper address the problem of scheduling work shifts for a group of physiotherapists, in developing the proposal raises the welfare of employees as key factors for success in providing

the service, which is guarantee a level of welfare represented in terms of the following requirements:

- Each physiotherapist must work 216 hours in 31 days.
- Provide a weekend off with pay in each 31 day period for each employee.
- Assure that employees ending a night shift are not scheduled for the next day.
- Distribute the workload equitable among employees.

Many researchers have often studied this problem in service industries such as airlines, hospitals, clinics and transportation companies, and they have developed different models using exact, heuristic and Meta heuristic techniques [2].

Dantzig was one of the first researchers to study the Labor Scheduling Problem for which he made a mathematical model that seeks to minimize the cost of having all employees covering all shifts, and satisfy the demand with enough workforce in all periods [3]. Brusco and Jacobs proposed a new solution to the discontinuous labour tour scheduling problem where the objective was to minimize the number of full-time employees required to satisfy forecasted demand. They developed a simulated annealing meta heuristic for solving the problem [4].

[5] Presented a daily and weekly New Formulation of Labor Scheduling Problem (NFLSP) which incorporates information on how changing the number of employees working in each planning period affects profits.

In [6] the author addressed a labor scheduling problem of nurses in a hospital using Tabu search with strategic oscillation. Here the principal objective was to guarantee the permanence of enough nurses at any time slots considering equal workloads, requests for days off and costs. In this paper the well-being of nurses is timidly considered in reference to the requests for days off. However, it was a positive aspect of the approach since it considered employee well-being. After that, in [7] the authors proposed a system that programs shifts by determining time of entry and exit of each worker during the planning horizon, taking into account workload at any given time, rest periods and changes in shifts.

In [8] the authors proposed a model that aims to assure the number of nurses required by different hospitals, minimize the total cost through the implementation of assignment strategies and consider the nurse's own requirements by applying an Ant Colony Optimization (ACO) methodology. In this study, the well-being of nurses is represented by an interesting approach that gives them the ability to set some preferences.

This paper presents a methodological proposal has four phases, our paper includes several restrictions which guarantee employee well-being in the Health Care industry where the service level must be 100% and this directly depends on the employee mood.

Methodology

1. Identification system and data collection

In this phase is to perform the analysis to the initial state of the system, which seeks to hold the scheduling of shifts. For this, you must collect the necessary data from various primary and secondary sources taking into account the time horizon in which you plan to do programming.

To solve the Labor Scheduling Problem is important to identify the factors involved, their interrelation and the degree of complexity that each of them contributes to the problem. See Figure 1

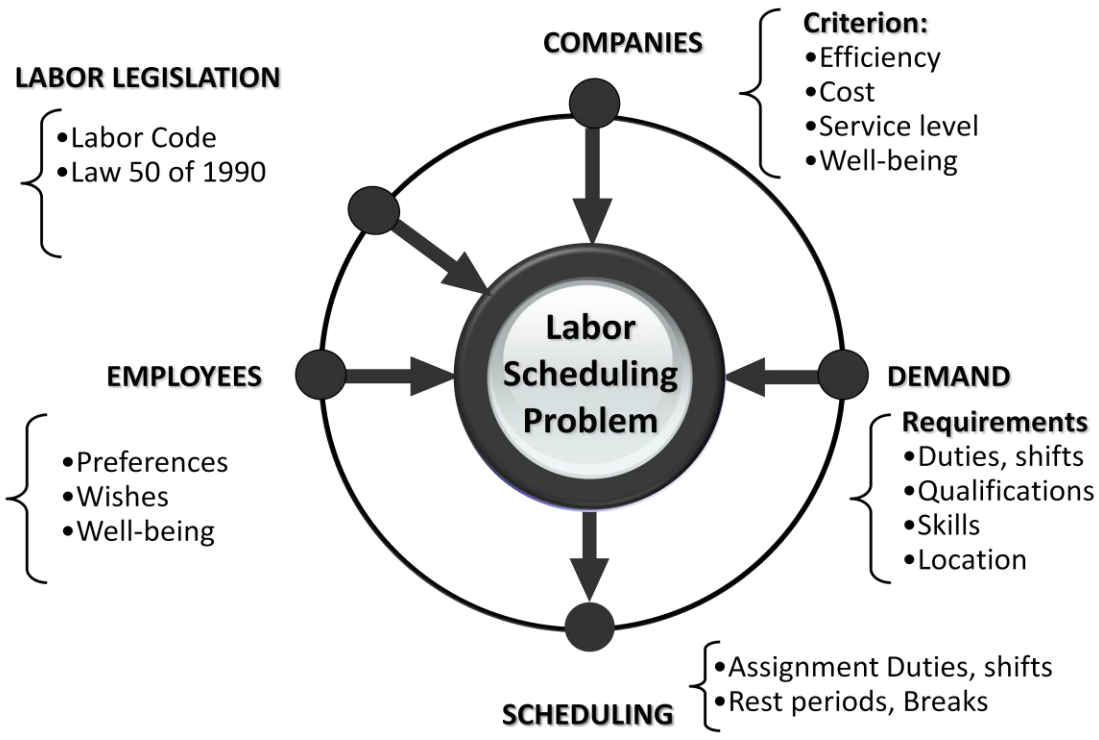

Figure 1: Factors involved in Labor Scheduling Problem

Company

Currently, many companies in their quest to achieve objectives and to adapt capacity to demand, have made an unequal distribution of time among temporary and part-time contracts, thus increasing the expansion and variability of shifts [9].

Employees

Employees have individual needs, wishes and preferences to execute their jobs efficiently, e.g. the need to rest, the desire to avoid consecutive night shifts or adjust to shift changes that affect their health, safety, family and social life. We must also have equity in workload and compensation between employees.

Demand Requirements

Each area of a company has different requirements with regard to the number of employees per shift, their skills, competencies and working hours. Therefore, a company must establish a balance in the assignment of shifts to the employees taking into account their skills and availability.

Legislation and regulations

The Legislation and regulations provide guidelines to control employer-employee interactions with regard to type of work, shift duration, spacing of breaks and workload. For the specific case of Colombia, these factors are mostly found in [10].

2 Definitions of shift and working days

Possessing all the information pertaining to the problem you are facing, proceed to validate, define or redefine the shifts in which employees perform.

To define a shift is not only necessary to consider the minimum and maximum working hours set by law, as it is also important to determine the start time and end of it, because there are times when what is difficult to transport of employees to and from their place of residence.

Another element to consider is the definition of the number of shifts in the day, as they can determine the length of each shift, being necessary to consider the provisions of the law regarding the minimum and maximum duration of the workday.

3. Shift assignment

Once certain shifts, still needed are assigned to each employee, watching a series of conditioning factors, such as:

- Rest periods
- Days off
- Change of shift
- Total hours worked

Formulating linear programming model for the allocation of shifts

Due to the complexity presented include all the factors presented above, it is proposed to solve the problem of scheduling shifts by a technique of exact solution, and more specifically a linear programming model, which aims to minimize the costs associated with the regular hours,

overtime and surcharges arising from assigning employees to different shifts within a set time horizon. Below is the verbal formulation of the proposed linear programming model:

Verbal formulation

Objective Function: Minimize the costs associated with wage compensation taking into account overtime and surcharges, and higher paid employee's salary**.**

Restrictions:

This model has the following restrictions:

a) Activation of overtime

b) Limit Regular Shifts

c) Satisfaction of demand requirements and exclusion between regular hours and overtime.

d) Allocation and shift change

e) Schedule Employees

f) Balance night shift

g) Balance overtime shifts

h) Balance paid by salary

i) Free Weekend

j) Obvious

4. Analysis

To solve the problem of scheduling shifts and assigning them to employees, it is advisable to rely on a computational tool, which will generate an optimal program resulting linear programming model proposed in this project. Therefore, it is very important that the readings are adequate processing in relation to the organization and analysis of data arising from the implementation of the model.

Conclusions and future research

- The well-being consideration means that employees as well as the company have to take into account that the decisions for well-being generate decreases in the employees' earnings because of the loss of overtime and/or surcharges pay and they represent higher costs to the company and a decrease in the utilization level. However, the employees have additional benefits that assure adequate working conditions and generate a better mood, which contribute to a better level of service and customer satisfaction. The key to successful labor scheduling is to find a balance between these factors to satisfy the specific employee, company and customer needs.
- It is important to highlight that employee's well-being was considered since labor is a key and limited resource and it has not often been approached in the literature.
- The labor scheduling problem is an NP-hard problem and it is usually of a considerable size due to the many variables involved and the variability in demand patterns so companies seeks to adapt through shift flexibility, thus generating a high degree of computational complexity to find an optimal schedule in a reasonable computational time.

- In future research, the application of metaheuristic techniques could be explored to solve the proposed programming model, since increasing variables such as the number of employees or the time horizon and using the exact solution technique presented here will take excessive computational time to find an optimal schedule.

References

1. Huete Luis, D' Andrea Guillermo, Reinoso Javier. Administración de Servicios, Prentice Hall 2001.

2. D. Ballesteros, P. Ballesteros. "Algunos modelos para planeación y programación en empresas de servicios". Scientia et Technica. Vol. 34. 2007. pp. 315-320.

3. G. Dantzig. "A comment on Edie's traffic delays at toll booths". Operations Research. Vol. 2. 1954. pp. 339–341.

4. M. Brusco, L. Jacobs. "A Simulated Annealing Approach to the Solution of Flexible Labour Scheduling Problems". The Journal of the Operational Research Society. Vol. 44. No. 12. 1993. pp. 1191.

5. G. Thompson. "Labor scheduling using NPV estimates of the marginal benefit of additional labor capacity". Journal of Operations Management. Vol. 13. 1995. pp. 67-86.

6. K.A. Dowsland. "Nurse scheduling with tabu search and strategic oscillation". European Journal of Operational Research. Vol. 106. 1997. pp. 393-407.

7. R. Alvarez, E. Crespo y J.M. Tamarit. “Organización de turnos de trabajo en una instalación desuministro de combustible de un aeropuerto”. VI Jornadas ASEPUMA. Santiago de Compostela, Septiembre de 1998.

8. G. Thompson, M. Pullman. “Scheduling workforce relief breaks in advance versus in real-time”, European Journal of Operational Research. Vol.181. 2007. pp. 139–155.

9. W.J. Gutjahr, M.S. Rauner. “An ACO algorithm for a dynamic regional nurse-scheduling problem in Austria”. Computers & Operations Research. Vol. 34. 2005. pp. 642-666.

10. C. Delgado. Código sustantivo del trabajo y código procesal del trabajo y de la seguridad social. Legis, 2009, Colombia.