International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Summary Presentation of Methods Used for Resource Allocation Problem in the Mining Industry

M. Mambani

Kampala International University, School of Computing and Information Technology

Abstract: ***Studies carried out in the mining industry context in optimization and computing are rare. Several of them present a complexity in the various methodologies. That is why a summary presentation of some methods can turn out very important to clarify concepts bound to mines optimization.***

Keywords: Mining Industry, Resource Allocation Problem (RAP), Combinatorial optimization, Optimal Control, Stochastic optimization algorithms, Functional analysis and convex optimization

1. Introduction

World over allocation of resources has been essential in industrial discharge of responsibilities. Any sensible organization could love to see that resources are optimally allocated for the benefit of the organization. When the processing times of jobs are controllable, selected processing times affect both the manufacturing cost and the scheduling performance.

The effectiveness of resource allocation directly affects process performance. In order to optimize resource allocation, researchers should propose a resource allocation model in view of the relationship between resource allocation and process performance, which minimizes process execution time in terms of resource preference, cost constraints and resource availability criteria as suggested by Zhao *et al* (2015).

Mining industry - The branch of manufacture and trade based on the extraction of ores, fossil fuels, minerals, stone, clay, gravel, and similar commodities. The sector has a significant number of companies located around the world and operates with large revenues.

Resource Allocation Problem - The resource allocation problem is to allocate resources to activities so that the cost becomes as optimal as possible. (Lee, 2005) It can be stated as allocating the resources (frequency and power blocks) with efficacy and efficiency, to a number of users demanding a variable set of services within a geographical area.

2. Related Work

From prehistoric times to the present, mining has played an important part in human existence (Madigan, 1981). Here the term mining is used in its broadest context as encompassing the extraction of any naturally occurring mineral substances solid, liquid, and gas from the earth or other heavenly bodies for utilitarian purposes.

Dynamically allocating the most appropriate resource to execute the different activities of a business process is an important challenge in business process management. An ineffective allocation may lead to an inadequate resources usage, higher costs, or a poor process performance.

Nehring *et al* (2010) relate that maximizing value is the main objective when developing long term mine production schedules. These results provide input for the development of a short term schedule that aims to meet process plant feed requirements so as to produce a quality saleable product. They proposed a new dynamic mathematical model using mixed integer programming to optimize short term production scheduling and machine allocation for application in sublevel stopping operations.

That is how some mining industries in purpose to increase their performance in term of resource allocation use some procedures and models.

3. Some Methods Used to Solve RAP in Mining Industry

3.1. Combinatorial optimization

Some common problems involving combinatorial optimization are the Travelling Salesman Problem (TSP), the Minimum Spanning tree Problem (MST), Assignment problem, Closure problem, Constraint satisfaction problem, Cutting stock problem, Integer programming, Knapsack problem, Nurse scheduling problem, Vehicle routing problem, Vehicle rescheduling problem, Weapon target assignment problem, etc.

3.2. Optimal Control

Optimal control problems are generally nonlinear and therefore, generally do not have analytic solutions (e.g., like the linear-quadratic optimal control problem). As a result, it is necessary to employ numerical methods to solve optimal control problems. In the early years of optimal control (1950s to 1980s) the favored approach for solving optimal control problems was that of indirect methods. In an indirect method, the calculus of variations is employed to obtain the first-order optimality conditions. These conditions result in a two-point (or, in the case of a complex problem, a multi-point) boundary-value problem. This boundary-value

problem actually has a special structure because it arises from taking the derivative of a Hamiltonian.

3.3. Functional analysis and convex optimization

Functional analysis is a branch of mathematical analysis, the core of which is formed by the study of vector spaces endowed with some kind of limit-related structure (e.g. inner product, norm, topology, etc.) and the linear functions defined on these spaces and respecting these structures in a suitable sense.

A convex optimization problem is one of the form

$$\text{minimize} f_0(x)$$
$$\text{subject to } f_i(x) \leq b_i,\ i = 1, \ldots, m,$$

where

the functions $f_0, \ldots, f_m : \mathbf{R}^n \rightarrow \mathbf{R}$ are convex, i.e., satisfy

$$f_i(\alpha x + \beta y) \leq \alpha f_i(x) + \beta f_i(y)$$

for all $x, y \in \mathbf{R}^n$ and all $\alpha, \beta \in \mathbf{R}$ with $\alpha + \beta = 1$, $\alpha \geq 0$, $\beta \geq 0$.

3.4. Stochastic optimization algorithms

Stochastic optimization (SO) methods are optimization methods that generate and use random variables.

Stochastic optimization plays a significant role in the analysis, design, and operation of modern systems. Methods for stochastic optimization provide a means of coping with inherent system noise and coping with models or systems that are highly nonlinear, high dimensional, or otherwise inappropriate for classical deterministic methods of optimization. Stochastic optimization algorithms have broad application to problems in statistics (e.g., design of experiments and response surface modeling), science, engineering, and business. Algorithms that employ some form of stochastic optimization have become widely available. For example, many modern data mining packages include methods such as simulated annealing and genetic algorithms as tools for extracting patterns in data. (Gentle, Härdle, and Mori, 2004)

For stochastic problems, the random variables appear in the formulation of the optimization problem itself, which involve random objective functions or random constraints. Stochastic optimization methods also include methods with random iterates. Some stochastic optimization methods use random iterates to solve stochastic problems, combining both meanings of stochastic optimization. Stochastic optimization methods generalize deterministic methods for deterministic problems.

4. Conclusion

Time is a crucial variable in every mine, detailed studies on models and algorithms using to optimize time inside mine associated with mathematical and operational research in computer science were done in purpose to help company to save time considerably.

Companies are generally confronted to Resource Allocation Problem. Mines in particular for their case are confronted to the resource allocation of resource. If that management is not optimal, time will be lost and the mine can lost important capital. It was extremely crucial to make understand different methods used to solve resource allocation problems.

References

[1] J.E. Gentle, W.K., Härdle, Y. Mori, "Handbook of Computational Statistics. Concepts and Methods," Springer-Verlag Berlin Heidelberg, Edition Number 1, 2004
[2] Z.J. Lee, "A hybrid search algorithm with heuristics for resource allocation problem," Information Sciences 173(1):155-167. DOI: 10.1016/j.ins.2004.07.010. 2005.
[3] R.T. Madigan, (1981). "Of minerals and man," Austalasian lust. Mag and Wetportville, Australia, p. 138, 1981.
[4] M. Nehring, E. Topal, & P. Knights, (2010). "Dynamic short term production scheduling and machine allocation in underground mining using mathematical programming," Mining Technology, 119:4, 212-220, 2010.
[5] W. Zhao, L. Yang, H. Liu, R. Wu, "The Optimization of Resource Allocation Based on Process Mining", ICIC, 2015.

Author Profile

Mambani wa Mambani received the M.S. degree in Information Technology from Université Adventiste de Lukanga in 2012. Since 2012, he works on the customs Congolese as IT specialist and teaches some courses at the University of Lisala (Democratic Republic of Congo) and University of Cepromad (Democratic Republic of Congo). He actually prepares a Ph.D degree in Information Systems at Kampala International University.