Well Maintenance Scheduling Using Dynamic Programming Approach: Influence Diagram

Rio Aurachman[1*], Tito Ajiguno[2], and Ericha Mutia Putri[3]

[1,3] Telkom University, Jalan Telekomunikasi Nomor 1, Bandung 40257, Indonesia
[2] PT Pertamina EP, Menara Standard Chartered, Jl. Prof. Dr. Satrio No. 164 Jakarta, Indonesia

* rioaurachman@telkomuniversity.ac.id

Abstract. Petroleum-producing wells sometimes facing production problem. These problems can be solved by deploying a Maintenance fleet that requires 2 days of travel and 3 days of repair time for the well. With 80 wells that are probabilistically appearance of problem, we need a Mathematical model that can minimize idle time of the well, in the condition of not Produce any. Trought this research, obtained problem solving formulation using the Dynamic Programming approach. The first step of this research are building an influence diagram.

1. Introduction

The organization has limited resources. Internal and external constraints are considered in decision making. Resources is one of the internal constraint in organizations [1] [2]. Strategies are needed to be able to optimize the available resources so as to produce an optimal return. Decision selection is at a strategic level [3] to the tactical and technical level.

In operating a crude oil-producing well, sometimes unexpected conditions are found. A maintenance and repair process is needed to repair the existing damage. However, the damage settlement is hampered by the condition of limited resources. Of the many wells available, there are fewer maintenance devices that must be dispatched from the depot to repair the well. The distance traveled requires the well to wait to be repaired. As long as the well is damaged, the well cannot produce. The production of the well because waiting for the maintenance device to come is a loss for the company. Then we need a decision support system that can help decision makers determine which wells first need to be repaired to minimize losses arising from not being able to produce.

The approach to be used is mathematical modeling using influence diagram [4]. Some previous research has proven successful in modeling mathematics with this approach; Inventory management [5] , Queueing system [6], employment system [7] [8] , transportation problem, [9], distribution planning [10], and many more.And there is some research which build a mathematical model for well service and maintenance [11], [12], [13], [14], [15]. And some patent has been published relevant to this topic [16] [17]. This research try to contribute in aspect that which has not been done by previous research by developing conceptual models. Conceptual models are made in the form of influence diagrams using a systems approach.

2. Methods

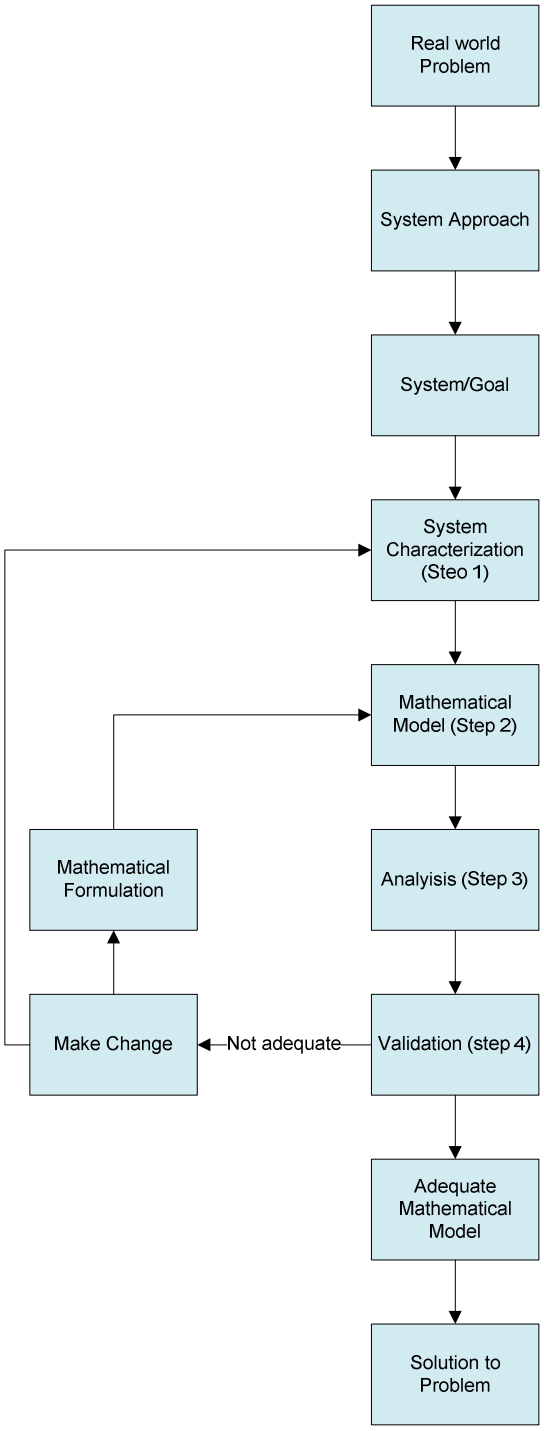

Figure 1. Mathematical model [18]

The research begin with system approach using influence diagram. The next step is define the goal, system characterization, develop mathematical model, analysis, and validation. The final step is get and implement solution.

3. Result and discussion

The result of influence diagram shown in figure 2:

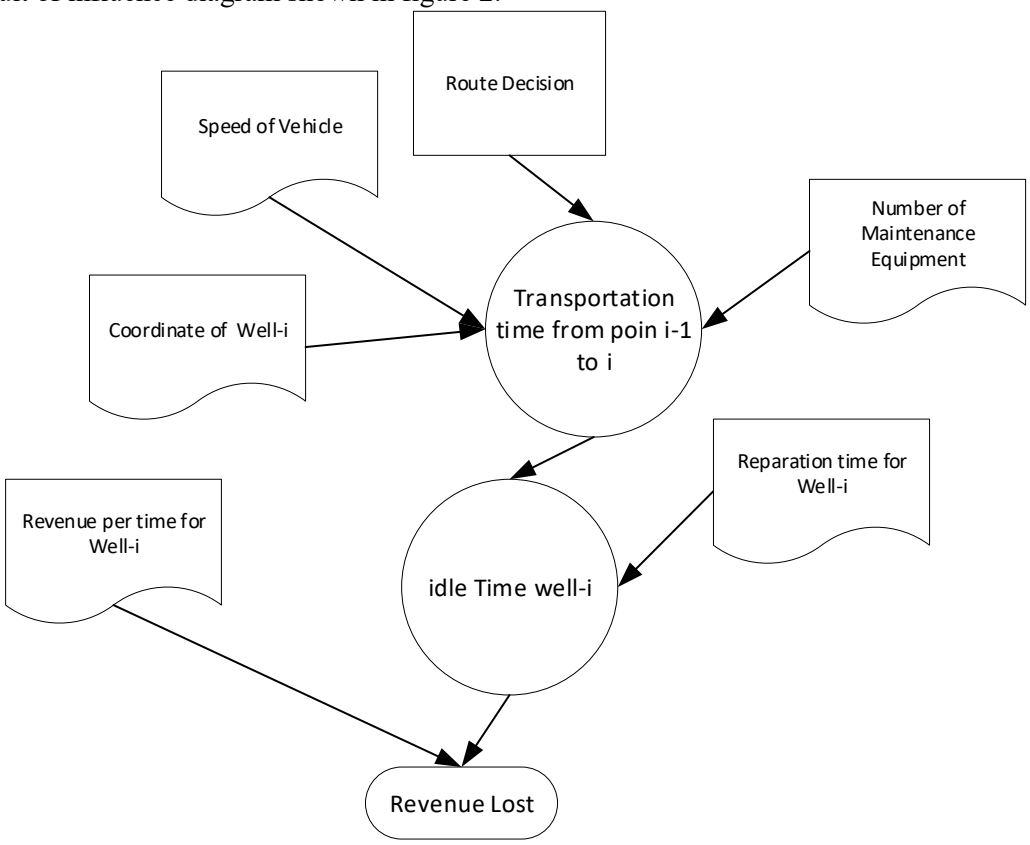

Figure 2. Influence diagram

The purpose of this model is to minimize revenue lost. Revenue lost is caused by idle time from well i and revenue lost due to idle time from well i. Each well is estimated to have a different level of production. This also causes a difference in revenue lost due to idle and damage. The idle time of the well is caused by the process of waiting for the arrival of maintenance and repair devices.

Then the idle time in the diagram is illustrated due to the transportation time and repair time of the well. Whether or not the distance to the location, the speed of the vehicle carrying the maintenance equipment, route decision, and the number of vehicles available, affects the transportation time. Decision variable is the vehicle route of the well repair device carrier. Decision makers are assisted by the system to choose the best route. The best route is measured by revenue lost that is successfully reduced. Then this model helps minimize lost revenue from the process of waiting for the repair of wells.

4. Conclusion and suggestion

Obtained influence diagram which becomes the initial stage in decision making to minimize losses from inactivity in the well due to damage and due to the process of waiting for the arrival of the repair device. Influence diagram is the initial basis for determining mathematical models. After obtaining a mathematical model, the next step is to find the optimal solution of the mathematical model.

Some research development can be done. In this research it is assumed that the process of repairing wells will take the same time even if using any maintenance device. In further research it can be assumed that each well has a different processing time depending on the device used. Revenue lost is also

assumed to be static. In the development of the next model it can be assumed that revenue lost develops and changes dynamically depending on the waiting time and the circumstances. Development can also be made by considering the different repair costs.

References

[1] E. Chumaidiyah, W. Tripiawan and R. Aurachman, "Exploring the internal and external constraint of it business start up in Bandung, Indonesia," *International Journal of Innovative Technology and Exploring Engineering,* 2019.

[2] E. Chumaidiyah, R. Aurachman and B. H. Sagita, "Strategy for Capability Development of Knitting Small Medium Enterprises Using SWOT Analysis," in *Proceedings of the International Conference on Industrial Engineering and Operations Management*, Bandung, 2018.

[3] S. Guntara, B. Yogaswara and R. Aurachman, "Strategi Transformasi Pt Greeneration Indonesia Menuju Perusahaan Ramah Lingkungan Yang Unggul Dengan Pendekatan Matriks Boston Consulting Group," in *eProceedings of Engineering 4, no. 3*, Bandung, 2017.

[4] H. D. D. McNickle and S. Dye, Management science: decision-making through systems thinking, Palgrave macmillan, 2012.

[5] E. G. B. Kuncoro, R. Aurachman and B. Santosa, "Inventory policy for relining roll spare parts to minimize total cost of inventory with periodic review (R, s, Q) and periodic review (R, S)(Case study: PT. Z)," in *IOP Conference Series: Materials Science and Engineering*, Jakarta, 2018.

[6] R. Aurachman and A. Y. Ridwan, "Perancangan Model Optimasi Alokasi Jumlah Server untuk Meminimalkan Total Antrean pada Sistem Antrean Dua Arah pada Gerbang Tol," *JRSI (Jurnal Rekayasa Sistem dan Industri),* vol. 3, no. 2, pp. 25-30, 2016.

[7] R. Aurachman, "Model Matematika Dampak Industri 4.0 terhadap Ketenagakerjaan Menggunakan Pendekatan Sistem," *Jurnal Optimasi Sistem Industri,* pp. 14-24, 2019.

[8] R. Aurachman, "Perancangan Influence Diagram Perhitungan Dampak Dari Revolusi Industri 4.0 Terhadap Pengangguran Kerja," *Jurnal Teknologi dan Manajemen Industri,* vol. 4, no. 2, pp. 7-12, 2018.

[9] A. Desiana, A. Y. Ridwan and R. Aurachman, "Penyelesaian Vehicle Routing Problem (vrp) Untuk Minimasi Total Biaya Transportasi Pada Pt Xyz Dengan Metode Algoritma Genetika," in *eProceedings of Engineering*, Bandung, 2016.

[10] B. M. Muttaqin, S. Martini and R. Aurachman, "Perancangan Dan Penjadwalan Aktivitas Distribusi Household Product Menggunakan Metode Distribusi Requirement Planning (DRP) Di PT. XYZ Untuk Menyelaraskan Pengiriman Produk Ke Ritel," *JRSI (Jurnal Rekayasa Sistem dan Industri),* pp. 56-61, 2017.

[11] S. Kromodihardjo and E. S. Kromodihardjo, "Modeling of Well Service and Workover to Optimize Scheduling of Oil Well Maintenance," in *Applied Mechanics and Materials*, 2016.

[12] D. J. Aloise, D. Aloise, C. T. M. Rocha, C. C. Ribeiro, J. C. Ribeiro Filho and L. S. S. Moura, "Scheduling workover rigs for onshore oil production," *Discrete Applied Mathematics,* vol. 154, pp. 695-702, 2006.

[13] G. M. Ribeiro, G. R. Mauri and L. A. N. Lorena, "A simple and robust Simulated Annealing algorithm for scheduling workover rigs on onshore oil fields," *Computers & Industrial Engineering,* vol. 60, pp. 519-526, 2011.

[14] M. A. Fernández Pérez, F. Oliveira and S. Hamacher, "Optimizing Workover Rig Fleet Sizing and Scheduling Using Deterministic and Stochastic Programming Models," *Industrial & engineering chemistry research,* vol. 57, pp. 7544-7554, 2018.

[15] I. M. Santos, "Mathematical Programming Models and Local Search Algorithms for the Offshore Rig Scheduling Problem," 2018.

[16] M. J. R. Segura, C. W. Roddy, R. R. Koch, R. L. Morgan, R. G. Morgan, R. G. Ingalls, W. J. Giffen and W. J. Caveny, *Methods for Designing, Pricing, and Scheduling Well Services and Data Processing Systems Therefor,* Google Patents, 2010.

[17] M. Segura, R. Morgan, R. Ingalis, W. Giffen, C. Roddy, R. Koch, R. Morgan and W. Caveny, *Methods for designing, pricing, and scheduling well services and data processing systems therefor,* Google Patents, 2007.

[18] D. N. P. Murty, N. W. Page and E. Y. Rodin, Mathematical modelling: a tool for problem solving in engineering, physical, biological, and social sciences, Oxford: Pergamon Press, 1990.

[19] A. V. F. Pacheco, G. M. Ribeiro and G. R. Mauri, "A GRASP with path-relinking for the workover rig scheduling problem," *International Journal of Natural Computing Research (IJNCR),* vol. 1, pp. 1-14, 2010.

[20] H. V. Bassi, V. J. M. Ferreira Filho and L. Bahiense, "Planning and scheduling a fleet of rigs using simulation--optimization," *Computers & Industrial Engineering,* vol. 63, pp. 1074-1088, 2012.