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On-screen equipment movement and monitoring system (OEMS) for oil and gas company: A *case study*

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Abstract: On-Screen Equipment Movement and Monitoring System (OEMS) is an expert system designed to manage inventories (equipment) for an oil and gas project. The OEMS is integrated with the network analysis to assist the planning of the project. This expert system is an all-in-one system that solves the problems that faced by the Oil and Gas operation department and able to trace the equipment movement from becomes untraceable. The main objective of developing this system is because the available system is often lacked in a few areas such as equipment traceability and user friendliness. In this research, an expert system called the On-Screen Equipment Movement and Monitoring System (OEMS) was developed using the Microsoft Visual Studio 2013. This expert system combines the inventory control technique and Network Analysis. This technique was chosen because it is meets the requirements for the equipment inventory, and project planning and control. The main functionality of the system is to view, track and plan all the equipment movements. At the same time the system can also assist in the planning of the supplies needed for a project. This helps the planner in avoiding errors in estimating time for equipment preparation. The performance of this system was measured by the total lead time of the equipment acquisition for every project. By comparing the two systems, which are the OEMS and current manual systems, OEMS proved that the system can save acquisition time about 40% more than using the current manual system. However, in order to fully optimize the OEMS, further improvements or modifications are needed so that the system can perform more efficient.

Key words: Equipment management system; Inventory control; Network analysis; Oil and gas

1. Introduction

Inventory management concerns with the planning and controlling of inventories in order to meet the competitive priorities of the organization (Krajewski et al., 2010). Inventory management plays major role in enabling a manufacturing organization to operate effectively by allowing the inventory to absorb variation in demands. In addition, inventory also plays a significant role in the scheduling system of the organization. In short, inventory management system for any company is essential to fulfil customer demands on time and in a cost effective manner (Zaidi et al., 2012). As a result, the selection and implementation of an efficient inventory management system for any company management is vital.

Inventory management is one of the parts of decision made within the company operation management. There are four main objectives of inventory management; maximize customer service, maximize efficiency of purchasing and production, minimize inventory investment and lastly maximize profit. Inventory represents an important decision variable at all stages of product manufacturing, distribution and sales. At the same time, the inventory also contributes significantly in the major portion of total current assets of many businesses (Sahari et al., 2012) (Temeng et al., 2010). Since inventory constitutes a major segment of total investment, it is important that good inventory management be practiced to ensure growth and profitability. On the other hand, one of the disadvantages of inventory is high cost of keeping inventory. Keeping inventory means that the company has fund the gap between paying for the stock to be produced and getting revenue in by selling it. Moreover, the disadvantages of excessive inventories are the unnecessary tie up of the firm funds, excessive carrying cost and lastly the risk of liquidity. So, a proper planning of inventory management is very important to ensure the effective operations of a firm.

In this research, the oil and gas company was established on Oct 10, 2010 to provide equipment services for the oil and gas industries. Increasing number of projects received by the company has indirectly resulted in increased in equipment movements, which are difficult to be tracked due to logistics (with possibility of equipment lost or damaged) amplified by the current manual tracking technique. Any equipment that is lost or damaged while in logistics will result in increased costs to be borne by the company. Furthermore, report on the list of all equipment at each location, such as at Miri workshop and Labuan warehouse, needs to be done

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manually on a monthly basis. This tracking is to ensure that the amount of the latest equipment is known especially when new equipment is continuously being purchased for each project. So, the objective of this research is to develop the On-Screen Equipment Movement and Monitoring System (OEMS) as an inventory management and expert system for the company.

Specifically, this research is an improvement and extension to work by Mohd_Lair et al (2014) and Mohd Lair et al (2013) on development of an inventory management system. The earlier researches demonstrated the application of the EOQ concept in continuous and periodic monitoring environments in controlling spare part inventories. This research, on the other hand, attempts to integrate inventory management system with project management concept in controlling and managing equipment inventories used by an oil and gas industry.

2. Literature review

The needs for an efficient inventory management system have led to various researches in exploring and developing inventory management system. Whelpton (1988) focused on the implementation of inventory management on equipment for medical equipment maintenance department. In this research, he used cost-effectiveness as the performance measure and undertook this study using manual technique. Even though, he was only using the workers as technical implementation of the system, he concluded that in-house support is highly cost-effective despite, the chronic under payment of highly dedicated staff.

Sinha et al (1989) developed an expert system for inventory control system. The performance of this system was measured by a few of operating characteristics such as the number of cycles, number of stock-outs, average number of back orders, average inventory, average inventory value, inventory carrying cost, shortage cost, ordering cost and total cost. However, this research was only limited to single item and a single problem only. At the end of the research, they found that facilities provided in the expert system is not only aid the practitioner in selecting the appropriate model but also in obtaining and calculating the parameters required for solving problems.

Ng et al. (1993) conducted research on problems and benefits involved in implementing a computer inventory control system in a particular lighting products manufacturing company. They used empirical analysis technique throughout the study of which involved the survey and observations made during the implementation of the system. They performed an assessment based on several factors including time savings, accuracy and cost. They concluded that the management of inventories has an important bearing on the financial strength and competitive position of a manufacturing organization, because it directly affects the working capital, the production and customer services.

Hong and Zhong (1994) conducted research related to the implementation of a computer-aided inventory control system in boiler works at China. Using the model (T, Q, SS, s), they calculated the cost and found that with the new inventory system the total inventory cost is continuously reduced. Besides that, the manual work has been reduced and data processing has dramatically improved in terms of precision, flexibility, variety and real-time operation. Furthermore, flexibility and adaptability of the enterprise has increased and redundant data are greatly reduced. As a resulted the slow responses and data inconsistencies have improved.

Sepehri (2011) used simulation to prove the cost and inventory benefits of cooperation in multi-period and multi-product supply. Using cost as a performance measure, he developed a set of linear programming models to develop and solved an integrated supply chain framework. This framework has considered operation capacities and costs for all members in the supply chain. The simulation results indicate an approximately 26% reduction in total costs of the supply chain, utilizing this formulation over competitive setups.

Hochmuth and Kochel (2011) also used a simulation optimization on research concerning the ordering and transhipping in multi-location inventory system. Using cost as a performance measure, they have successfully combined a widely adaptable simulation model with a genetic algorithm, which allows the investigation of highly complex models with few assumptions and is theoretically not limited to a location. In addition, they also succeed in developing a flow of transhipments and also suggested next researchers to evaluate varying flows of transhipment by limiting pooling.

Golini and Kalchschmidt (2011) conducted an empirical analysis to review supply chain management (SCM) at a global level. The purpose of their research is to investigate the impact of global sourcing on inventory performance and the role played by SCM in moderating this relationship. They collected data from the International Manufacturing Strategy Survey (IMSS). The data collected comprises of the percentage of purchases from the outside of the region and also the level of the material inventory. They concluded that performing global sourcing in supply chain management (SCM) has been helpful in keeping the company inventories under control.

Different from others journal, Liang (2013) had chosen prediction model as a method in performing the inventory system. She conducted her research for the Food-Processing and Distribution Industry with the aim of solving the storing problem. She surveyed the experts and come out with the prediction model to predict the forthcoming materials in an inventory. Quantity of stored foods, the input or output frequency of the same foods and the recency of input or output foods. The QFR

(Quantity, Frequency, Recency) are the factors used to calculate the importance of each material in inventory. She found that through the prediction model, the best accuracy of inventory prediction could be 66.3% and it is useful for a company to adopt as the inventory prediction technique.

Mishra et al. (2013) in their journals studied the relationships between the chain-of-effects linking IT capability, inventory efficiency, and stock market returns. Using the empirical analysis, they used the stock market returns and risk from the secondary information of multiple industries across the 10-year time period of 2000–2009 to calculate the measures of inventory efficiency and the control variables. From the analysis, they found that firms IT capability improves the inventory efficiency of firms, thereby leading to higher stock market returns and also directly reduces their stock market risk and enhances their stock market returns.

Differ from the inventory control, there are few techniques used for project planning. Three journals were selected for review on the techniques used. Gupta and Ghosh (1989) conducted a survey on expert systems in manufacturing and process planning based on a case study of manufacturing and process planning. From the survey, they concluded that there are few keys to success in development of expert systems, which firstly prototype the system rapidly, then extracting domain knowledge from the experts, have a very strong management commitment, do an early demonstration to user and also upgrade the expert systems continuously.

Nowak and Nowak (2013) used a decision tree method to solve research related to the project planning for railway industry. They measured the profit margin as the performance measure and they found that the decision tree seems to be an efficient tool for the project planning.

Torabi et al. (2014) conducted research on optimal planning of oil and gas development projects considering long-term production and transmission. They used the linear mixed-integer-programming model. They used number of sensitivity to measure the performance of the method applied. Lastly, they found that the model is able to select the best combination of development projects as well as scheduling them and predicting transmission sub-problems.

Mohd Lair et al (2013) centred on the development of the Computerised Inventory Management System (CIMS) for the maintenance team at Weida Integrated Industries Sdn. Bhd. The inventory management technique used to control the spare parts inventory in this research was the basic Economic Order Quantity models (EOQ). However, the CIMS developed is unique as it has the ability in handling inventories in multiple-storage locations. The CIMS was written using the Visual Basic 2010 software. This CIMS has the abilities to keep records and process the spare parts information effectively and faster besides helping the user to perform spare parts ordering tasks compared to the current manual recording. However, observation indicates that the overall average inventory level currently at the factory is lower than the expected overall average inventory level produced by the CIMS. This is due to the fact that the CIMS was unable to consider the opening stock in ordering the inventories. Therefore, further improvements are needed to optimize the performance of the system such as using the EOQ with the reorder point technique, the periodic or continuous review system.

Mohd_Lair et al. (2014) developed the Spare Part Inventory Management System (SPIMS) for the Profound Heritage Sdn Bhd (PHSB) while adopting improvement proposed in Mohd Lair et al. (2013). This automatic software used the Economic Order Quantity (EOQ) in the periodic review environment to control the inventory and written using the Microsoft Visual Studio 2012. This newly developed SPIMS have the ability to keep the spare parts transaction records, calculate the EOQ for each part and remind the user to purchase more spare parts at its dedicated date. The developed SPIMS performance was then evaluated by comparing it to the current Kadex or manual method. Comparison across the overall average inventory indicated that the EOQ with zero opening balance performs better than the Kadex method. However, the Kadex method is found to perform better than the EOQ when current opening balance is considered. The deterioration in the EOQ performance, when current opening balance is considered, is due to the fact that more data and longer time for observation is required before the EOQ reached its steady state. However, it is expected that once the system reached it steady state, the result similar to the EOQ with zero opening balance will be observed. In addition, the EOQ also produces some shortages on the stock, which is non-existent in the Kadex method. This problem is caused by the EOQ inability in detecting any shortages as the inventory will only be checked on a specific time interval. Due to this, an improvement on the SPIMS by implementing the continuous review environment is needed.

This research is similar to Mohd_Lair et al. (2014) and Mohd Lair et al. (2013) on development of inventory management system. However, those researches demonstrated the application of EOQ concept in continuous and periodic monitoring environment to control spare part inventories. This research, on the other hand, attempts to integrate inventory management system with project management concept in controlling and managing equipment inventories used by an oil and gas industry.

3. The case study

The oil and gas company is a wholly Malaysian owned company with the head office in Miri, Sarawak, Malaysia. The company was established on Oct 10, 2010 to provide services for oil and gas industries. The Management team of the company has encryption track records in managing, and executing oil and gas projects (and services) for

downstream and upstream sectors for the past 10 years. Their core service is the Mechanical Engineering Maintenance — Joint Integrity Management and Hydraulic Bolt Tensioning & Torqueing. Their other services are the Project Management, Minor Fabrication and Pipeline Maintenance. The company through its own experience providing project management service and has its own strategic approaches in providing the best services to meet objectives and other requirements by the clients.

Currently, the company has two separate offices and a warehouse in Labuan. The company faced a problem of tracing the position of existing equipment. Increasing number of existing equipment contributed to the difficulty in monitoring because when the equipment increases, the datasheet for the equipment also increases. Therefore, they have difficulty in monitoring the movements of the equipment, which may be being used for a project or being stored in the company warehouse in Labuan. Efforts to create tracking system for the equipment is ever made but ended in failure. For this reason, they are still using the manual method for tracking all equipment.

4. The on-screen equipment movement and monitoring

The On Screen Equipment Movement and Monitoring System (OEMS) software developed in this research is able to manage the equipment to meet the project demand and was integrated with the network analysis for project planning technique.

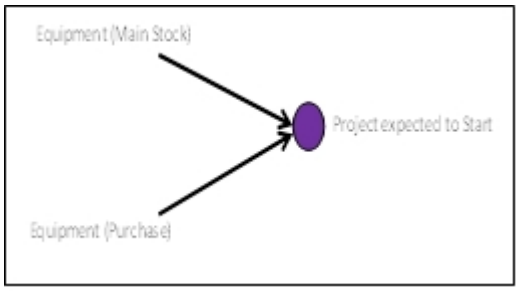

Fig. 1: Network diagram for project planning

Fig. 1 shows the network diagram implemented in OEMS for the project planning. The precedence relationship in this network indicates that the project will only start when the preparation for the equipment from the main stock and purchase is done. So, the operation team have to make sure all the equipment is prepared on time before the project start.

5. The OEMS performance: results and discussions)

Gantt chart in Fig. 2 illustrates the project planning prepared by the oil and gas company operation team for the previous project. From the chart, it seems that the equipment can either be taken from the main stock or purchased (for the new equipment). Total of time taken to prepare this project is 7 days. The network analysis system assumed to start on the same time so that the maximum lead time taken for the project is considered as the minimum time for all the equipment to be ready. Thus, the operation team may know the planning period for certain project and uses the extra time for another project preparation.

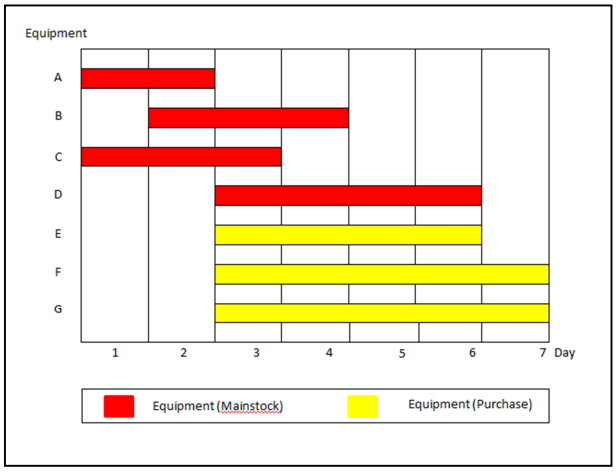

Fig. 2: Project planning by current method

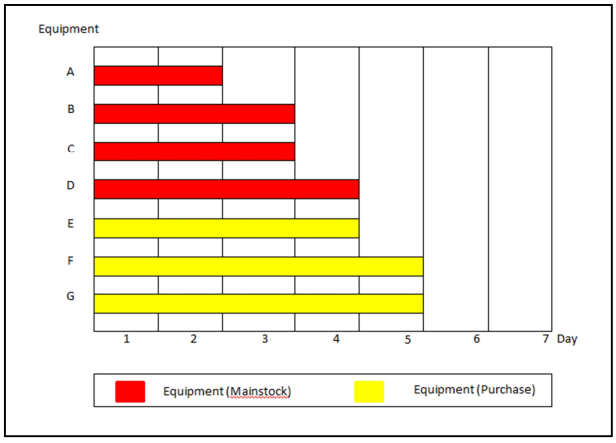

Fig. 3: Project planning by network analysis method

By using the same lead time (completion time) and data, the project preparation can be completed within 5 days, which is less 2 days compare to the time taken by the manual system.

Percentage Error =

$$\left|\frac{\text{Approximatevalue}-\text{Exactvalue}}{\text{Exactvalue}}\right| \times 100\% \quad (1)$$

$$= \left|\frac{7-5}{5}\right| \times 100\% \quad (2)$$

$$= 40\% \quad (3)$$

Therefore, the network analysis has save 40% of time and also improved 40% from the existing method. This proves that with the implementation of network analysis, time taken for organised and planning of the project can be optimised.

6. Conclusion

Efficiency in managing the equipment, which becomes the core business controlling the whole

business and influence the project, is very important in an oil and gas industries. Inefficiency in managing the equipment for the overlap project resulted in the time wasted. Therefore, OEMS help to overcome the problem so that the oil and gas company can manage equipment for certain project effectively.

This research proved that the network analysis technique can save up to 40% of acquisition time than the current technique. The developed OEMS is ready for the oil and gas company operation department. Though, there are still some weaknesses in the system that needs some improvements. So, a few recommendations were suggested in order to improve the OEMS. The suggested improvements include adding the link between the purchased equipment and main stock database. The OEMS should also be able to be linked to the Microsoft Project for ease of display.

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References

C. A. Hochmuth, & P. K¨ochel, (2012). How to order and transship in multi-location inventory systems: The simulation optimization approach. Int. J. Production Economics, 140, 646 – 654.

D. Sinha, N. Ghiaseddin, & K. Matta, (n.d.). Expert Systems For Inventory Control Management. Computers Industry Engineering, 17, 425–429.

D. Whelpton, (1988). Equipment management: the Cinderella bio-engineering. Butterworth & Co, 10, 499 – 505.

hih-C. Liang, (2013). Smart Inventory Management System of Food-Processing-and Distribution Industry. Procedia Computer Science, 17, 373 – 378.

L. J. Krajewski, L. P. Ritzman, & M. K. Malhotra, (2010). Operations Management Processes and Supply Chains (Ninth Edition.). Prentice Hall.

M. Nowak, & B. Nowak, (2013). An application of the multiple criteria decision tree in project planning. Procedia Technology, 826–835.

M. Sepehri, (2011). Cost and inventory benefits of cooperation in multi-period and multi-product supply. Scientia Iranica, 18(3), 731–741.

Mohd-Lair, Noor Ajian, Muhiddin, Faqih-Anas, Laudi, Saimon, Mohd-Tamiri, Fadzlita, Chua, Bih-Lii (2014) "The Spare Part Inventory Management System (SPIMS) for the Profound Heritage Sdn Bhd: A Case Study on the EOQ Technique" IMPACT: International Journal of Research in Engineering & Technology (IMPACT: IJRET) ISSN(E): 2321-8843; ISSN(P): 2347-4599 Vol. 2, Issue 1, Jan 2014, 11-18 (JCC Impact factor : 1.3268) http://www.impactjournals.us/download.php?fname=--1388989805-3. Eng-The Spare Part-Noor-Ajian Mohd-Lair.pdf.

Mohd-Lair, Noor-Ajian, Pang, Chuan Kian, Liew, Willey Y. H., Semui, Hardy, Loh, Zhia Yew (2013) "An EOQ Based Multi-Storage Location of Spare Part Inventories: A case study." Applied Mechanics and Materials. Vol. 315. Page 733-738. ISSN print 1660-9336 ISSN cd 1660-9336 ISSN web1662-7482 doi:10.4028/www.scientific.net/AMM.315.733

R. Golini, & M. Kalchschmidt, (2011). Moderating the impact of global sourcing on inventories through supply chain management. Int. J. Production Economics, 133, 86 –94.

S. A. H. Zaidi, S. A. Khan, & F. Dweiri, (n.d.). Implementation of Inventory Management System in a Furniture Company: A Real Case study. International Journal of Engineering and Technology, (2(8)), 1457–1474.

S. Mishra, S. B. Modi, & A. Animesh, (2013). The relationshipbetwee information technology capability, inventory efficiency, and shareholder wealth: A firm-level empiricalanalysis. Journal of Operations Management, 31, 298 – 312.

S. O. E. Ng, E. C. Partington, & D. Sculli, (1993). A computer system for inventory management of lighting products: A case study. Computers in Industry, 22, 71– 79.

S. Sahari, M. Tinggi, & N. Kadri, (2012). Inventory Management in Malaysian Construction Firms: Impact on Performance. *SIU Journal of Management*, (2(1)), 14.

T. Gupta, & B. K. Ghosh, (1988). A Survey of Expert Systems in Manufacturing and Process Planning. Computers in Industry, 11, 195–204.

V. A. Temen, P. A. Eshun, & P. R. K. Essey, (2010). Application of Inventory Management Principles to Explosive Products Manufacturing and Supply — A Case Study. International Research Journal of Finance and Economics, ((38)), 198–209.

Y. Hong, & X. C. Zhong*, (1994). A computer-aided inventory control system in China. Int. J. Production Economics, 35, 153 – 159.