

IV. CONCLUSION

In this paper, a new variant of inventory routing problem is considered. The problem is an extension of the work in the area in that the problem considers a ship that can only enter and leave the ports within their time windows during planning horizon. A mathematical model is formulated as mixed integer programming for solving this problem. A set of new parameters, new variables and modified constraint, especially scheduling and time windows constraints and inventory constraints are discussed. The objective of the problem is to find a minimum cost solution while satisfying a number of technical and physical constraints within a given planning horizon. Several problem instances are created due to uniqueness of the problem. The test results on problem instances show that the longer planning horizon the higher objective function and the longer computational time. This excessive running time was a major motivation for our next research agenda, developing a heuristic method.

REFERENCES

- [1] N. Siswanto, D. Essam, R. Sarker, "Solving the ship inventory routing and scheduling problem with undedicated compartments" *Computers and Industrial Engineering*, vol. 61, pp. 289-299, September 2011.
- [2] M. Christiansen, K. Fagerholt, "Robust ship scheduling with multiple time windows", *Naval Research Logistics*, vol. 49(6), pp. 611-625, August 2002.
- [3] D. Favaretto, E. Moretti, P. Pellegrini, "Ant colony system for a vrp with multiple time windows and multiple visits", *Journal of Interdisciplinary Mathematics*, vol. 10 (2), pp. 263-284, 2007.
- [4] K.F. Doerner, M. Gronalt, R.F. Hartl, G. Kiechle, M. Reimann, "Exact and heuristic algorithms for the vehicle routing problem with multiple interdependent time windows", *Computers and Operations Research*, vol. 35 (9), pp. 3034-3048, September 2008.
- [5] F. Tricoire, M. Romauch, K.F. Doerner, R.F. Hartl, "Heuristics for the multi-period orienteering problem with multiple time windows", *Computers and Operations Research*, vol. 37 (2), pp. 351-367, February 2010.
- [6] F. Al-Khayyal, S.J. Hwang, "Discrete Optimization-Inventory constrained maritime routing and scheduling for multi-commodity liquid bulk, Part I: Applications and model", *European Journal of Operational Research*, vol. 176, pp. 106-130, January 2007.
- [7] M. Christiansen, B. Nygreen, "A method for solving ship routing problems with inventory constraints", *Annals of Operations Research*, vol. 81, pp. 357-378, June 1998.
- [8] M. Christiansen, B. Nygreen, "Modeling path flows for a combined ship routing and inventory management problem", *Annals of Operations Research*, vol. 82, pp. 391-413, August 1998.
- [9] M. Christiansen, "Decomposition of a combined inventory and time constrained ship routing problem", *Transportation Science*, vol. 33 (1), pp. 3-16, February 1999.
- [10] S.J. Hwang, "Inventory Constrained Maritime Routing and Scheduling for Multi-Commodity Liquid Bulk", Thesis (Unpublished), School of Industrial and Systems Engineering, Georgia Institute of Technology, April 2005.

BIOGRAPHY

Nurhadi Siswanto is currently the Head of Industrial Engineering Department at Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia. He holds a Bachelor of Science degree in Industrial Engineering from Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia, Master of Science in Industrial Engineering (MSIE) from Purdue University, West Lafayette, Indiana, USA and PhD in Computer Science with specialisation in Operation Research from University of New South Wales (UNSW), Canberra, Australia. His research interests includes large scale optimization and simulation modeling, and also maritime transportation. He has been involved consultancy activities in several companies, such as Pertamina, Garuda Indonesia, Semen Indonesia and Petrokimia Gresik.