

Manufacturing process improvement of offshore plant: Process mining technique and case study

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Abstract. The shipbuilding industry is characterized by order production, and various processes are performed simultaneously in the construction of ships. Therefore, effective management of the production process and productivity improvement form important key factors in the industry. For decades, researchers and process managers have attempted to improve processes by using business process analysis (BPA). However, conventional BPA is time-consuming, expensive, and mainly based on subjective results generated by employees, which may not always correspond to the actual conditions. This paper proposes a method to improve the production process of offshore plant modules by analysing the process mining data obtained from the shipbuilding industry. Process mining uses information accumulated from the system-provided event logs to generate a process model and determine the values hidden within the process. The discovered process is visualized as a process model. Subsequently, alternatives are proposed by brainstorming problems (such as bottlenecks or idle time) in the process. The results of this study can aid in productivity improvement (idle time or bottleneck reduction in the production process) in conjunction with a six-sigma technique or ERP system. In future, it is necessary to study the standardization of the module production processes and development of the process monitoring system.

Keywords: shipbuilding industry; production process; process mining; productivity improvement

1. Introduction

The concept of ‘Industry 4.0’ initiated in Germany in 2011 is often considered as the heralding of the fourth industrial revolution, wherein the integration of cyber-physical systems (CPSs) into the manufacturing process is the key to enhance manufacturing competitiveness (Park 2016). In this regard, several recent studies have focused on the building of ‘smart factories’ in the manufacturing industry based on this concept. The core technologies of a ‘smart factory’ are

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- Lee, S.I., Ryu, K.Y. and Song, M.S. (2012), "Process improvement for PDM/PLM Systems by using process mining", *Korean J. Comput. Des. Eng.*, **17**(4), 294-302. (in Korean).
- Mans, R.S., Schonenberg, M.H., Song, M., Van der Aalst, W.M. and Bakker, P.J. (2008), "Application of process mining in healthcare—a case study in a dutch hospital", *Proceedings of the International joint conference on biomedical engineering systems and technologies*, Springer, Berlin, Heidelberg.
- Park, J.S. (2016), "Employment structure and characteristics of block manufacturer in shipbuilding industry", *Mon. Labor Rev.*, **39**, 51-64. (in Korean).
- Park, S. (2016), "Development of innovative strategies for the Korean manufacturing industry by use of the Connected Smart Factory (CSF)", *Procedia Computer Science*, **91**, 744-750.
- Rozinat, A., de Jong, I.S., Gunther, C.W. and Van der Aalst, W.M. (2009), "Process mining applied to the test process of wafer scanners in ASML", *IEEE T. Syst. Man Cy. C*, **39**(4), 474-479.
- Saldivar, A.A.F., Li, Y., Chen, W.N., Zhan, Z.H., Zhang, J. and Chen, L.Y. (2015), "Industry 4.0 with cyber-physical integration: A design and manufacture perspective", *Proceedings of the Automation and computing (icac), 2015 21st international conference on. IEEE*.
- Shin, S.H., Kim, D.N. and Jeon, J.H. (2016), "Analyze the causes of ship rework problems using process mining", *Proceedings of the Korean Institute of Industrial Engineers*, (in Korean).
- Song, M.S., Jung, I.K., Jo, Y.J. and Jo, H.J. (2012), "Analysis of production process data using process mining", *Proceedings of the Korean Institute of Industrial Engineers*, (in Korean).
- Van Der Aalst, W., Adriansyah, A., De Medeiros, A.K.A., Arcieri, F., Baier, T., Blicke, T., *et al.* (2011), "Process Mining Manifesto", *Proceedings of the International Conference on Business Process Management Springer, LNBIP*, **99**, 169-194.
- Van der Aalst, W.M., Reijers, H.A., Weijters, A.J., van Dongen, B.F., De Medeiros, A.A., Song, M. and Verbeek, H.M.W. (2007), "Business process mining: An industrial application", *Inform. Syst.*, **32**(5), 713-732.
- Woo, J.H. (2014), "Research on the HSE application with smart device and biometrics", *Korean J. Comput. Des. Eng.*, **19**(2), 157-168.