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Development of a Discrete Event Simulation Tool for Assembly Line Simulation

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Abstract. Discrete event simulation (DES) is a powerful tool for better decision-making. Its application can be found in almost every sector ranging from industrial to services. However, the cost of commercial DES tools sometimes makes them unaffordable for small and medium enterprises. On the other hand, the open-source DES requires good programming knowledge for model customization. This paper presents the development of the DES tool specifically for production and assembly line simulation. The developed tool known as Discrete Event Simulation for Assembly Line (DESIMAL) is flexible enough to support different types of the assembly line. Testing and validation have been conducted using an industrial case study. The result indicated that the developed DESIMAL has similar output with a small error margin (1.08% – 3.60%) compared with commercial DES software. In comparison with real problem output, DESIMAL obtained the result with an error of less than 5%. Therefore, the developed DESIMAL has been validated as an acceptable tool for assembly line simulation. The main contribution of this work is an establishment of DES tool for assembly line simulation.

INTRODUCTION

Discrete event simulation (DES) is an approach used to mimics an actual system as a series of events with the purpose to research the system behavior. It has been widely used in the production, logistics, services and healthcare sectors. In production, DES has been implemented to simulate assembly flow, scheduling, manpower, productivity and many more [1]–[3]. Besides that DES has been implemented to evaluate the supply chain, the distribution system and also warehouse control [4]–[6].

In production line application, a researcher utilized DES to simulate cross-training strategies for dynamics operator assignment to workstation [1]. It enables the operators to have multi-skills in conducting the jobs. In another work, DES has been applied to predict power consumption in the garment industry [3]. In warehouse management, DES was used to analyze layout and storage assignment policies. The purpose is to improve the picking performance in the warehouse [6].

DES also has been widely used in the services sector such as in banking, transportation, retail, town planning, etc. In transportation for example, researchers utilize DES to assess different control strategies in intelligent transportation systems [7]. In different work, DES has been implemented to simulate train operation under emergencies [8].

Recently, healthcare is one of the sectors that highly depend on DES for providing an efficient service. During the pandemic COVID-19, DES has been used to predict and balance scarce hospital resources [9]. DES is also being used to design optimal testing stations for the COVID-19 swab test [10]. Previously, DES used to schedule operation theatre, outpatient appointments and also hospital bed planning.

DES has been used in different sectors because of various advantages. The main advantage of DES is related to the cost. DES enables the existing system to run as usual without any disruption. Besides that, DES benefits to reduce the time for testing. Other than that, the user is also able to test for different configurations and setting for the studied problem. It will assist the user to make a better decision before actual changes are made.

Despite DES advantages, a few issues are always raised by the end-user regarding the DES tool. One of the problems is the accuracy of the model. The accuracy is highly dependent on the parameter, collected data, assumptions

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