PERFORMANCE EVALUATION OF COMPUTER INTEGRATED MANUFACTURING SYSTEMS

N.D.I. WIJELATHA[1] AND S.D. DEWASURENDRA[2]

[1]*Department of Mechanical Engineering,* [2]*Department of Production Engineering, Faculty of Engineering, University of Peradeniya*

In the context of computer integrated manufacturing systems, an important issue is to improve effectiveness. Cellular manufacturing has received a considerable amount of attention in research literature on improving the performance of manufacturing facilities. However recent studies have shown that cellular layouts are not always superior to the traditional functional machine layout in improving performance. A project was set up to investigate performance evaluation in a Computer Integrated Manufacturing environment using the CIM facility in Department of Production Engineering. An experiment was designed for a simple assembly task to identify performance related parameters. An experimental design was done using design of experiments to select optimum operational parameters. Performance evaluation was carried out using Markov, queuing and stochastic Petri net models. The assembly task was stacking three solid blocks (blocks available in three different colours) on a pile in a pre-defined colour order in slots of a tray with nine similar slots. The colour sequence could differ from order to order. Orders can come in any sequence.

A two-factor factorial experiment was designed with three levels of Rbt-1 speed and Rbt-2 speed, respectively. Results of the experiment were used to identify performance related parameters. For performance evaluation, first the system was modeled as a semi Markov process (SMP). The performance criterion was taken as the average throughput rate. Next the system was modeled as a queuing system and analysis was done with Arena©: commercial queue simulation software. Finally performance evaluation with Petri net was done by modeling the assembly task with Coloured Generalized Stochastic Petri nets. Then by unfolding it into Generalized Stochastic Petri nets, generating marking process, by computing transition probability matrix and finally by computing steady state probabilities. This Stochastic Petri net based analysis was then repeated using SIMNET II© software. Using each approach the most important performance measures such as average cycle time and average sojourn time of each state were found.

The results obtained through the factorial experiment show that there is no significant effect on the selected performance measures due to different robot speeds. Using Markov chains the assembly station was modeled considering two assembly removal policies and found one policy to be superior, giving a throughput of 4 assemblies per hour. The authors have used Arena© for queue simulation and found long queues to occur at the Rbt-1 which is the input and much less at the conveyor. By modeling the assembly task using Coloured Generalized Stochastic Petri nets the assembling rate for the same (superior) policy was obtained as 6.6 per hour and by SIMNET II© Petri net simulation software it was 8 assemblies per hour. These differences in results are mainly due to the assumptions made in each case and also due to the different data input methods for the three methods of analysis.