312 Comparison of material handling solutions in assembly production line

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Performance of a pager company was often too low to meet the target production. One of the reasons was related to inefficient material handling process in the production line. Introduction of the box container solution reduced the process times but further consideration is under study to improve the total performance. Among several solution candidates, this study focuses on material handling operator (MHO) solution, where one MHO is assigned to transport the box container from one station to another in the assembly line so that operators in each workstation could concentrate on their own tasks. Using a process simulation approach, this paper compares the performance of the production model with MHO with that of without MHO, and discusses the feasibility of this solution.

1. Introduction

Material handling process is a crucial area that can be optimized in a production line in order to increase productivity. Generally, there are two categories of material handling devices based on their modeling requirements. The first category constrains the number of simultaneous transfer based on the number of individual material handling device (e.g. carts, hand trucks, people, AGVs etc) whereas the second category constrains the ability to start a transfer based on space availability (e.g. conveyor, overhead trolleys, power-and-free system etc)^[1]. Assembly line is a flow oriented production system where the productive units performing the operation referred to the workstation and the parts move from one station to one station with some kind of transportation system^[2]. Effect of material handling systems depends on each production system. The target production system in this study is an assembly production line of a pager manufacturing company in Malaysia. Three solutions to the problem in the production line are under study in this research; material handling operator (MHO), AGV (automated guided vehicle) and conveyor. However, this paper focuses only on the first solution and shows the results of modeling and simulation approach to the material handling process evaluation in this target system.

2. Description of the existing system and its problems

Previous study^[3] dealt with a non-systematic arrangement area in the assembly production line by introduction of the box container as a material handling equipment. The parts were well organized in each workstations and performance became better. As a result, the performance of the production line was improved. However, operators are required to manually deliver the parts to the next workstation, which may cause bottleneck at some workstations. Workstations become idle each time their operators walk off away to deliver the box container to the next station. Then, the performance of the production line is often decreased because of these reasons. Effective counter measures are required to improve the performance of the production line.

3. Research approach to the problems in the existing system

Three solutions to the problem in the production line are under study in this research; material handling operator (MHO), AGV (automated guided vehicle) and conveyor. However, this study focuses only on the first solution, where one MHO is assigned to transfer the box container from one station to another. As a result, the operators at each workstation could concentrate on their parts assembly task. This study uses a process simulation approach^[4] to evaluate the effect of MHO in the production line. The next section covers the process simulation model of this assembly line and the simulation results.

4. Modeling and simulation experiments

4-1 Simulation model based on an assembly production line

This section presents the simulation model designed/implemented in this study, to cover the assembly production line with/without the MHO.

The production system is composed of 9 workstations in the assembly production line in this study (Fig.1). Each workstation is managed by one workstation operator who is assigned to take responsibility of the task at each workstation. The assembly production line is actually divided into 2 sections; front assembly line section and back assembly line section. The front assembly line section consists of 5 workstations; Decoder programming (WS1), Decoder build (WS2), Decoder test (WS3), Radio build (WS4) and Case back assembly (WS5). The back assembly line section consists of 4 workstations; Alignment process (WS6), Final case up assembly (WS7), Final test (WS8) and Customization (WS9). Fig.1 shows the layout of the assembly line of the two sections as well as the nine workstations mentioned above, and flow-diagram of the parts.

Fig.1 An overview of assembly production line

This study focuses on the front assembly line section and designed two types of simulation model. One is without MHO (W/O-MHO Model), which is similar to the existing production line. The other model is with MHO (W-MHO Model), where one MHO is

assigned in the production line and responsible for the material handling task in the production line.

Fig.2 shows the snapshot of W/O-MHO Model, where the decoder programming operator at WS1 is transporting the parts to WS2 using a box container, while leaving WS1 behind at an idle status.

Fig.2 Snapshot of W/O-MHO simulation

Fig.3 shows the snapshot of W-MHO Model, where the MHO is transporting the parts from WS1 to WS2 using a box container, while the decoder programming operator is on-duty at WS1.

Fig.3 Snapshot of W-MHO simulation

4-2 Results and discussion

Using the two types of simulation models, performance comparison in these two models were conducted using simulation evaluation. Fig.4 shows the summary of results in terms of process time. As seen from this graph, process time at each workstation in W-MHO model is better than that of W/O-MHO model.

Fig.4 Comparison of process time performance between W/O-MHO and W-MHO models

As for the total performance of the production line, W-MHO model shows the better performance, or 3760 units/month in Fig.5, whereas 3100 units/month in W/O-MHO model, even though both of these are better than the performance before the introduction of box container.

Fig.5: Comparison of total production performance

5. Conclusions and future work

This paper describes the overview of material handling issue in a paper manufacturing company and considers MHO solution to solve this issue. Two types of simulation models were designed and implemented to work on this case study using a simulation-based approach, and some of the results were presented in this paper. The process-time performance of W-MHO was better than that of W/O-MHO in simulation evaluation. Moreover, introduction of MHO enabled the company's total performance in about 20% higher as opposed to that of W/O-MHO. These results show the feasibility of simulation-based approach for the comparison of performance. Further study is under way for other material handling solutions, including AGV and conveyor system.

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7. References

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