鋼鐵螺帽製造廠車台稼動率分析與排程決策支援系統

Equipment Utilization Analysis and Scheduling Decision Support System for Steel Nut Manufacturer

指導教授：李家岩 教授
專題成員：陳建旭、鄭佩怡
開發工具：MATLAB、ÉXCEL
測試環境：Windows 7

1. Introduction

Steel nut manufacturer is a highly competitive traditional industries. It must operate efficiently in accordance with various key performance indicators (KPIs) of facilities. Furthermore, it is necessary to integrate staves, machines and materials of various types of operational resources to enhance the core competence. We observed the high proportion of idle machines and the low utilization of production capacity via on-site investigation in this case, but we cannot propose reasonably explains and solutions for the status about idle machines in a rational way.

The main idea of this research project is to analyze the on-the-spot manufacturing process and the time management of machines states by the method of Work Study and Overall Equipment Effectiveness (OEE). Through the analysis of information systems and databases, we can effectively characterize the site and suggest the process reengineering. The method we suggested includes procedure-and-state analysis of machines and human-machine productivity analysis to reduce the stocks of work-in-process (WIP).

Last but not least, we employ the Particle Swarm Optimization (PSO) algorithm to build up the scheduling decision support system. Through meta-heuristic method, we can minimize the makespan and suggest a better schedule. Then, the new scheduling technology can address the line balance and improve the utilization of the equipment. Finally, we give a scheduling visualization and show the Gantt chart with EXCEL presenting result of computing and execution.

2. Result and Conclusion

After obtaining the data from the company and verifying the data in the field observations, we designed a scheduling decision support system with Particle Swarm Optimization (PSO) algorithm.

The following testing data is job-shop scheduling problem (JSP) obtained from Pinedo (2012). The Pinedo's scheduling textbook is well known in the research field, and its optimal solution of JSP example (3x4x4 in Chapter 7) is known to be 28. There are 3 jobs (Job 1 – 3) and 4 machines (M1 – M4). The jobs are processed on the machines in a predefined sequence. However, not all the jobs pass through all 4 operations on all 4 machines. The objective is to minimize the makespan.

We can find out that the result of makespan is 28, and it is an optimal solution validated in this job-shop problem.

Input Data：

Table 1 Process Time Table

Process Time	O1	O2	O3	O4
J1	10	8	4	0
J2	8	3	5	6
J3	4	7	3	0

Table 2 Machine Sequence Flow Table

Machine Sequence	O1	O2	O3	O4
J1	1	2	3	4
J2	2	1	4	3
J3	1	2	4	3

The Result of Optimal Schedule：

Makespan：28

The scheduling result is an optimal solution, and the Gantt chart is shown as Figure 1.

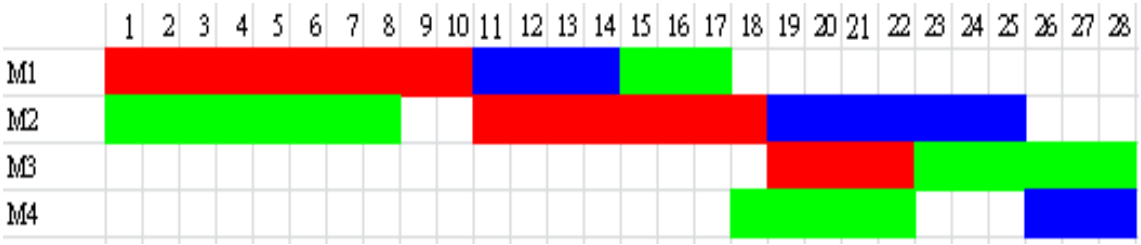

Figure 1 Gantt chart