

JOBS AND WORKFORCE SCHEDULING FOR FLOW SHOPS. A CASE STUDY IN THE METAL CANS MANUFACTURE

INTRODUCTION

Small and medium enterprises (SME) play a crucial part in the development of Thai economy. The thriving of large manufacturing companies relies very much on the support of parts and components such as packaging from these companies. However while SME helps deliver parts and supplies at low cost to large companies, they also face the competition in terms of labour wages and availability of skill labour with large manufacturing companies.

Thus, SME manufacturing firms have to improve themselves to survive in the world of competition amid rising pressure from fluctuating economic situation. They have to apply innovation to improve the manufacturing flexibility, reduce production / cost, enhance production quality and control the delivery schedules. Some persisting problems encountered by SMEs are

1. Consistency in product and service quality,
2. shortage of reliable raw material and supplier sources,
3. shortage of labour, high turn over and low skill labour,
4. competitive pricing and cost controlling,
5. competitive management skill,
6. meeting customers' expectations, etc.

In Thailand the definition of a SME company is defined by the number of employees which is less than 200. The nature of production system in SMEs is typified by human-centered manufacturing systems so that skill operators are very important to the productivity of the business (Figure 1). However with high labour turnover and pressing delivery due dates, most SME companies have to utilise their available labours in most efficient way by rotating them to any job positions at hand, regardless

of their skill levels. In doing so may improve labour productivity but may not be effective in term of meeting target deliveries especially if there exists the difference in the skill levels among workers.

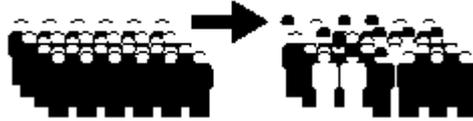


Figure1 The workers have different skills.

This study will demonstrate that by assigning the right skill workers to the right job assignments can actually improve the scheduling of a simple flow shop production and thus meeting the delivery due dates.

A pioneer in field of metal packaging company located in the Bangkok industrial zone is one example of such problem. The company manufactures can containers for paint and chemical products. Production process involves printing a pattern on a flat tin sheet, cut and stamp the metal sheet into the desired shapes, then piecing the components together to make the different can sizes. The environment is referred to as a 2 stage parallel flow shop (Pinedo,1995) where a number of operations have to be done on each job. Often these operations are done on all jobs in the same sequences implying that the jobs have to follow the same route and machines are set up in series.

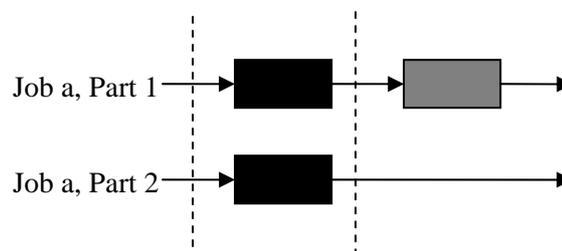


Figure 2 A typified flow shop where jobs follow the same route

Although production process can be grouped into three simple operations namely; body forming, part stamping and final assembly, but with high number of jobs and size varieties to be scheduled to a limited number of machines, this is then turned into a classic sequencing and scheduling problem.

At present, a software program is used to assist production planning of final assembly. However problem exists in the pre-assembly stage where parts are made through various stages of sequencing machines. Due to high number of customer orders and various can sizes, the planning for pre-assembly section is done manually through joint meeting of pre-assembly supervisors and final assembly manager on a daily basis. Daily production plan for pre-assembly line is adjusted to support the final assembly master plan. This often results in missing delivery due dates and leaving some machines idle in the part stamping stage.

The assignment of operators to each machines are random although it is apparent that some operators have higher skill and experience than others. The questions is arise as whether assigning the right operator to the machine will significantly reduce the amount of operation and improve production planning.

A two-step scheduling approach is then used to investigate the improvement on production planning in such situation.

The purpose of this research is to use a two-step flow shop scheduling approach to the assignment of jobs and workforce with skill differentiation for a production line using a pre-assembly line of a can manufacturing company as case study. This research will demonstrate the applicability of proposed dispatching rules for job scheduling and heuristics for workforce assignments to improve production planning.

The Problem Statement

The study of a production scheduling of a small metal forming company using two-step scheduling method and heuristics approach for dispatching rules to minimize the maximum completion time and meeting delivery targets.

Research objectives

The main objective of this research is to propose a production scheduling method for a can manufacturing company in order to minimize time loss in the production. The study aims at the following objectives:

1. Investigate various dispatching rules for a two stage flow shop scheduling.
2. Investigate the effect of skill levels on the assignment of workforce.
3. Propose a heuristic rule for workforce scheduling.
4. Test the result of model to justify the proposed method
5. An effective heuristic solving programs to shorten the planning time.

Conceptual Research Model

This model is base on jobs and workforce scheduling for flow shops at pre-assembly line or two-step scheduling that using dispatching rules for job scheduling and heuristics solutions approach for workforce scheduling. This scheduling can lead to improve machine utilization and reduce waiting job assignments by minimizing maximum completion time of each job. Conceptual Research model is presented as shown.

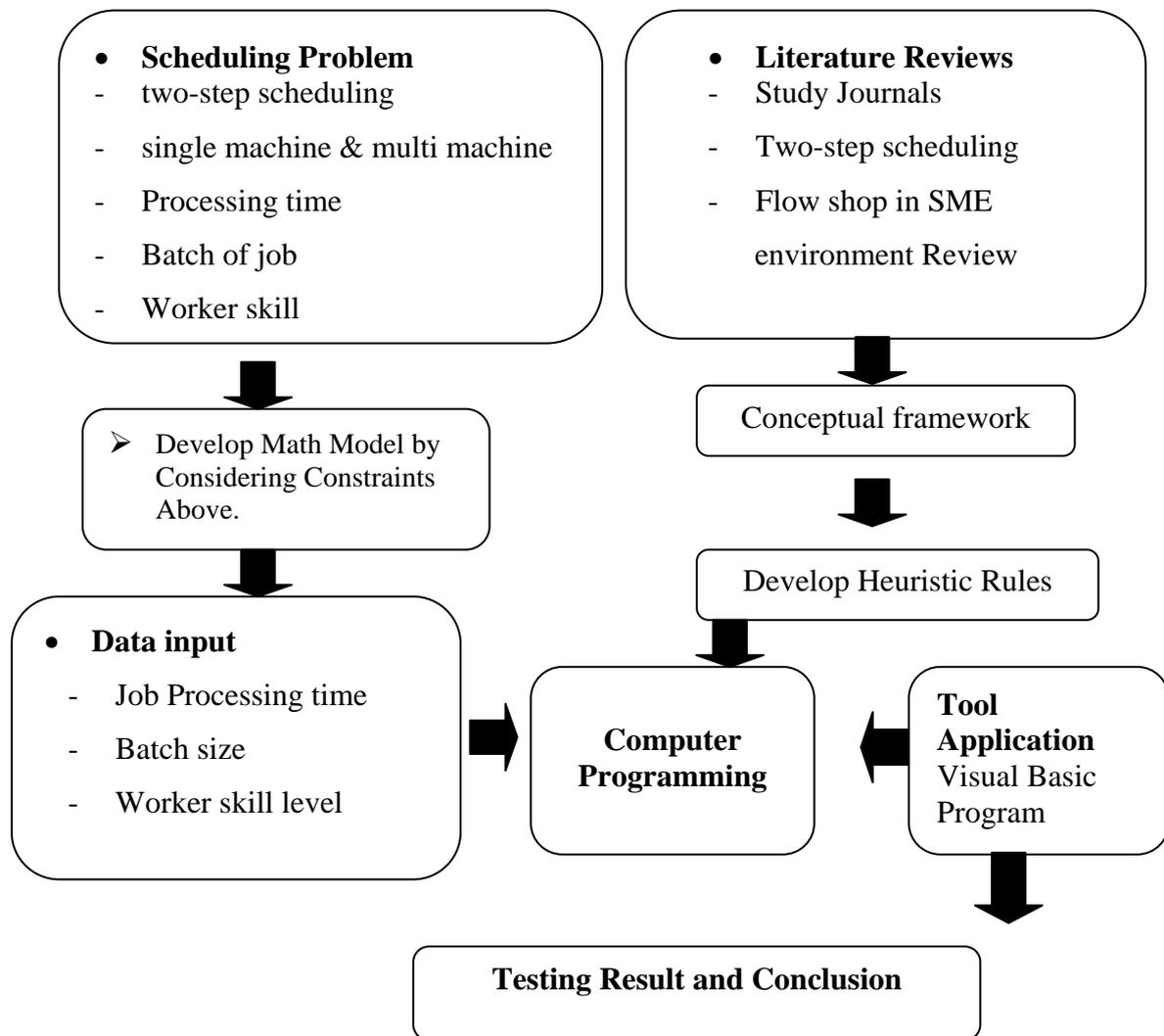


Figure 3 Conceptual Model

Scope and Limitation of Research

The scope of the study is limited to the pre-assembly line of the case study company which is a two stage parallel flow shop problem with numerous similar machines at each stage. All jobs can be processed on any machine and each job will follow a similar route. Other assumptions and limitations are;

- There are limited number of available workers and machines.
- There is differentiation in the skill levels of workers.
- Preemption on any machine is not allowed and all jobs are considered to be of same priority.
- No machine can handle more than one job at a time.
- Setup time at each machine is considered negligible compared to the processing time.