# MACHINE SCHEDULING PROBLEMS WITH A LEARNING EFFECT

Chuanli Zhao[1,2], Qingling Zhang[1] and Hengyong Tang[2]

[1] College of Science,
Northeastern University, Shenyang, China, 110004
[2] Department of Mathematics
Shenyang Normal University, Shenyang, China, 110034

**Abstract.** This paper deals with the machine scheduling problems with a learning effect. In a learning effect environment, the machine improves continuously as a result of repeating the same or similar jobs; hence the later a given job is scheduled in the sequence, the shorter its processing time. We introduce polynomial solutions for some single machine problems, parallel machines problems and flow shop problems. The objective functions, including makespan, (weighted) sum of completion times, maximum lateness are discussed respectively.

**Keywords**: Scheduling; Learning; Single machine; Parallel machines; Flow shop

**AMS (MOS) subject classification:** 65N30.

## 1 Introduction

A common assumption in traditional scheduling is that the processing time of a given job is independent of its position in the schedule. However, in many realistic settings, the machine improves continuously with time. As a result, the processing time of a given job is shorter if it is scheduled later, rather than earlier in the sequence. This phenomenon is known as a "learning effect". Analysis of scheduling problem with a learning effect is of a recent origin although many real world scheduling decisions fall into this category. Biskup[1] studies single machine problem and assumed two objective functions:(1) minimizing flow time, and (2) minimizing the weighted sum of completion time deviations from a common due-date and the sum of job completion times. The learning curve assumed in Biskup's paper reflects decrease in the processing time as a function of the number of repetitions. Mosheiov[2,3] studies several scheduling problems with a learning effect and show that solving scheduling problems with a learning effect requires more computational effort than the effort required for solving the original problems. He introduce polynomial solutions for the single machine makespan minimization problem and two for multi-criteria single machine problems and the minimum flow-time problem on parallel identical machines.

This paper deals with scheduling problems with learning considerations,