



Design of Cellular Manufacturing Systems with Manual Materials Lifting Consideration

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Abstract

Most of the cell formation models, which concentrated on the part families and machine cell formations problems, tend to ignore or forget the human factors or human issues involved in the manufacturing system. In this research, the mathematical model is developed to simultaneously solve the part family, machine cell formation, operator assignment problems. The objective of the models are to minimize the system costs while attempting to develop independent machine cells and ensure that the workers or operators involved in the manual-material-handling activities are working in an ergonomically safe condition based on the NIOSH Lifting Guidelines. The model developed is mixed integer programming model and also tested using a numerical example.

Keywords: Cellular Manufacturing Systems, Worker/Operator Assignment, Human Factors.

1. Introduction

Global economic growth and international trade have forced the manufacturing companies to face the significant increase in level of global competition. Customers are now requiring custom-made products with high quality and variety and also at a reasonable competitive price. The manufacturing companies are being forced to design and organize their manufacturing operations to survive the competition and to satisfy the customers' needs. Cellular Manufacturing Systems (CMS) have been considered as an important step in achieving these objectives.

Over the decades, researchers have developed numerous methods to solve the manufacturing cell formation problem. The methods and techniques can be classified into 6 main groups: classification and coding approach, algorithmic approach, heuristic approach, graph partitioning approach, artificial intelligence approach, and mathematical programming approach.

However, the primary focus of these methods is only on solving the part families and machine cell formation problems (Warner *et al.* 1997). Most of the previous research in the existing literature also indicated that human issues in the GT have not been studied and developed significantly. One of the important aspects in the human issues is the operator assignment to the machine cell. Workers or operators can be assigned to the manufacturing cells using several criteria, for example: technical skills, expertise, or ergonomics concern. The research in this paper is focused on developing mathematical models for design of manufacturing cells with worker assignment based on ergonomics point-of-view.

2. Background

2.1. Human issues in cellular manufacturing

Previous research publications indicated that human or worker issues have been considered into the application of Cellular Manufacturing Systems. The literature review regarding this matter is presented in this section.