論文 / 著書情報
Article / Book Information

題目(和文)	セル生産システムのセル形成とオペレーター配置に関する研究
Title(English)	Research on Multi-objective Cell Formation and Worker Assignment for Cellular Manufacturing System
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種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
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論 文 要 旨

THESIS SUMMARY

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学生氏名： Student's Name	呉　浪	指導教員（主）： Academic Advisor(main)	鈴木 定省
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Noticeable changes in current marketing environment, such as fierce international competition, diverse customer demand, short product life-cycle and small-lot-size production, are prompting manufacturers to seek more efficient, flexible, and quickly responding manufacturing system at a low cost. Traditional manufacturing system, such as job shop and flow line, can no longer fit these severe changes. Based on application of group technology in production, cellular manufacturing system (CMS) can be designed with flexibility of job shop and efficiency of flow line. In recent years, CMS has received extensive attentions from practitioners and researchers. However, its design is an intricate process due to comprehensive considerations of various production factors. Cell formation and worker assignment are two major missions for CMS design problem.

Cell formation is to identify part families and machine groups based upon similar process requirements and other factors, and determine manufacturing cells with corresponding part family and machine group. For cell formation, two different approaches are presented in this research.

On the one hand, we improve an existing similarity coefficient method in chapter 2, which is widely used in the field of cell formation by maximizing process similarity between any pair of parts/machines in each cell so as to minimize material inter-cell movements. The improved method innovatively considered operation sequences and repeated operation times which ignored by previous researches. We deem that more similar operation sequences and more repeated operations should lead to higher similarity coefficient between part/machine pairs. Therefore, it is necessary to consider these two factors to evaluate the process similarity of part pairs and machine pairs. According to experimental results, we can see that the proposed operation sequences and times-based similarity coefficient method has better performance than original method to form part-machine cells.

On the other hand, a two-phase procedure is developed to form manufacturing cells in chapter 3. The first phase is to form part families by using the proposed operation sequences and times-based similarity coefficient method. The second phase is to allocate machines into each part family by a new decomposed mathematical model. The new model aims at minimizing machine cost, operation cost and inter-cell movement cost, as well as maximizing utilization and workload balance of machines under considering several crucial operational aspects,

such as alternative routing, machine capacity, part demand, operation time, lot splitting. The model decomposed complicate NP-complete problem into several simple sub-problems so as to facilitate the cell formation problem and computational efforts. The model puts emphasis on the effect of trade-off between machine replication and material inter-cell movement on performance of the cell to form independent and dependent cell system. From experimental results, we can see that dependent cell system formed by reducing some superfluous machine replications and adding reasonable material inter-cell movements can help to save production cost and enhance machine utilization. Also, an specific material handling plan with optimum utilization and workload balance of machines can be attained by the proposed method.

Worker assignment is to assign suitable workers to tasks in each manufacturing cell. It is a complex problem, since different workers have different skill levels at different tasks. Chapter 4 presents a new model to assign cross-trained workers to divisional cell and rotating cell. The multiple objectives of model are to maximize throughput and workload balance of workers under consideration of various task time and skill levels of workers. Factorial experiments, which incorporate four factors (the number of tasks, similarity of task time, skill level, and gap of skill level), are performed to compare throughput performance of the two cell types obtained by worker assignment under different levels of the factors. Based on the analysis results, we can see that the maximum throughput of divisional cell is better than rotating cell, especially in manufacturing environment with relatively more tasks, more similarity of task time, higher general skill levels or larger gap of skill levels among workers. Therefore, managers may tend to select divisional cell for seeking maximum throughput. On the other hand, in smoothing manufacturing cell (loading of each task is smoothed in the cell), throughput performance of rotating cell is better than divisional cell when scale of cell (the number of tasks) is similar with the number of assigned workers. Especially, in the manufacturing environment with the more number of tasks, more similarity of task time, lower general skill levels of workers, or smaller gap of skill levels, the throughput superiority of rotating cell should be more obvious, so that managers may be tend to select rotating cell. The results can help managers to make more reasonable decisions for selecting right cell type for their cellular manufacturing system.

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