

CONCURRENTLY PART-MACHINE GROUPS FORMATION WITH IMPORTANT PRODUCTION DATA

Lokesh, K.* & Jain, P. K.**

* Department of Mechanical Engineering, J.M.I., Delhi-110025, India

** Department of Mechanical and Industrial Engineering, I.I.T., Roorkee, India

E-Mail: lokeshkrsax@rediffmail.com, pkjain123@gmail.com

Abstract

This work presents an algorithm for design of cellular manufacturing system. It considers sequence of operation for every component as ordinal level data. The ratio level data includes operation time per unit, production volume and machine capacity. A matrix model is developed to incorporate ordinal level data and ratio level data. Model is then standardized. From this, Part – Part correlation model is formed. This is undergone through principle component analysis. Now, Feature-Vector and New Standardized Sequence Part Load matrices are formed. These are used for grouping purpose. Part-machine orthographic view is used for concurrent part-machine family formation. Performance of algorithm is comparable and of good quality with existing methods in its class. To facilitate industrial application, it can be implemented by using free software, Scilab and/or commercial softwares.

(Received in November 2008, accepted in June 2009. This paper was with the authors 1 month for 1 revision.)

Key Words: Cellular Manufacturing, Part-Machine Families, Algorithm

1. INTRODUCTION

Cellular manufacturing (CM) is an applied concept of group technology and Just-in-time. It changes the conventional practice of manufacturing from functional production into small to medium-sized batch oriented production. The reported advantages of CM are such as better management of labour, tooling and production time, reduction of space, work in process inventory as well as paper work etc.

The basic problem in the design of cellular manufacturing system lies in the identification and grouping of parts that share similar process into families and their associate machines into cells, the ideal CM solution is to ensure all parts in a family fully processed within a cell. Parts that are manufactured by more then one cell are known as exceptional parts. There should be a minimum number of parts requiring intercell travel.

2. LITERATURE REVIEW

Techniques to develop possible solution are plentiful in the literature. These techniques can be classified into machine-part grouping approaches, the machine grouping approaches and the part grouping approaches. The machine-part grouping approach consists of the simultaneous identification of machine cells and part families, the part grouping approach attempts the initial formation of part families and followed by assignment of machines to those families. The machine grouping approaches are based on first identification of machine cells and then assign parts to those machines.

The main theme throughout the most research papers is clustering the unit valued (i.e. binary 0 or 1) entries of part-machine incidence matrix alone [1-11]. Many researchers considered similarities coefficients based approaches to solve cell formation (CF) problem.

- [14] George, A. P.; Rajendran, C.; Ghosh, S. (2003). An analytical-iterative clustering algorithm for cell formation in cellular manufacturing systems with ordinal-level and ratio-level data, *International Journal of Advanced Manufacturing Technology*, Vol. 22, 125-133
- [15] Nair, J. G.; Narendran, T. T. (1998). CASE: A clustering algorithm for cell formation with sequence data, *Int. J. of Production Research*, Vol. 36, No. 1, 157-179
- [16] Nair, J. G.; Narendran, T. T. (1999). ACCORD: A bicriterion algorithm for cell formation using ordinal and ratio-level data, *Int. J. of Production Research*, Vol. 37, 539-556
- [17] Suresh, N. C.; Slomp, J.; Kaparathi, S. (1999). Sequence-dependent clustering of parts and machines: a Fuzzy ART neural network approach, *Int. J. of Production Research*, Vol. 37, No. 12, 2793-2816
- [18] Yin, Y.; Yasuda, K.; Kazuhiko, K. (2002). Manufacturing cells' design in consideration of various productions factors, *Int. J. of Production Research*, Vol. 40, No. 4, 885-906
- [19] Jayaswal, S.; Adil, G. K. (2004). Efficient algorithm for cell formation with sequence data, machine replications and alternative process routings, *Int. J. of Production Research*, Vol. 42, No. 12, 2419-2433
- [20] Wu, X.; Chu, C. H.; Wang, Y.; Yan, W. (2006). Concurrent design of cellular manufacturing systems: a genetic algorithm approach, *Int. J. of Production Research*, Vol. 44, No. 6, 1217-1241
- [21] Won, Y.; Currie, K. R. (2007). Fuzzy ART/RRR-RSS: a two-phase neural network algorithm for part-machine grouping in CM, *Int. J. of Production Research*, Vol. 45, No. 9, 2073-2104
- [22] Alhourani, F.; Seifoddini, H. (2007). Machine cell formation for production management in cellular manufacturing systems, *Int. J. of Production Research*, Vol. 45, No. 4, 913-934
- [23] Miltenburg, J.; Montazemi, A. R. (1993). Revisiting the cell formation problem: assigning parts to production systems, *Int. J. of Production Research*, Vol. 31, No. 11, 2727-2746
- [24] Seifoddini, H.; Tjahjana, B. (1999). Part-family formation for cellular manufacturing: a case study at Harnischfeger, *Int. J. of Production Research*, Vol. 37, No. 14, 3263-3273
- [25] Lokesh, K.; Jain, P. K. (2008). Part-Machine Group Formation with Operation Sequence, Time and Production Volume, *Int. J. of Simulation Modelling*, Vol. 7, No. 4, 198-209
- [26] Chandrasekharan, M. P; Rajagopalan, R. (1986). An ideal seed nonhierarchical clustering algorithm for cellular manufacturing, *Int. J. of Production Research*, Vol. 24, No. 2, 451-463
- [27] Selim, H. M.; Askin, R. G.; Vakharia, A. J. (1998). Cell formation in-group technology: review, evaluation and direction for future research, *Computers & Industrial Engineering*, Vol. 34, No. 1, 3-20
- [28] Nash, J. F. (1950). The bargaining problem, *Econometrica*, Vol. 21, 155-162
- [29] Panneerselvam, R. (2004). *Research Methodology*, 2nd edition, Prentice Hall of India Pvt. Ltd., Delhi
- [30] Kothari, C. R. (2004). *Research Methodology*, 2nd edition, New Age Publisher Ltd., Delhi
- [31] Gnanadesikan, R. (1997). *Methods for Statistical Data Analysis of Multivariate observations*, 3rd edition, Wiley, New York, 7-15
- [32] Rummel, R. J. (1988). *Applied factor analysis*, 1st edition, Evanston: Northwestern University Press
- [33] Jolliffe, I. T. (2002). *Principal component analysis*, 2nd edition, Springer-Verlag, New York
- [34] Howard, A. (1998). *Elementary Linear Algebra*, Fifth edition, John Willy and Sons Inc.
- [35] Gonzalez, R. C.; Wintz, P. (1987). *Digital Image Processing*, 2nd edition, Addison-Wesley Publishing Company, New York
- [36] Kusiak, A.; Wang, J. (1993). Efficient organizing of design activities, *Int. J. of Production Research*, Vol. 31, No. 4, 753-769
- [37] Boctor, F. F. (1991). A linear formulation of the machine-part cell formation problem, *Int. J. of Production Research*, Vol. 29, No. 2, 343-356
- [38] Venugopal, V.; Narendran, T. T. (1992). A genetic algorithm approach to the machine component grouping prob. with multiple objectives, *Computers & Industrial Engineering*, Vol. 22, 469-480
- [39] Seifoddini, H.; Wolfe, P. M. (1986). Application of similarity coefficient method in GT, *IIE Transactions*, Vol. 21, 382-388
- [40] Scilab: Platform – Scilab.org/Platform