

# Cellular Manufacturing application in Manufacturing Industry – A Review

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**Abstract:** In the present worldwide and aggressive environment manufacturing industry confront numerous issues. Group technology and cellular manufacturing philosophy diminish the issue. Cellular manufacturing (CM) is one of the on-going manufacturing systems. CM attempts to accomplish the advantages of a product oriented system for medium volume, medium variety condition by setting up a parts in a group on a cell of a machines. CM helps to reduce work-in-process inventory, material handling, set-up time and improve operators capability. The aim of this paper is to investigate and assess past work concentrating on the relationship and connections between CM and its implementation in manufacturing industries. It is required to be a concise reference for future researchers that diminishes exertion and tedious amid their studies.

**Keywords:** Group technology, Cellular manufacturing, Implementation case study, Review

## 1. Introduction

Cellular manufacturing (CM) is a philosophy in which diverse machines have been amassed into cells, which is devoted to the production of a part family (Dekkers, 2018). In CM, Group Technology (GT) is utilized to make part families in light of same processing required for the job. Machines and parts are then group together to form machine cell. Mitrofanov was the first who presented the idea of GT and the machine grouping issue in the late 1950's. The other early pioneers in the field of GT are Burbidge and Ham. Burbidge in 1960 proposed PFA (production flow analysis) method for GT. From 1960-2017 numbers of strategies, models and algorithms created identified with different issues in CM. The aim of this paper condenses a survey of the research papers distributed in the era from 1987 to 2018 that are specifically identified with the uses of CM in manufacturing industries.

The structure of this study is as per the following. The first section contains the introduction in general, followed by the second section, which includes the methodology of the study. Next section incorporates the redundant examination of past investigations and the conclusions are discussed in the last section.

## 2. Methodology

The methodology of this study includes following steps: Literature review on CM application in manufacturing industries. Assessing the suitability of subjects. Table 1 demonstrates a concise clarification of the methodology.

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Table 1. Research methodology

Study type	Qualitative
Papers source	Journals and conferences accessible through Google Scholar.
Time Period	1987-2018

### 3. Cellular manufacturing application

This study depends on CM application in manufacturing industries, as CM is viewed as a key reason for enhancing the performance of the organization. Table 2 represents summary of the case studies on the application of CM in manufacturing industries.

Table 2. Summary of CM application.

Sr. No.	Author	Cellular Manufacturing application
1.	(Ballakur A. & Steudel H., 1987)	Proposed a usefulness of a heuristic for cell formation in manufacturing industry.
2.	(Wemmerlöv & Hyer, 1989)	Presents a finding on survey on CM implementation in 32 US firms
3.	(Gu P & Monid Al , 1993)	Discusses CM system development in manufacturing industry
4.	(Alford, 1994)	Assessment of CM application through case study
5.	(Wemmerlov & Johnson, 1997)	Reports a survey study of CM in manufacturing plants.
6.	(Marsh R F., <i>et al.</i> 1999)	Test the applicability of CM through 14 case studies.
7.	(Bazargan-Lari M <i>et al.</i> 2000)	Presents the application of CM to white-goods manufacturing company.
8.	(Musbah & Uk, 2001)	Investigate challenges with CM in project organization.
9.	(Molleman, Slomp, & Rolefes, 2002)	Describes CM evolution in batch production industry.
10.	(Slomp, Bokhorst, & Molleman, 2005)	Presents the industrial applicability for training in CM.
11.	(Andrés, <i>et al.</i> , 2005)	Presents GT application in tile industry
12.	(Murugan & Selladurai, 2007)	Presents cell formation clustering algorithm in a pump industry.
13.	(Das, Lashkari, & Sengupta, 2007)	Demonstrate the applicability of preventive maintenance model in CM system.
14.	(Fraser, Harris, & Luong, 2007)	Presents CM implementation benefits through case study.
15.	(Ngampak N & Phruksaphanrat B, 2011)	Presents CM layout design in Electronic manufacturing service plant
16.	(Suzic N., <i>et al.</i> 2012)	Presents GT application to furniture manufacturing industry
17.	(Hung & Maleki, 2013)	Presents GT application to the forging industry
18.	(Varanujit & Peerapattana, 2013)	Presents the application of CM to Hard disk drive industry
19.	(Karim & Biswas, 2015)	Presents the application of cell formation to batch production system

20.	(Rezaei-Malek, <i>et. al</i> , 2016)	Presents the applicability of operator assignment in CM through a real case study.
21.	(Cveti, Ili, & Sciences, 2017)	Presents the performance of a heuristic to cell formation through case study

(Ballakur A. & Steudel H., 1987) have use the heuristic for part family and machine group in industry involving 305 parts and 64 machines. The proposed model is flexible, reliable, and effective. It is valuable tool for trading off different objective of cell formation like machine utilization in a cell, number of machines in a cell and percentage of part completion.

(Wemmerlöv & Hyer, 1989) reports the finding of survey performed in US manufacturing industries involved with CM. The focused of the survey was on benefits of CM, cell formation methods, number of cells and labour related issues. The authors conclude that training and involving people early in the process of CM implementation is crucial. Authors also report that after implementation of CM through put time is reduced by 45.6 %, WIP inventory by 41 % and material handling by 39 %.

(Gu P & Monid Al , 1993) applied a clustering algorithm with objective of minimizing bottleneck machines in the design of CM system. Author applied the proposed algorithm in a manufacturing industry. The algorithm is flexible and easy to use.

(Alford, 1994) presents in-depth data on CM application through case study. Author take a gander at how CM is being connected at present, by analysing overview prove and a contextual investigation. They endeavour to survey the express that the hypothesis and routine with regards to CM have achieved; where they are going and what might valuable headings are for additionally look into future.

(Wemmerlov & Johnson, 1997) makes a contribution to the learning by giving bits of knowledge into the CM execution encounters and CM execution accomplishment's at 46 US firms. Author concluded that rebuilding the industrial facility to embrace CM ought not to be seen only as a technical issue however as a change procedure where peoples are also important. They also fortify the requirement for exact examination into CM implementation.

(Marsh R F., *et al*. 1999) distinguishes the consistency between CM as imagined by researchers and CM as utilized in industries. They found that a large number of the issues researchers are researching are definitely not those that managers are really worried about.

(Bazargan-Lari M *et al*. 2000) presented cell formation algorithm with integrated approach to CM layout design through case study at Australian white-good manufacturing company. The proposed algorithm is efficient and flexible to constraints expressed by the company.

(Musbah & Uk, 2001) proposed the simulation model for CM. The data from manufacturing industry were input to the model.

(Molleman *et al.*, 2002) focus on the impact of transformation decision of CM system. Through case study author shows that a CM framework is weak against changes in business sectors, while useful designs are less touchy to such changes.

(Slomp *et al.*, 2005) developed an integer programing model for selecting worker for particular machine. Author shows that training to the worker in CM for balanced workload situation that has positive effect on the performance of the organization.

(Andrés, *et al.*, 2005) developed a methodology of part grouping in the tile manufacturing industry. Authors first time introduced coefficient of similarity in tile industry. Proposed method proved that GT is an effective method to improve efficiency of a tile making firm.

(Murugan & Selladurai, 2007) proposed three rank order clustering method for cell formation. These methods were direct clustering analysis, rank order clustering and rank order clustering-2. The proposed method implemented in pump manufacturing industry. Input to the algorithm is part incidence matrix including 15 parts and 16 machines. Evaluation of three algorithms was done through Group efficiency and group efficacy. The outcome of the result shows that direct clustering analysis is more effective method.

(Das *et al.*, 2007) proposed preventive maintenance model to improve the performance of CM system for machine reliability. Model is designed considering cost and reliability approach to optimize cost of maintenance. Authors also solved four case study problems for proposed model.

(Fraser *et al.*, 2007) presented a six phase model of CM implementation. Six phases are, feasibility, team, cell design, human factor, reorganization and installation and continuous improvement. Proposed framework implemented in case company. Number of benefits achieved was reduction of scrap, reduction in work-in-process inventory and lead time.

(Ngampak N & Phruksaphanrat B, 2011) implemented cellular layout in electronic manufacturing services. Systematic layout planning and analytical hierarchy process were applied for creating and selecting best layout design.

(Suzic N., *et al.* 2012) applied group technology and production flow analysis for implementation of mass customization in furniture making industry.

(Hung & Maleki, 2013) applied group technology and coding system and metal forging industry. Through case study author shows that application of GT reduces lead time as well as repetitive activity. GT also increases production efficiency.

(Varanujit & Peerapattana, 2013) applied rank order clustering and rank order clustering-2 method of cell formation in hard drive factories. They check the efficiency of the system through Arena simulation. Study concludes that efficiency of the system was increased and work flow distance decreases.

(Karim & Biswas, 2015) proposed a heuristic considering genetic algorithm to make part family and machine cells. The proposed approach was presented for batch production system. The objective of the model was to minimize intercellular movement. The result of the study shows that grouping efficacy was improved by 30.87 %.

(Rezaei-Malek, *et. al.*, 2016) proposed the model for cell formation considering worker assignment. The mathematical model was designed considering consistency between two workers in the cell and consistency between worker and machines. The application of the proposed model was presented in compressor manufacturing industry.

(Cveti, Ili, *et. al.*, 2017) presented the performance measure of CM system to check quality of cell formation. Author study the outcome found by GAVNS, GRASP, and CFOPT method. Best performance was given by CFOPT method.

## 4. Conclusion

There is a great amount of valuation studies on CM implementation. CM was implemented in various manufacturing industry. Most of the aims of the case studies are to measure performance of the system. Common performances were group efficiency, group efficacy, and intercellular movement. Most of the studies were modelled for cell formation. Few studies also focus on human related issues in CM system. Common methodologies used in most of the studies were quantitative. Results of various case studies shows that CM reduces work-in-process, scrap and lead time and at the same time improve efficiency of the system.

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