



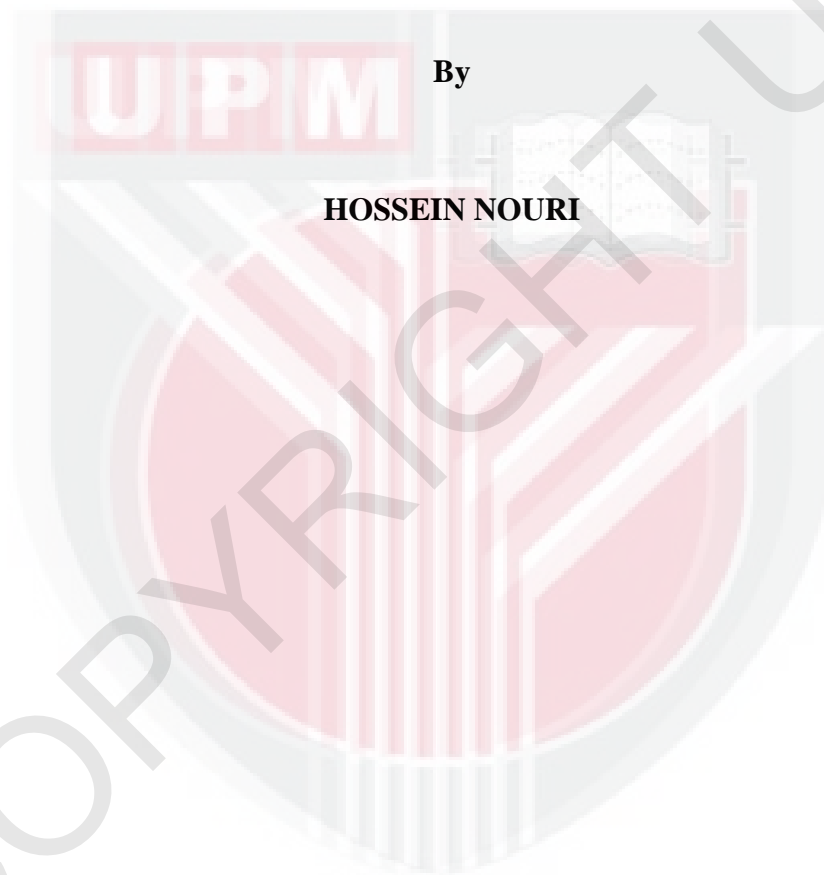
UNIVERSITI PUTRA MALAYSIA

***DEVELOPMENT OF CELL FORMATION ALGORITHM AND MODEL
FOR CELLULAR MANUFACTURING SYSTEM***

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**DEVELOPMENT OF CELL FORMATION ALGORITHM AND MODEL
FOR CELLULAR MANUFACTURING SYSTEM**



By

HOSSEIN NOURI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfillment of the Requirements for the Degree of Doctor of Philosophy**

October 2011

DEDICATION

Dedicated to my family for their love, support, and encouragement.



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

**DEVELOPMENT OF CELL FORMATION ALGORITHM AND MODEL
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October 2011

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The Cellular Manufacturing System (CMS) is considered as an efficient production strategy for batch type production. The CMS relies on the principle of grouping machines into machine cells and grouping machine parts into part families that is named cell formation. Cells are formed based on presuming fixed single route and parts demand (traditional cell formation) or fluctuation of parts demand (dynamic cell formation).

The majority of existing models are defined in traditional cell formation and a few of them have considered machine assignment, inter-cell travel and subcontracting excluding worker assignment and workload balancing cells based on operation sequences in dynamic environment. Therefore, This research work attempts to solve a developed comprehensive model which integrated cell formation and process

planning problem meanwhile taking into consideration important cell design issues. These issues consist of workload balancing among cells and operation issues such as machines assignment, inter/intra-cells material handling, workers assignment, subcontracting based on operational time, operation sequence of the parts and assessing effects of these parameters on cell design in dynamic environment.

In addition, one of the main challenges has been development of efficient algorithm for solving aforementioned model to find exact feasible optimal solution. Previous methods have produced infeasible solution. It is consequence of the designers could not handle constraints satisfaction. Therefore, for this proposes good benchmarked algorithm, bacteria foraging algorithm is selected and developed to solve multi-objective cell formation model and traced constraints satisfaction handling to produce feasible optimal solution. The basic bacteria foraging has been successful in solving single objective non-matrix space NP-hard optimization problems.

The performance of the proposed algorithm is compared with a number of key algorithms that reported in the corresponding scientific literature. For this purpose, performance measures such as number of exceptional elements courier of inter-cell material handling, number of voids courier of intra-cell material handling and machine utilization, total cells load variation, operation costs, and maintaining solution diversity in Pareto frontier courier of improvement in domain exploring performance and drift-avoiding are used. The results show proposed algorithm approximately solved problems averagely 22% better in terms of find feasible optimal solutions depends of various performance measures in 72.2% of computational time than other previous considered key algorithms.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**PEMBANGUNAN ALGORITMA PEMBENTUKAN SEL DAN MODEL
UNTUK SISTEM PEMBUATAN SELULAR**

Oleh

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Sistem Pembuatan Selular (CMS) dianggap sebagai strategi pengeluaran baik untuk pengeluaran jenis kelompok. CMS berharap pada prinsip mengelompokkan mesin-mesin ke dalam sel-sel mesin dan bahagian mesin kumpulan ke dalam keluarga-keluarga bahagian yang dinamakan pembentukan sel. Sel-sel adalah dibentuk berdasarkan mengandaikan laluan tunggal tetap dan bahagian-bahagian menuntut (pembentukan sel tradisional) atau pergolakan bahagian-bahagian menuntut (pembentukan sel dinamik). Majoriti model-model sedia ada didefinisikan dalam pembentukan sel tradisional dan sedikit dari mereka telah mempertimbangkan tugas mesin, perjalanan antara sel dan subkontrak tidak termasuk tugas pekerja dan sel-sel keseimbangan beban kerja berdasarkan jujukan-jujukan operasi dalam suasana dinamik. Lantarnya, kerja penyelidikan ini cuba untuk menyelesaikan satu model dimajukan komprehensif yang mana bersepadu pembentukan sel dan masalah perancangan proses sementara itu mengambil ke dalam pertimbangan isu-isu reka

bentuk sel penting. Isu-isu ini terdiri daripada keseimbangan beban kerja antara sel-sel dan isu-isu operasi seperti tugas mesin-mesin, menguburkan / pengendalian bahan intra sel-sel, tugas pekerja-pekerja, subkontrak berdasarkan masa operasi, jujukan pengendalian bahagian-bahagian dan menaksir kesan-kesan parameter ini pada reka bentuk sel dalam suasana dinamik. Sebagai tambahan, satu daripada cabaran utama telah menjadi pembangunan algoritma cekap untuk menyelesaikan model tersebut sebelumnya mencari tepat penyelesaian optimum munasabah. Kaedah-kaedah sebelumnya telah menghasilkan penyelesaian tak tersaur. Ia akibat pereka-pereka tidak boleh menangani kepuasan kekangan. Lantarananya, untuk ini mengemukakan algoritma tanda aras baik, bakteria mencari algoritma dipilih dan dibangunkan untuk menyelesaikan pembentukan sel objektif pelbagai model dan mengesan kepuasan kekangan pengendalian menjanakan penyelesaian optimum munasabah. Bacteria asas mencari telah berjaya dalam menyelesaikan satu objektif ruang tidak matriks masalah-masalah pengoptimuman NP-hard. Prestasi algoritma dicadangkan dibandingkan dengan sejumlah algoritma utama yang melaporkan dalam karya ilmiah sepadan. Untuk tujuan ini, mengukur prestasi seperti nombor unsur-unsur luar biasa kurier pengendalian bahan antara sel, nombor batal kurier pengendalian bahan intra sel dan penggunaan mesin, sel-sel berjumlah memuatkan variasi, kos operasi, dan memelihara kepelbagaian penyelesaian dalam Pareto kurier sepadan peningkatan dalam domain menjelajah prestasi dan hanyut mengelakkan digunakan. Keputusan-keputusan menunjukkan algoritma dicadangkan tentang menyelesaikan masalah-masalah averagely 22% lebih baik dalam soal mencari penyelesaian optimum munasabah bergantung pelbagai mengukur prestasi dalam 72.2% masa pengiraan daripada lain algoritma utama dianggap sebelumnya.

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