



UNIVERSITI PUTRA MALAYSIA

***DEVELOPMENT OF AN INTEGRATED MODEL FOR PRODUCTION PLANNING
AND CELL FORMATION IN CELLULAR MANUFACTURING SYSTEMS***

REZA RAMINFAR

FK 2010 31

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FOR PRODUCTION PLANNING AND CELL FORMATION IN
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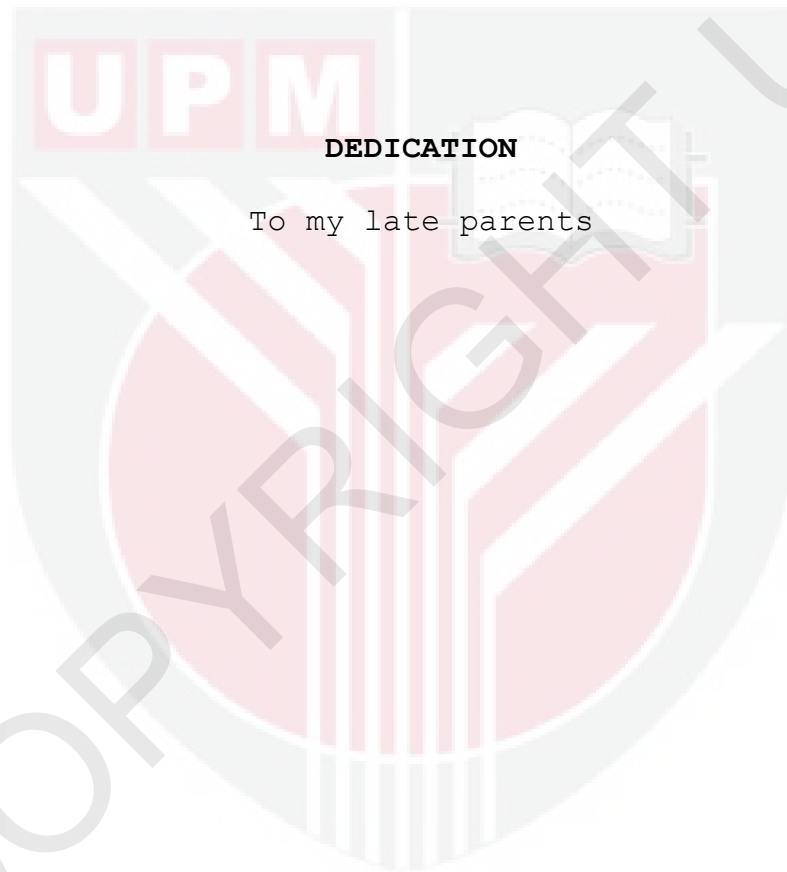


By

REZA RAMINFAR

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

March 2010



DEDICATION

To my late parents

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment
of the requirement for the degree of Master of Science

**DEVELOPMENT OF AN INTEGRATED MODEL
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REZA RAMINFAR

March 2010

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Faculty: Engineering

A cellular manufacturing system (CMS) is a manufacturing structure organized based on the group technology (GT) concept. CMS manufacturing system has many advantages compared to job shop or flow line manufacturing system. The design of CMS involves many structural and operational issues. One of the most important design steps is the formation of part families and machine cells or cell formation problem (CF), another problem is “how to determine the optimal quantities of different part-types” or in the other word production planning problem in CMS.

Over the last decades, many researchers have worked on CF problem and suggested many heuristic and mathematical algorithms to obtain the best results. On the other hand, various manufacturing production planning and inventory control problems have been studied by many production management researchers. However, only a few studies explicitly and simultaneously incorporate the CMS context, production planning and cell formation problem.

In this thesis, a mathematical programming model is developed using an integrated approach for production planning and CF problems in a CMS. This non-linear mixed integer mathematical model minimizes the inter-cell material handling (with respect to the different travel distances between cells), finished-goods inventory cost and machine set-up cost (considering the machine set up cost for every operation). This non-linear model is then converted to a linear model. Numbers of numerical examples are provided from existing literature to test and illustrate the proposed model. These examples are written with lingo codes in LINGO software. In order to evaluate and verify the performance of the proposed model, it is compared with a well-known cell formation method (Rank order clustering, ROC), using group capability index (GCI) measure. ROC method and GCI measure have been frequently used and suggested in previous literature. The results and comparisons between GCI measures of ROC method and proposed CF model in last two examples shows 23%, 50% improvement, which indicates that the proposed CF model has a higher and satisfactory performance. This also should be considered that the proposed model is more applicable while it takes into account the production planning problem too.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PEMBANGUNAN MODEL BERSEPADU UNTUK PERANCANGAN
PENGELUARAN DAN PEMBENTUKAN SEL DALAM SISTEM
PENGELUARAN SEL**

Oleh

REZA RAMINFAR

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Sistem sel pengeluaran (CMS) adalah sebuah struktur pengeluaran yang disusun berdasarkan kepada konsep teknologi kumpulan (GT). CMS mempunyai banyak kebaikan jika dibandingkan dengan 'job shop' atau sistem pengeluaran 'flowline'. Rekabentuk CMS melibatkan banyak isu-isu struktur dan operasi. Salah satu langkah rekabentuk yang paling penting adalah pembentukan bahagian utama dan sel enjin atau masalah pembentukan sel (CF), Masalah lain adalah "bagaimana untuk menentukan kuantiti optimum dari jenis bahagian yang berbeza" atau dengan kata lain perancangan pengeluaran masalah di CMS.

Sejak beberapa dekad kebelakangan ini, ramai penyelidik telah menghadapi masalah CF dan menyarankan banyak heuristic dan matematik algorithm untuk mendapatkan hasil yang terbaik. Selain daripada itu, pelbagai perancangan pengeluaran manufaktur dan masalah pengendalian persediaan masalah telah dikaji oleh para penyelidik pengurusan pengeluaran. Namun, hanya beberapa kajian secara jelas dan

secara serentak menggabungkan konteks CMS, perancangan pengeluaran dan masalah pembentukan sel.

Di dalam tesis ini, satu model pengaturcaraan matematik telah dibangunkan dengan menggunakan pendekatan berpadu untuk perancangan pengeluaran dan masalah CF dalam sebuah CMS. Model matematik campuran integer tidak lurus ini, meminimumkan pengelolaan bahan antara-sel (yang berkaitan dengan jarak perjalanan yang berbeza antara sel-sel), kos inventori produk siap dan kos penyediaan mesin (mengambil kira kos persediaan untuk setiap operasi). Model tidak lurus ini kemudian ditukar kepada model lurus. Beberapa contoh berangka diambil dari literatur sedia ada untuk menguji dan memberi gambaran model yang dicadangkan. Contoh-contoh tersebut ditulis dan diselesaikan menggunakan kod perisian LINGO. Untuk menilai dan mengesahkan prestasi model yang dicadangkan, ia dibandingkan dengan kaedah susunan pemangkatan bergugusan (Ranking order clustering, ROC), dengan menggunakan pengukuran indeks keupayaan berkumpulan (GCI). Kaedah ROC dan GCI sering digunakan dan dicadangkan dalam kajian literatur terdahulu. Keputusan dan perbandingan antara sukatan kaedah ROC bagi GCI dan cadangan model CF pada dua contoh terkini menunjukkan 23%, peningkatan 50%, yang menunjukkan bahawa model CF yang dicadangkan mempunyai prestasi yang lebih tinggi dan memuaskan. Ini juga harus dipertimbangkan bahawa model yang dicadangkan lebih relevan sambil mengira masalah perancangan pengeluaran juga.

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I certify that a Thesis Examination Committee has met on 17 March 2010 to conduct the final examination of Reza Raminfar on his Master of Science thesis entitled “Development of an integrated model for production planning and cell formation problem in cellular manufacturing systems” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the candidate be awarded the relevant degree.

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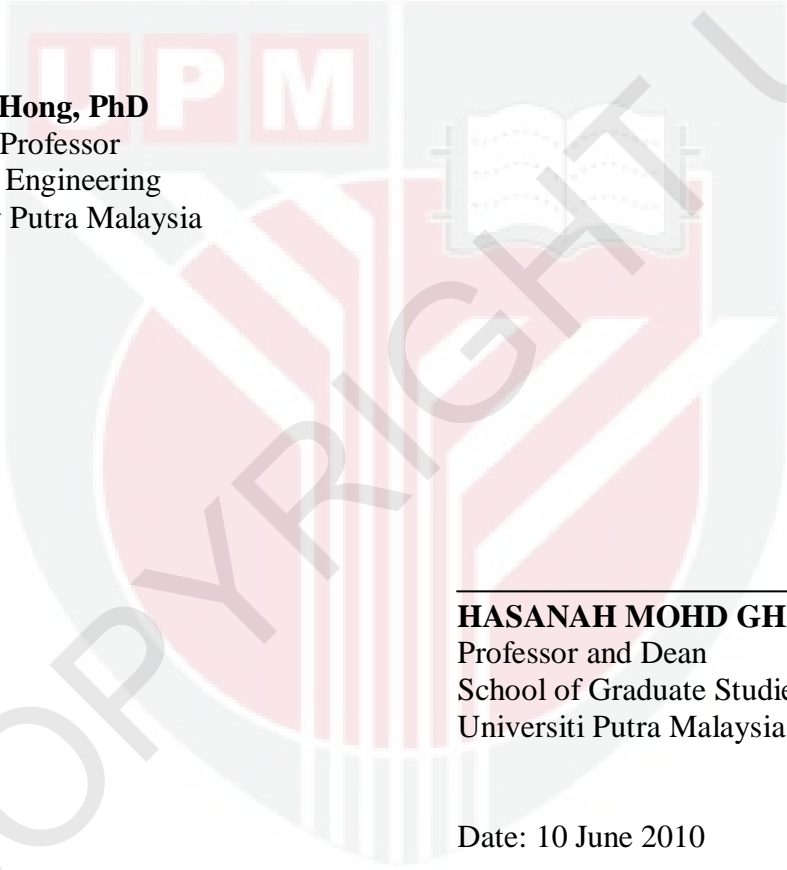
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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at University Putra Malaysia or at any other institution.



REZA RAMINFAR

Date: 20 March 2010

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