



إسراء الجامعة
Isra University

**Multi-Criterion Multi-Product/ Machine Assignment Problem in
Industrial Factories**

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**This Thesis is Submitted as Partial Fulfillment of the Requirements
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DEDICATION

This humble work is dedicated to my family, teachers, and friends. And to everyone who would need this work to refer to in his/her studying journey.

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ABSTRACT

Multi-criterion Assignment of Multi-product/machine Problem in Industrial Factories

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The problem of products-to-machines assignment (PMA) is an important concern in industrial factories, and may have a significant impact on the overall cost of the operations. In spite of the problem complications, a primarily approach is to consider suitable product-machine assignment. The importance of solving such a multi-products multi-machine assignment problem increases as the size of the production facility increase; as the problem becomes more complicated when the number of products and machines getting higher. Furthermore, many factors are included in calculating the cost of products add a tedious work. Therefore, dealing with such a problem for a certain case study requires a considerable working time.

In this thesis, an optimization approach is explored to solve the assignment of products in unrelated parallel machines' environment with an objective function to minimize the overall operation cost. The methodology is to modify the linear programming approach in solving the assignment problem. In addition, criteria affecting the operating cost are defined and transferred to a cost unit to prepare the input matrix for the assignment problem. In specific, the problem is solved using sequential arrangement and parallel arrangement methods.

A real case (a factory for plastic item's production) is studied to verify the proposed solution and to understand the practical side of the management problem. The initial results are discussed with the factory engineers and manager to validate the use of the optimal approach. The interviews' feedback is used to update the optimal solution. As an important result that can be announced is that the actual solution is only suboptimal. This is because incomplete conditions and work constraints are considered; this result indicates the necessity of mixing the prevailing manager rules with theoretical solution methods.

ARABIC ABSTRACT

مشكلة التخصيص متعدد المعايير للمنتجات\المكانن المتعددة في المعامل الصناعية

إعداد

علا رياض سلام

تعتبر مشكلة تخصيص المنتجات إلى الآلات قضية هامة في المعامل الصناعية، ومن الممكن أن تؤثر بشكل ملموس على التكلفة الإجمالية للعمليات التشغيلية. تزداد أهمية إيجاد حل لمشكلة تخصيص المنتجات إلى الآلات باستخدام طريقة منهجية بزيادة حجم المنشأة وزيادة عدد المنتجات والآلات، وبزيادة العوامل التي تؤثر على التكلفة التشغيلية، حيث تصبح عملية اتخاذ القرار أكثر صعوبة وذلك لزيادة معطيات المشكلة.

في هذا البحث، تم حل مشكلة تخصيص المنتجات إلى الآلات في بيئات الإنتاج التي تتضمن آلات متقابلة غير متماثلة وبهدف تقليل التكلفة الإجمالية المترتبة على تشغيل العمليات. تم حل المشكلة باستخدام خوارزمية مشكلة التخصيص وتم التعديل على طريقة الحل لتناسب مع معطيات المشكلة. تم حل المشكلة باستخدام طريقتي الترتيب التسلسلي والترتيب المتوازي.

للتحقق من الحل الذي تم التوصل إليه في هذا البحث، ولفهم الجانب العملي للمشكلة، تم تطبيق دراسة واقعية في مصنع لإنتاج المواد البلاستيكية، وتمت مناقشة النتائج الأولية التي تم الحصول عليها مع مهندس ومدير المصنع للتحقق من واقعية الحل. وتم استخدام الملاحظات لتعديل الحل والتوصل إلى حل يمكن قبوله عملياً من قبل إدارة المصنع. إحدى النتائج المهمة التي يجدر ذكرها، أن الحل الأمثل لم يتم قبوله من قبل إدارة المصنع بسبب محددات لم يتم اعتبارها من البداية، والحل المقبول هو حل بديل للحل الأمثل.

LIST OF CONTENTS

1	INTRODUCTION.....	1
1.1	PROBLEM STATEMENT AND RESEARCH MOTIVATION.....	1
1.2	RESEARCH OBJECTIVES	2
1.3	RESEARCH HYPOTHESIS.....	3
1.4	RESEARCH METHODOLOGY	3
1.5	RESEARCH CONTRIBUTION	4
1.6	THESIS STRUCTURE	5
2	LITERATURE REVIEW.....	6
2.1	INTRODUCTION.....	6
2.2	MOTIVATIONS FOR OPTIMIZATION IN INDUSTRIAL FACTORIES.....	7
2.3	TASK ASSIGNMENT PROBLEM	8
2.4	PRODUCTION SCHEDULING AND ASSIGNMENT	11
2.5	DEFINITION OF UNRELATED PARALLEL MACHINES	18
2.6	THE ASSIGNMENT PROBLEM.....	20
2.7	SUMMARY	24
3	RESEARCH METHODOLOGY.....	25
3.1	INTRODUCTION.....	25
3.2	PROBLEM STATEMENT	25
3.3	METHODOLOGICAL APPROACH.....	26
3.3.1	<i>Define the differences between variant non-identical machines.....</i>	<i>26</i>
3.3.2	<i>Derive the factors affecting the operating cost</i>	<i>32</i>
3.3.3	<i>Convert the deviation as cost factor.....</i>	<i>33</i>
3.3.4	<i>Data collection procedure.....</i>	<i>35</i>

3.4	ASSIGNMENT PROBLEM	37
3.4.1	<i>Assignment problem model</i>	38
3.4.2	<i>Unbalanced assignment problem</i>	38
4	DATA ANALYSIS AND RESULTS	46
4.1	INTRODUCTION.....	46
4.2	HYPOTHETICAL EXAMPLE OF ASSIGNMENT PROBLEM SOLUTION	46
4.3	A CASE STUDY- A FACTORY OF PLASTIC PRODUCTS	48
4.3.1	<i>Environment of the Production System in the Study Factory</i>	48
4.3.2	<i>Classification and Collection of Input Data</i>	49
4.4	RESULTS OF PRODUCTS-MACHINES ASSIGNMENT	55
4.4.1	<i>Current assignment</i>	55
4.4.2	<i>Sequential arrangement method</i>	56
4.4.3	<i>Parallel arrangement method</i>	57
4.4.4	<i>Comparison between the two solution</i>	58
4.4.5	<i>Capacity of machine to accommodate assigned products</i>	60
4.5	SENSITIVITY ANALYSIS.....	64
4.5.1	<i>Significance of the cost included in factor</i>	65
4.5.2	<i>Increment and decrement of total operating cost</i>	66
4.5.3	<i>Sensitivity of electrical cost</i>	68
4.5.4	<i>Sensitivity of labor factor</i>	70
4.5.5	<i>Rent cost</i>	74
5	CONCLUSIONS AND RECOMMENDATIONS.....	76
5.1	CONCLUSIONS	76
5.2	RECOMMENDATIONS	78

5.3 FUTURE WORK.....	79
5.3.1 <i>Products-machines assignment problem considering machines'</i> <i>depreciation and maintenance costs</i>	79
5.3.2 <i>Products-machines assignment problem considering machines'</i> <i>capacity and utilization as constraints</i>	79
5.3.3 <i>Multi-criterion assignment problem with mixed maximization and</i> <i>minimization objectives</i>	80

LIST OF FIGURES

FIGURE 2-1 PARALLEL MACHINES ENVIRONMENT (REFERENCE: SENTHIL ET AL., 2007)	
.....	19
FIGURE 3-1 OEE MEASUREMENT TOOL AND THE PERSPECTIVE IN PERFORMANCE	
INTEGRATED IN THE TOOL.....	30
FIGURE 4-1 COMPARISON BETWEEN THE TWO PROPOSED ASSIGNMENT METHODS	
COMPARING TO CURRENT SITUATION REGARDING THE NUMBER OF ASSIGNED	
PRODUCTS	59
FIGURE 4-2 COMPARISON BETWEEN THE TWO PROPOSED ASSIGNMENT METHODS AND	
CURRENT ASSIGNMENT REGARDING TOTAL OPERATING COST.....	59
FIGURE 4-3 THE CURVE OF ASSIGNMENT COST FOR FACTORS MULTIPLICATIVE	66

LIST OF TABLES

TABLE 3-1 TRANSFERRING PROBLEM'S FACTORS TO COST	33
TABLE 3-2 EXPLANATION OF TRANSFERRING FACTORS AS COST	34
TABLE 3-3 LIST OF PRODUCTS VERSUS MACHINES AND PRODUCTIONS POSSIBILITIES.....	36
TABLE 3-4 THE INITIAL MATRIX FOR THE ASSIGNMENT PROBLEM	37
TABLE 3-5 EXAMPLE OF INITIAL UNBALANCED ASSIGNMENT MATRIX.....	39
TABLE 3-6 EXAMPLE OF THE RESULTS OF ASSIGNMENT WITH DUMMY MACHINES.....	40
TABLE 3-7 ASSIGNMENT MATRIX OF THE SECOND ITERATION	41
TABLE 3-8 EXAMPLE OF INITIAL ASSIGNMENT MATRIX USING THE PARALLEL METHOD ..	42
TABLE 4-1 HYPOTHETICAL INITIAL ASSIGNMENT MATRIX.....	47
TABLE 4-2 RESULTS OF HYPOTHETICAL ASSIGNMENT PROBLEM USING SEQUENTIAL ARRANGEMENT AND PARALLEL ARRANGEMENT METHODS	48
TABLE 4-3 PRODUCTS-MACHINES MATRIX OF THE CASE STUDY FACTORY.....	50
TABLE 4-4 INITIAL DATA MATRIX FOR THE ASSIGNMENT PROBLEM.....	54
TABLE 4-5 PRODUCTS-MACHINES CURRENT ASSIGNMENT BY THE FACTORY	56
TABLE 4-6 ASSIGNMENT RESULTS USING SEQUENTIAL ARRANGEMENT METHOD	57
TABLE 4-7 ASSIGNMENT RESULTS USING PARALLEL ARRANGEMENT METHOD	58
TABLE 4-8 TOTAL OPERATING HOURS FOR PRODUCTS-PER-MACHINE AND TOTAL OPERATING HOURS PER EACH MACHINE	61
TABLE 4-9 FINAL ASSIGNMENT RESULT WITH MACHINES' AVAILABILITY OF FOUR TIMES	63
TABLE 4-10 SUMMARY OF THE OPTIMUM ASSIGNMENT COST THROUGH MULTIPLE ITERATIONS OF MACHINES' AVAILABILITY	64
TABLE 4-11 SUMMARY OF THE EFFECT OF PROBLEM COSTS IN CASE IF EACH COST IS DISABLED	65
TABLE 4-12 SENSITIVITY OF THE ASSIGNMENT WHEN CHANGING THE OVERALL COST	67

TABLE 4-13 SENSITIVITY OF THE ASSIGNMENT FOR CHANGING ELECTRICAL COST	69
TABLE 4-14 SENSITIVITY OF THE ASSIGNMENT FOR CHANGING THE ELECTRICAL CONSUMPTION FOR SOME MACHINES	70
TABLE 4-15 THE CHANGES IN THE ASSIGNMENT INPUT TO TEST THE SENSITIVITY FOR CHANGING NUMBER OF LABORS.....	71
TABLE 4-16 SENSITIVITY OF THE ASSIGNMENT FOR CHANGING NUMBER OF LABORS OPERATING THE MACHINE	72
TABLE 4-17 SENSITIVITY OF THE ASSIGNMENT FOR CHANGING LABOR COST	73
TABLE 4-18 SENSITIVITY OF THE ASSIGNMENT FOR CHANGING RENT COST	75

LIST OF ABBREVIATION

PMA: Products-machines Assignment

TAP: Task Assignment Problem

PMS: Parallel Machine Scheduling

AP: Assignment Problem

OEE: Overall Equipment Effectiveness

UPM: Unrelated Parallel Machines

UNB-AP: Unbalanced Assignment Problem

TPM: Total Preventive Maintenance

IMM: Injection Molding Machine