بسم اللّه الرحمن الرحيم

HOSSAM MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

HOSSAM MAGHRABY

شبكة المعلومات الجامعية

بعض الوثائق

الأصلية تالفة

HOSSAM MAGHRABY

بالرسالة صفحات

لم ترد بالأصل

HOSSAM MAGHRABY

Menoufia University
Faculty of Engineering
Department of Production Engineering and Mechanical Design

IMPACT OF MACHINE DUPLICATION ON PROCESS QUALITY IN MANUFACTURING SYSTEMS

A Thesis

Submitted in Partial Fulfillment of the Requirements for M. Sc. Degree in Engineering "Production Engineering"

By

Omayma Abdul-Aziz Nada

B. Sc. in Production Engineering and Mechanical Design

Supervised By

Dr. Mahmoud M. El-Khabery
M. M. ElKhaly
Associate Professor,
Dept. of Prod. Eng. & Mech. Des.,
Faculty of Engineering,
Menoufia University

Dr. Ahmed A. El-Sawi
A. Elsawy
Associate Professor,
Dept. of Basic Engineering Sciences, Faculty of Engineering,
Menoufia University

A. M. King
Hady Nasser

1999

Menoufia University
Faculty of Engineering
Department of Production Engineering and Mechanical Design

IMPACT OF MACHINE DUPLICATION ON PROCESS QUALITY IN MANUFACTURING SYSTEMS

A Thesis

Submitted in Partial Fulfillment of the Requirements for M. Sc. Degree in Engineering "Production Engineering"

By

Omayma Abdul-Aziz Nada

B. Sc. in Production Engineering and Mechanical Design

Approved By

Prof. Mohamed S. Ali Osman (M.O)
Professor of Operations Research and Vice Dean of Higher Technological Institute, Tenth of Ramadan City.

Prof. Adel M. Abdel Maaboud (Adel)
Professor, Department of Production Engineering and Mechanical Design, Faculty of Engineering, Menoufia University.

Dr. Mahmoud M. El-Khabery (M. M. Elkhaberi)
Associate Professor, Department of Production Engineering and Mechanical Design, Faculty of Engineering, Menoufia University.

Dr. Ahmed A. El-Sawi (A. Elsawy)
Associate Professor, Department of Basic Engineering Sciences, Faculty of Engineering, Menoufia University.

A. M. Kinawy

1999

A Hady Nasser

ACKNOWLEDGMENTS

The author is deeply grateful and indebted to **Dr. Mahmoud El-Khabery,** Associate Professor, Dept. of Production Engineering & Mechanical Design, Faculty of Engineering, Menoufia University and **Dr. Ahmed El-Sawi**, Associate Professor, Dept. of Basic Engineering Sciences, Faculty of Engineering, Menoufia University; her Advisory Committee, for their constant guidance, generous help and support during the preparation of this investigation. Their suggestions, encouragement and constructive criticism are greatly appreciated.

Thanks are also due to **Dr. Gamal S. Weheba**, Lecturer, Dept. of Production Engineering & Mechanical Design, Faculty of Engineering, Menoufia University for the initiation and suggestion the point of this research.

CONTENTS

NOMENCLATURE

Notations

Cd_j costs per period to operate equipments in a duplicated work station j.

CL_j costs per period to operate equipments in a work station j in the serial line.

C_{pm} process capability index.

CT_{max} theoretical maximum permissible cycle time.

CT_{min} theoretical minimum value of cycle time for serial line.

d task which must succeed all other tasks.

E_i earliest station for task i.

I set of tasks, $\mathbf{I} = \{1,2,\ldots, i, \ldots, M\}$.

J set of work stations ,$\mathbf{J} = \{1,2,\ldots, j, \ldots, N_{max}\}$.

k quality loss coefficient.

L_i latest station for task i.

M number of tasks.

m target value of the quality characteristic .

N number of serial work stations.

N_{max} theoretical maximum number of serial work stations.

OC operating cost per period for all stations.

p(i) set of all predecessors of task i.

Q average quality loss per period.

QL_a sum of losses of assembled product individual tasks.

q quality characteristic of interest of an item of the final product .

q_i quality characteristic of interest of task i .

s(i) set of all successors of task i .

t_i processing time of task i .

X_{ij} zero-one decision variable, equals 1 if task i is assigned to station j and equals 0 otherwise, $\forall$ $\mathbf{i} \in \mathbf{I}$, $\mathbf{j} \in \mathbf{J}$.

Y_j zero-one decision variable, equals 1 if station j is duplicated and equals 0 otherwise, $\forall$ $\mathbf{j} \in \mathbf{J}$.

Δ_0 customer semi-tolerance.

μ process mean.

σ^2 process variance.

Abbreviations

ALB Assembly Line Balancing

ALBP-1 Assembly Line Balancing Problem type-1

ALBP-2 Assembly Line Balancing Problem type-2

NP Nondeterminstic Polynomial

UALBP U-shaped ALB Problem

ULINO U-Line Optimizer

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The decision of duplicating work stations in assembly line balancing (ALB) problems is traditionally made based on production rates and economics of operations. However, duplicating production facilities is considered to be a source of variability that affects the process quality. Hence, the product quality requirements and the cost incurred due to variation in the output quality should be considered while making such a decision.

In this research, a single-model, deterministic ALB problem type-1, with the option of duplicating work stations is considered. The problem is formulated as a zero-one integer programming model with the objective of minimizing the cost per period associated with operating stations. This cost may include labor, overhead, maintenance and fixed cost of the capital investment of the equipment over its expected service life. To incorporate the quality considerations of the final assembled product while solving the problem and making duplication decisions, the concept of quality loss is applied on the final assembled product. Taguchi's quadratic loss function is used to estimate the monetary loss incurred due to deviation of product quality characteristic from its target value. The average quality loss of the final assembled product is incorporated into the objective function. This leads to the development of a quadratic zero-one integer programming model. The developed model is linearized and an illustrative problem from published literature is considered for model verification.

The results indicate that the developed model can effectively handle the considered ALB problem. Moreover any computer program for solving