



UNIVERSITI PUTRA MALAYSIA

**IMPLEMENTATION OF ADVANCED MANUFACTURING
TECHNOLOGIES (AMTs) IN THE SMALL AND
MEDIUM SCALE INDUSTRIES (SMIs) OF MALAYSIA**

ROSNAH MOHD. YUSUFF

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(AMTs) IN THE SMALL AND MEDIUM SCALE INDUSTRIES (SMIs) OF
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By

ROSNAH MOHD. YUSUFF

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

July 2002



DEDICATION

To my beloved parents, May ALLAH bless their souls

To my dear husband for his support and encouragement

**To my children, Muhammad, Amal, Hasiefah, Naqiyah, Nuha and Ahmad, for all
the laughter, joy and tears without which, surely life is an endless bore, and**

To those that stood against tyranny, and fight for justice and truth

MAY ALLAH BLESS US ALL AND GUIDE US IN HIS PATH

AMEEN



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

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(AMTs) IN THE SMALL AND MEDIUM SCALE INDUSTRIES (SMIs) OF
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July 2002

Chairman: Assoc. Professor Shamsuddin Sulaiman, Ph.D.

Faculty : Engineering

The implementation of advanced manufacturing technology (AMT) has been known to increase the competitiveness of manufacturing firms. For the small and medium scale industries (SMIs), the implementation of AMT is necessary to face the challenges of globalization and to ensure their future survival. However, studies have shown that the full potential of AMT can only be realized if certain requirements are in place before embarking on AMT implementation. The competitive benefits can be fully acquired if there is alignment between the technology and organization. Thus, the implementation of AMT requires not only technological change, but also supported by operational and organizational change.



This study evaluates the ability and capabilities of the Malaysian SMIs to implement AMT successfully. The current level of technology, the organizational and managerial capabilities of the SMIs were investigated to determine the extent of 'alignment' or 'misalignment' between technology and organization. By identifying the gap of the 'misalignment', the necessary steps can be taken to close this gap.

A survey questionnaire was developed to meet the objectives of the study. A total of 1182 companies were included in the sample, and only 136 (~12%) companies responded. The results were analysed using the Statistical package for Social Science (SPSS) for mean values, percentages and correlation coefficients. To determine the 'gap' between technology and organization, a regression analysis was conducted to find the 'best fit curve'.

The results showed that among the AMTs implemented, CAD and PLC were the most commonly used and adopted by about 25% of the companies. Other AMTs were used by less than 25% of the companies. It was found that, overall, the business techniques have greater emphasis compared to the engineering and manufacturing techniques, especially for the AMT that are in place and in progress. The companies showed a greater tendency for software based AMTs. The technologies implemented can be classified as 'stand alone' or level one AMT against the level four or fully integrated systems signified by the least common technologies implemented. Computer controlled equipment is hardly used and integration of functions through computer systems is very low. The companies showed a higher usage of computers for the business functions rather than in production.

Based on the level of organization and technology of the industries, a Technology – Organization (T-O) map was developed. The fourth polynomial regression was found to give the best curve fit with a R^2 value of 0.38766, for all industries, indicating that there is a lack of fit between technology and organization. The curve traced by the regression analysis is used to identify the paths taken by the industries and the stages of AMT implementation. The metal-based and furniture industries showed that they are following the O-path, indicating that they can implement more technologies, and the electronic industries, which is inclined towards the T-path, should implement more organizational changes to achieve a better fit between the organization and technology.

The success of AMT implementation requires mutual adaptation between organization and technology. The survey results showed that the organizational structure and managerial capabilities of the industries are not adequate for AMT implementation even at the current level of technology, especially in the electronics industries. The lack of an organic structure, understanding of the technologies, level of skilled workers and engineers and the culture of the industries are among the factors that will hinder the SMIs from achieving the full benefits of AMT. Thus, the opportunities that these technologies have to offer cannot be capitalized and exploited. This ‘lack of fit’ between organization and technology need to be addressed before future investments in AMT are carried out.

This study has provided an insight on the AMT implementation capabilities of the SMIs in Malaysia by evaluating the current conditions as compared to the requirements of successful AMT implementation. It has provided us with the knowledge of the current situation, the paths and factors to be considered by the SMIs to ensure that the implementation of AMTs will achieve the full benefits. Further work in this area should consider conducting case studies, which will enrich the information process and guidelines to be developed for specific AMT implementation. Studies on performance measures for organization-inclined companies and technology-inclined companies will also help in determining the appropriate paths to be taken by the SMIs.



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

**PERLAKSANAAN TEKNOLOGI PEMBUATAN TERMAJU (TPT) DI DALAM
INDUSTRI KECIL DAN SEDERHANA (IKS) DI MALAYSIA**

Oleh

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Kajian telah menunjukkan bahawa pelaksanaan teknologi pembuatan termaju (TPT) dapat meningkatkan daya saing sesebuah syarikat. Bagi industri kecil dan sederhana, pelaksanaan TPT adalah penting untuk menghadapi cabaran globalisasi dan memastikan kewujudan syarikat masa hadapan.. Walau bagaimanapun pelaksanaan TPT memerlukan persediaan yang tersusun yang boleh menjamin kejayaan pelaksanaan itu. Keperluan ini mesti disediakan lebih awal sebelum TPT dilaksanakan.

Kajian ini menilai kemampuan IKS dalam melaksanakan TPT. Keadaan dalam IKS sekarang dinilai untuk mengukur sejauh mana IKS perlu diperbaiki dari segi tahap teknologi, struktur organisasi dan kemampuan pengurusan menampung pelaksanaan TPT. Kajian ini dijalankan dengan mengguna soal selidik. Sebanyak 1182 syarikat telah dijadikan sample populasi kajian. Hanya 136 (12%) syarikat telah mengambil bahagian



dalam kajian ini. Hasil soal selidik telah dianalisis dengan menggunakan pakej SPSS untuk mencari min, peratus dan pekali korelasi. Analisis regresi telah dijalankan untuk mencari 'curve-fit' yang terbaik antara indeks organisasi dan teknologi.

Hasil kajian menunjukkan tiada satu TPT yang digunakan lebih dari 25% syarikat kecuali rekabentuk terbantu komputer (CAD (25.4%)) dan PLC (25%). Kajian menunjukkan TPT yang lebih digunakan adalah teknik perniagaan berbanding dengan teknik kejuruteraan dan pembuatan terutamanya untuk teknologi yang sedia ada dan sedang dijalankan.. Syarikat menunjukkan kecenderungan menggunakan teknologi TPT berasaskan software. Teknologi yang dilaksanakan boleh diklasifikasikan sebagai sistem 'stand-alone', atau TPT aras satu berbanding dengan aras empat atau sistem integrasi sepenuhnya. Kajian juga mendapati integrasi fungsi melalui komputer adalah rendah dan kebanyakan integrasi berlaku dalam fungsi perniagaan dan tidak pada pengeluaran.

Berdasarkan tahap teknologi dan organisasi, satu peta Teknologi-Organisasi(T-O) telah dibangunkan untuk syarikat-syarikat yang mengambil bahagian dalam soal selidik ini. Satu persamaan regresi polynomial kuasa empat antara O dan T menghasilkan nilai $R^2 = 0.38766$. Ini menunjukkan kurang keserasian antara organisasi dan teknologi yang akan menyebabkan kejayaan TPT terbatas. Persamaan regresi ini juga memberi gambaran kecenderungan atau arahnya industri sekarang dan juga tahap teknologi. Untuk industri berasaskan logam dan kayu/perabot, oleh kerana lebih cenderung kepada laluan O, ianya boleh meningkatkan teknologi, manakala untuk industri elektronik, ianya perlu meningkatkan kemampuan organisasi untuk mengimbangi antara O dan T. Perkara ini

penting untuk menentukan halatuju sesebuah syarikat kerana keputusan untuk melabur dalam TPT perlu melihat pada keadaan sekarang.

Kejayaan pelaksanaan TPT bergantung pada adaptasi antara organisasi dan teknologi. Hasil kajian menunjukkan bahawa struktur organisasi dan kemampuan pengurusan pada industri tersebut tidak memadai untuk pelaksanaan TPT, terutamasekali dalam industri elektronik. Tanpa struktur oraganisasi yang anjal, kefahaman teknologi, dan tahap pekerja mahir dan jurutera dalam syarikat serta budaya dalam industri adalah antara factor-faktor yang akan menghalang pencapaian optimum TPT. Pelaburan terhadap TPT dalam keadaan ini tidak menjamin syarikat dapat meningkat daya saingnya. Peluang-peluang yang lebih luas daripada TPT juga tidak dapat diterokai.

Kajian ini telah menilai kemampuan IKS melaksanakan TPT dengan membanding sejauhmana perbezaan keadaan yang ada dalam IKS sekarang dan keperluan untuk melaksana TPT dengan berjaya. Dengan mengetahui keadaan IKS sekarang dan arahuju IKS dan mengenalpasti faktor faktor yang perlu diambilkira, diharap pelaksanaan TPT akan lebih berjaya. Diharap kajian masa depan akan mempertimbangkan kajian kes-kes kerana ini akan member maklumat yang lebih terperinci dan membolehkan satu panduan dibina untuk TPT tertentu. Kajian juga perlu dibuat untuk mengukur tahap kejayaan yang dicapai oleh industri yang menjurus kepada organisasi dan menjurus kepada teknologi Ini dapat lagi membantu menentukan arahuju yang sesuai untuk sesebuah industri.

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I certify that an Examination Committee met on 19th July 2002 to conduct the final examination of Rosnah Mohd. Yusuff on her Doctor of Philosophy thesis entitled "Implementation of Advanced Manufacturing Technologies (AMTs) in the Small and Medium Scale Industries (SMIs) of Malaysia" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.


ROSNAH MOHD. YUSUFF

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LIST OF ABBREVIATIONS

AGV	Automated Guided Vehicle
AHMD	Automated Material Handling Devices
AHMS	Automated Material Handling System
AID	Automated Identification
AIN	Automatic Inspection
AITE	Automated Inspection & Testing Equipment
AITS	Automated Inspection & Testing System
AMS	Advanced Manufacturing System
AMT	Advanced Manufacturing Technology
ASRS	Automated Storage & Retrieval System
B	Balanced
BPMP	Malaysian Development Bank
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
CAP	Computer Aided Process
CAPP	Computer Aided Process Planning
CEO	Chief Executive Officer
CGC	Credit Guarantee Corporation
CHIM	Computer Human Integrated Engineering
CIE	Computer Integrated Enterprise
CIM	Computer Integrated Manufacturing
CNC	Computer Numerical Control Machines
DNC	Direct Numerical Control Machines
EDM	Engineering Data Management
FMC	Flexible Manufacturing Cell

FMM	Federation Manufacturer
FMS	Flexible Manufacturing System
GDP	Gross Domestic Product
GT	Group Technology
HIM	Human Integrated Manufacturing
HRD	Human Resource Development
ICA	Industrial Coordination Act
IMP	Industrial Master Plan
IMS	Integrative & Managerial System
ITJM	International Journal of Management
JIT	Just In Time.
LAN	Local Area Network
MEDEC	Malaysian Entrepreneurship Development Centre
MIDA	Malaysian Industrial Development Authority
MITI	Ministry of International Trade & Industry
MNC	Multi National Corporation
MP	Malaysian Plan
MRP	Material Requirements Planning
MRP II	Manufacturing Resources Planning
MWL	Material Working Lasers
NC	Numerical Controlled
NCMT	Numerical Control Machining Technology
NIC	Newly Industrial Countries
NIE	Newly Industrialised Economies
NPC	National Productivity Centre
O	Organisational
OPP	Outline Perspective Plan
PBR	Pick & Place Robots
PLC	Programmable Logic Controller
PPIC	Production Planning / Inventory Management Software

QCC	Quality Control Circle
R&D	Research & Development
ROB	Other Robots
SBA	Small Business Administration
SDS	System, Devices & Stations
SED	Small Scale Enterprise Division
SIRIM	Standard & Industrial Research Institute of Malaysia
SME	Small & Medium Enterprises
SMI	Small & Medium Industries
SMIDEC	Small & Medium Scale Industries Development Corporation
SPC	Statistical Process Control
SPCS	Shop Floor Control System
SPSS	Statistical Package for Social Science
T	Technological
TBC	Time Based Competition
TQM	Total Quality Management
UK	United Kingdom
UKM	Universiti Kebangsaan Malaysia
USA	United States of America
WIP	Work In Progress



CHAPTER I

INTRODUCTION

1.1 Project Background

The SMIs play an important role in the development of a country. The entrepreneurial spirit that drives the small and medium scale industries must be encouraged and fostered because the economic well being of many countries depends on it. The small and medium-sized business of today can be the multinationals of tomorrow. The SMIs form the majority of enterprises in developed countries and they are also regarded as the engine of growth in the Newly Industrialized Economies (NIEs). Thus, proper support and creating a positive climate will ensure that small and medium sized businesses can develop their niche markets and become world players.

As one of the fastest developing country in the world, Malaysia has switched over its development strategies from an agriculture base economy to industrialization. It now has a more diversified economic structure, one based on manufacturing industries and guided by private-sector investment. Although large firms, particularly Multi-National corporation (MNC) dominate Malaysia's manufacturing sector in terms of output, investment outlay, technical know-how and employment generation, it is well recognized that the success of the efforts to accelerate and deepen the industrial base require a comprehensive and integrated approach for promotion and development of SMIs (Md. Salleh, 1990).

