## Faculty of Technology Management and Technopreneurship

# FACTORS INFLUENCING IMPLEMENTATION OF ADVANCED MANUFACTURING TECHNOLOGY IN MALAYSIAN AND INDONESIAN SMALL AND MEDIUM ENTERPRISES

**Jani Rahardjo**

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# FACTORS INFLUENCING IMPLEMENTATION OF ADVANCED MANUFACTURING TECHNOLOGY IN MALAYSIAN AND INDONESIAN SMALL AND MEDIUM ENTERPRISES

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**A thesis submitted**
**in fulfillment of the requirements for the degree of Doctor of Philosophy**

**Faculty of Technology Management and Technopreneurship**

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## DECLARATION

I declare that this thesis entitled "Factors Influencing Implementation of Advanced Manufacturing Technology in Malaysian and Indonesian Small Medium Enterprises" is the result of my own research except as cited in the references. This thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : Jani Rahardjo

Date : May 2015

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## APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Doctor of Philosophy

Signature :

Supervisor Name : Prof. Dr. Salleh Bin Yahya

Date : May 2015

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## DEDICATION

I would like to dedicate this dissertation to my family and my parents in peace. There is no doubt that without their continual support and counsel I would not have completed this piece of work.

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## ABSTRACT

Small and Medium Enterprises (SME) play a vital role in boosting a country's economic development. While a huge number of SME have been founded, the total contribution to the Gross Domestic Product (GDP) is considered to be small compared to the contribution of large companies. In this sense, one way to boost competitiveness is through implementing Advanced Manufacturing Technology (AMT); whereas large companies have no issue in implementing it, it is not the case for SME. This study then examined the prospect of implementing AMT in Malaysian and Indonesian SME. Structural Equation Modeling was arranged for analyzing variables covering Critical Success Factors (CSF), Obstacles, Organizational Characteristics, Strategic Alliances and Monitoring in every stage of the implementation. An approximately 535 samples of data used in this study were SME in food, herbs, and craft industry in Malaysia and Indonesia. Smart Path Least Square (PLS) was used to analyze the model. In conclusion, it was found that the AMT implementation had a significant impact on the performance of Malaysian SME but it did not have any significant impact on the performance of Indonesian SME. This might be due to the fact that AMT implementation in Indonesian SME was generally low. Also, Indonesian SME used hard AMT more than soft AMT. The hard AMT was used as the substitution for labor functions such that AMT has not been optimized the support from soft AMT. Nest, the factors that gave significant impacts on the AMT implementation were Strategic Alliances, Monitoring, and Critical Success Factors while the others, namely Obstacles and Organizational Characteristics, gave no significant impact on the AMT implementation. For the Malaysian SME, good leadership was the critical success factor for the AMT implementation, while for Indonesian SME it was organizational culture. Several Strategic alliances significantly affected the success of AMT implementation; they were strategy alliances with vendors, universities and government for Malaysian SME, and strategic alliances with vendors, customers, and government for the Indonesian SME. Monitoring also gave a significant impact on the success of AMT implementation, especially monitoring in humanware for AMT implementation in Malaysian SME and monitoring in technoware for AMT implementation in Indonesian SME. The strategic alliances had a particularly different level and priority in every stage of the AMT implementation. At the early stage of AMT implementation, Malaysian SME needed to make an alliance with university, while the Indonesian SME needed to make an alliance with vendor. At the installation phase, Malaysian and Indonesian SME needed to collaborate with vendors and the government. Furthermore, at the growth stage, Malaysian SME needed to make an alliance with the university, while the Indonesian SME needed to make an alliance with the government. Monitoring of the AMT implementation in every stage was different for both Malaysian and Indonesian SME. For Malaysian SME, monitoring at the pre-installation and installation stage was mainly important on orgaware and humanware, while monitoring at the growth stage was on orgaware. For Indonesian SME, monitoring every stage was relatively at the same level, which was mainly on technoware. This research then gave Malaysian and Indonesian SME new insights into the implementation of AMT. In short, to be successful in


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implementing AMT as an attempt to boost SME's performance, SME should take into account the strategic alliances and monitoring factors.

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# ABSTRAK

Industri Kecil dan Sederhana (IKS) memainkan peranan penting dalam menjana pembangunan ekonomi sesebuah negara. Walaupun sebahagian besar IKS telah ditubuhkan, namun begitu jumlah sumbangannya kepada Keluaran Dalam Negara Kasar (KDNK) masih dianggap kecil jika dibandingkan dengan syarikat- syarikat besar. Oleh yang demikian, salah satu cara untuk meningkatkan daya saing IKS adalah melalui dengan melaksanakan Teknologi Pembuatan Termaju (AMT). Kajian ini seterusnya menilai prospek dalam melaksanakan AMT bagi IKS di Malaysia dan Indonesia. Kaedahnya ialah menggunakan Permodalan Persamaan Struktural (SEM) untuk menganalisisa pembolehubah-pembolehubah yang merangkumi Faktor Kejayaan Kritikal (CSF), hambatan, ciri- ciri organisasi, pakatan strategik dan pemantauan di setiap peringkat pelaksanaan dengan menggunakan analisisa model jalur majmuk terkurang (PLS). Kira-kira 535 sampel data digunakan dalam kajian ini melibatkan IKS dalam sektor makanan, herba dan kraftangan di Malaysia dan Indonesia. Kesimpulannya ialah didapati melalui pelaksanaan AMT ini, ia telah memberi kesan yang ketara terhadap prestasi IKS di Malaysia, tetapi tidak di IKS Indonesia. Secara faktanya, ini mungkin disebabkan oleh pelaksanaan AMT di IKS Indonesia adalah rendah berbanding di Malaysia. Selain itu, IKS Indonesia juga lebih kepada pendekatan AMT keras daripada lembut. Secara terperincinya adalah pelaksanaan AMT tidak dioptimumkan daripada sokongan AMT lembut tetapi hanyalah kepada AMT keras contohnya, penggantian fungsi buruh. Seterusnya, didapati juga bahawa faktor-faktor yang memberi kesan yang ketara ke atas pelaksanaan AMT ini adalah seperti kerjasama yang strategik, pemantauan dan faktor kejayaan kritikal manakala hambatan dan ciri- ciri organisasi tidak memberi sebarang kesan - ke atas pelaksanaan ini. Kepimpinan yang baik adalah faktor kejayaan kritikal bagi pelaksanaan AMT di IKS Malaysia manakala budaya organisasi adalah penyumbang bagi IKS Indonesia. Selain itu, beberapa bentuk kerjasama strategik telah memberi kesan yang ketara kepada kejayaan pelaksanaan AMT. Contohnya di Malaysia adalah melalui kerjasama strategik dengan pembekal, universiti dan kerajaan manakala di Indonesia ianya adalah melalui kerjasama strategik dengan pembekal, pelanggan dan kerajaan. Faktor pemantauan juga memberi kesan yang ketara kepada kejayaan pelaksanaan AMT, terutamanya ke atas '*humanware*' di UKM Malaysia dan '*technoware*' di UKM Indonesia. Secara dasarnya, didapati bahawa kerjasama strategik memiliki tahap yang sangat berbeza dan keutamaan di setiap peringkat pelaksanaan AMT. Di awal pelaksanaan AMT, IKS di Malaysia memerlukan kerjasama dengan universiti, sedangkan IKS di Indonesia memerlukan kerjasama dengan pembekal. Pada fasa pemasangan, IKS di Malaysia dan Indonesia memerlukan kerjasama dengan pembekal dan kerajaan manakala di peringkat pertumbuhan, IKS di Malaysia memerlukan kerjasama dengan universiti, sedangkan di Indonesia bekerjasama dengan kerajaan. Lanjutan itu, didapati bahawa pemantauan pelaksaan AMT di setiap peringkat adalah berbeza untuk kedua- dua IKS, samada di Malaysia mahupun di Indonesia. Bagi IKS di Malaysia, pemantauan di peringkat pra-pemasangan dan pemasangan terutamanyapada '*orgaware*' dan '*humanware*', manakala di Indonesia melibatkan pertumbuhan '*orgaware*' sahaja. Bagi

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UKM Indonesia, pemantauan di setiap peringkat lebih kurang sama, melibatkan *'technoware'*. Hasil kajian ini telah memberikan senario baru dalam pelaksanaan IKS di Malaysia dan Indonesia, selain dapat merumuskan bahawa kerjasama strategik dan faktor-faktor pemantauan adalah penentu kejayaan kepada pelaksanaan AMT di IKS.

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## TABLE OF CONTENT


| | | PAGE |
|---|---|---|
| **DECLARATION** | | |
| **APPROVAL** | | |
| **DEDICATION** | | |
| **ABSTRACT** | | **i** |
| **ABSTRAK** | | **iii** |
| **ACKNOWLEDGEMENT** | | **v** |
| **TABLE OF CONTENT** | | **vi** |
| **LIST OF ABBREVIATION** | | **x** |
| **LIST OF TABLES** | | **xii** |
| **LIST OF FIGURE** | | **xviii** |
| **CHAPTER** | | |
| **1.** | **INTRODUCTION** | **1** |
| 1.1 | Background | 1 |
| 1.2 | Problem Statement | 10 |
| 1.3 | Research Questions | 11 |
| 1.4 | Research Objective | 12 |
| 1.5 | Contribution of The Research | 13 |
| 1.6 | Key Concept | 13 |
| 1.6.1 | Definition of AMT | 13 |
| 1.6.2 | Influencing Factors | 14 |
| 1.6.3 | Definition of Malaysian And Indonesian SME | 14 |
| 1.7 | Layout of The Thesis | 14 |
| **2.** | **LITERATURE REVIEW** | **16** |
| 2.1 | Advanced Manufacturing Technology (AMT) | 16 |
| 2.2 | AMT Implementation Process | 19 |
| 2.2.1 | Organizational Characteristic | 24 |
| 2.2.2 | Critical Success Factors | 26 |
| 2.2.3 | Obstacles | 27 |
| 2.2.4 | Strategic Alliance | 28 |
| 2.2.5 | Monitoring | 31 |
| 2.3 | Performance | 33 |
| 2.4 | Previous Research in AMT | 34 |
| 2.5 | Resource Based View (RBV) | 36 |
| 2.6 | Small Medium Enterprises (SME) | 41 |
| **3.** | **THEORETICAL FRAMEWORK AND HYPHOTHESES** | **52** |
| 3.1 | Theoretical Framework | 52 |
| 3.2 | Relationship among Variables and Hyphoteses | 55 |
| 3.2.1 | Impact of AMT Implementation to Performance | 55 |
| 3.2.2 | Relationship Between Organizational Characteristics and AMT Implementation | 57 |
| 3.2.3 | Relationship Between Critical Success Factors And AMT Implementation | 58 |
| 3.2.4 | Relationship Between Obstacles And AMT Implementation | 59 |


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3.2.5 Effect Of Strategic Alliances To The AMT Implementation 59
3.2.6 Effect Of Monitoring To The Success Of AMT Implementation 60
3.2.7 The Differences Of Strategic Alliances In Every Stage Of AMT Implementation 61
3.2.8 The Differences Of Monitoring In Every Stage Of AMT Implementation 61
3.3 Definition Of Operational Variables 62
3.3.1 Definition Of Operational AMT Implementation (X1) 62
3.3.2 Operational Definition Of Performance (X2) 62
3.3.3 Operational Definition Of Organizational Characteristics (X3) 62
3.3.4 Operational Definition Of Critical Success Factors (X4) 63
3.3.5 Operational Definition Of Obstacles (X5) 63
3.3.6 Operational Definition Of Alliances (X6) 63
3.3.7 Operational Definition Of Monitoring (X7) 63
3.4 Measurement Of Variables 63
3.4.1 Measurement Of AMT Implementation 64
3.4.2 Measurement Of Performance 64
3.4.3 Measurement Of Organizational Characteristics 66
3.4.4 Measurement Of Critical Success Factors 66
3.4.5 Measurement Of Obstacles 67
3.4.6 Measurement Of Alliances 67
3.4.7 Measurement Of Monitoring 68
3.5 Chapter Summary 68

**4. RESEARCH METHODOLOGY 70**
4.1 Research Design 70
4.1.1 Purpose Of The Study 70
4.1.2 Type Of Research 71
4.1.3 Research Area And Time Horizon 71
4.1.4 Unit Of Analysis 71
4.1.5 Sampling Design 72
4.1.6 Data Collection Methods 75
4.2 Data Analysis Methods 77
4.2.1 Validity And Reliability Test 77
4.2.2 Descriptive Analysis 78
4.2.3 Hypothesis Testing 78
4.2.4 Factor Analysis 80
4.2.5 Structural Equation Modeling (SEM) 82
4.3 Chapter Summary 89

**5. MALAYSIAN SME IN THE FOOD, HERBS AND CRAFT INDUSTRY DATA ANALYSIS 91**
5.1 Reliability And Validity Test 91
5.2 Respondents Profile 91
5.3 AMT Implementation 93
5.3.1 AMT Technique 93
5.3.2 Impact Of AMT On Sales Turnover Growth, Profitability And Organization Performance 100

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5.3.3 AMT Implementation 107
5.4. Structural Equation Modeling (SEM) For AMT Implementation 125
5.5 Hypothesis Testing 147
5.5.1 Impact Of AMT Implementation To Performance 147
5.5.2 Relationship Between Organization And AMT Implementation 149
5.5.3 Relationship Between Critical Success Factor And AMT Implementation 150
5.5.4 Relationship Between Obstacles And AMT Implementation 152
5.5.5 Effect Of Strategic Alliances To The AMT Implementation. 154
5.5.6 Effect Of Monitoring To The Success Of AMT Implementation 155
5.5.7 The Differences Of Strategic Alliances In Every Stage Of AMT Implementation. 157
5.5.8 The Different Monitoring In Every Stage Of AMT Implementation 158
5.6 Chapter Summary 159

**6. INDONESIAN SME IN THE FOOD, HERBS AND CRAFT INDUSTRY DATA ANALYSIS 164**
6.1 Reliability And Validity Test 164
6.2 Respondent Profile 164
6.3 AMT Application 167
6.3.1 AMT Technique 167
6.3.2 Impact Of AMT On Sales Turnover Growth, Profitability And Organizational Performance 173
6.3.3 AMT Implementation 180
6.4 Structural Equation Modeling (Sem) For AMT Implementation 195
6.5 Hypothesis Testing 218
6.5.1 Impact Of AMT Implementation To The Performance 218
6.5.2 Relationship Between Organization And AMT Implementation 220
6.5.3 Relationship Between Critical Success Factor And AMT Implementation 221
6.5.4 Relationship Between Obstacles And AMT Implementation 222
6.5.5. Effect Of Strategic Alliances To The AMT Implementation 222
6.5.6 Effect Of Monitoring On The Success Of AMT Implementation 224
6.5.7 Different Strategy Alliances In Every Stage Of AMT Implementation 225
6.5.8 Different Monitoring Level In Every Stage Of AMT Implementation 226
6.6 Chapter Summary 227

**7. COMPARISON AND DISCUSSION 230**
7.1 AMT Implementation Model In Malaysian And Indonesian SME 230

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7.1.1 Effect Analysis Of AMT Implementation To Performance 232
7.1.2 Effect Analysis Of Organizational Characteristics To AMT Implementation 238
7.1.3 Effect Analysis Of Critical Success Factors (CSF) To AMT Implementation 240
7.1.4 Effect Analysis Of Obstacles In AMT Implementation 241
7.1.5 Effect Analysis Of Strategic Alliances To AMT Implementation 242
7.1.6 Effect Analysis Of Monitoring To AMT Implementation 244
7.1.7 Differences Analysis Of Strategic Alliances In Every Stage Of AMT Implementation 245
7.1.8 Differences Analysis Of Monitoring In Every Stage Of AMT Implementation 246
7.2 Discussion 247
7.3 Chapter Summary 250

**8. SUMMARY AND CONCLUSION 251**
8.1 Summary 251
8.2 Conclusion 252
8.3 Implication For Small Medium Enterprises 254
8.4 Contribution To The Body Of Knowledge 256
8.5 Limitation And Direction For Future Research 256

**REFERENCES 258**
**APPENDICES 273**

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## LIST OF ABBREVIATION

| | |
|---|---|
| ABC | : Activity Based Costing |
| AMT | : Advanced Manufacturing Technology |
| ANOVA | : Analysis of Variance |
| AVE | : Average Variance Extracted |
| BC | : Bar Coding |
| BSR | : Buyer-Supplier Relationship |
| CAD | : Computer Aided Design |
| CAE | : Computer Aided Engineering |
| CAM | : Computer Aided Manufacturing |
| CAPP | : Computer Aided Process Planning |
| CB-SEM | : Covariant Based Structural Equation Modelling |
| CFA | : Confirmatory Factor Analysis |
| CIM | : Computer Integrated Manufacturing |
| CNC | : Computer Numerical Control |
| CRM | : Customer Relation Management |
| CSF | : Critical Success Factors |
| EDI | : Electronic Data Interchange |
| ERP | : Enterprise Resource Planning |
| FMS | : Flexible Manufacturing System |
| GDP | : Gross Domestic Product |
| HACCP | : Hazards Analysis Critical Control Point |
| HVAC | : Heating Ventilation and Air Conditioning |
| IMP | : Industrial Master Plan |
| ISO | : International Organization for Standardization |

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JIT : Just In Time

LAN : Local Area Network

LE : Large Enterprise

ME : Medium Enterprise

MIES : Micro Enterprises

MIS : Management Information System

MITI : Ministry of International Trade and Industry

MP : Malaysia Plan

MRP : Material Requirement Planning

NC : Numerical Control

NEM : New Economic Model

NIES : New Industrial Countries

OSHAS : Occupational Safety and Health Administration System

PCA : Principal Component Analysis

PLS-SEM : Partial Least Square Structural Equation Modelling

OEE : Overall Efficiency Equipment

QC : Quality Control

QFD : Quality Function Deployment

RFID : Radio Frequency Identification

R&D : Research and Development

SCM : Supply Chain Management

SE : Small Enterprise

SEM : Structural Equation Modeling

SME : Small Medium Enterprises

SMIDEC : Small and Medium Industries Development Corporation

SPC : Statistical Process Control

SQR : Square Root

TLC : Technology Life Cycle

TQM : Total Quality Management

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## LIST OF TABLES


| TABLE | TITLE | PAGE |
|---|---|---|
| 2.1 | Benefit, Sub-benefit, and Best Indicator | 34 |
| 2.2 | SME Definitions in Terms of Annual Sales Turnover | 42 |
| 2.3 | SME Definitions in Terms of Full-Time Employees | 42 |
| 2.4 | SME Definition according to Ministry of Cooperative and SME and Bank of Indonesia | 43 |
| 2.5 | Behaviors Perceived Associated with SME Failure | 48 |
| 2.6 | Success criteria among SME in Australia and Malaysia | 50 |
| 3.1 | Summaries of AMT implementation and its impact. | 57 |
| 3.2 | Classification of AMT Implementation on Input | 64 |
| 3.3 | Classification of AMT implementation on Tranformation | 65 |
| 3.4 | Classification of AMT implementation on Output | 65 |
| 3.5 | Classification of AMT implementation on Environment | 65 |
| 4. 1 | List of Participants and Sample Size in Malaysian Expos and Exhibitions | 74 |
| 4.2 | List of Participant and Sample Size in Indonesian Expos and Exhibitions | 74 |
| 4.3 | Statistical Test for Hypothesis Testing | 81 |
| 4.4 | Comparison between PLS-SEM and CB-SEM | 84 |
| 5.1 | Profile of the Respondents based on the Sales Turnover | 92 |
| 5.2 | Profitability Rate | 92 |


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| | | |
|---|---|---|
| 5.3 | Use of AMT | 93 |
| 5.4 | Percentages of the overall reason | 94 |
| 5.5 | Percentage of High Usage of AMT Technique | 99 |
| 5.6 | Percentage of high usage of Hard and Soft Technology | 99 |
| 5.7 | Relationship Between the use of AMT and Org Sales Turnover | 100 |
| 5.8 | Chi-Square Tests for Org. Sales turnover with Use of AMT | 101 |
| 5.9 | Relationship Between the use of AMT and Profitability Rate | 102 |
| 5.10 | Chi-Square Tests for profitability with Use of AMT | 102 |
| 5.11 | Relationship Between the use of AMT with the Organizational Performance | 103 |
| 5.12 | Wilcoxon Signed Rank Test | 104 |
| 5.13 | Regression Analysis Impact of Soft & Hard Technology on Sales turnover growth | 105 |
| 5.14 | AMT impact on Sales turnover growth, Profitability and Organizational Performance | 106 |
| 5.15 | Participation and contribution of partnerships | 108 |
| 5.16 | The percentage of partnership motivation | 109 |
| 5.17 | The percentage of partnerships participation on each AMT implementation stage | 110 |
| 5.18 | Impact of Strategic Partnerships on Company Performance | 112 |
| 5.19 | Descriptive Statisticsfor Monitoring | 113 |
| 5.20 | Descriptive Statistics for Technoware Monitoring | 113 |
| 5.21 | Descriptive Statisticsfor Humanware Monitoring | 114 |
| 5.22 | Descriptive Statisticsfor Inforware Monitoring | 115 |
| 5.23 | Descriptive Statistics for Orgaware Monitoring | 116 |


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| | | |
|---|---|---|
| 5.24 | Average importance level of Monitoring of AMT implementation on each stage | 116 |
| 5.25 | Priority order of Monitoring AMT Implementation on each stage | 117 |
| 5.26 | Testing of priority order between two stages of AMT implementation process | 118 |
| 5.27 | Value of Significance on the impact of Monitoring on Company Performance | 119 |
| 5.28 | Descriptive Statistics for Critical Success Factors | 121 |
| 5.29 | Five Rank Critical Success Factors at every stage | 121 |
| 5.30 | Descriptive of Obstacles | 123 |
| 5.31 | Descriptive of Obstacles on Financial | 123 |
| 5.32 | Descriptive of Obstacles on Human Resources | 124 |
| 5.33 | Description of Obstacles in Organization | 124 |
| 5.34 | Descriptive of Obstacles on External Support | 125 |
| 5.35 | Reliability and Validity Test for AMT Implementation | 126 |
| 5.36 | Reliability Test for Latent Variable | 127 |
| 5.37 | Validity Test for Indicators | 128 |
| 5.38 | Cross Loading of Initial Model | 137 |
| 5.39 | Matrix Correlation and SQR AVE | 138 |
| 5.40 | Average Variance Extracted (AVE) on Initial Model | 138 |
| 5.41 | Value of Composite reliability on Latent Variable | 139 |
| 5.42 | Cross Loading of the Second Model | 141 |
| 5.43 | Matrix Correlation and SQR AVE of second model | 142 |
| 5.44 | AVE of Second Model | 142 |
| 5.45 | Composite Reliability of Second Model | 143 |


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| | | |
|---|---|---|
| 5.46 | Results for inner weights | 145 |
| 5.47 | Results for outer loadings | 146 |
| 5.48 | Value of R-square | 147 |
| 5.49 | Hypotheses Testing | 162 |
| 6.1 | Organizational Sales Turnover | 165 |
| 6.2 | Descriptions of Profitability Rate | 166 |
| 6.3 | Use of AMT | 166 |
| 6.4 | Percentage of the overall reasons | 167 |
| 6.5 | Percentage of High Usage of AMT Technique | 172 |
| 6.6 | Percentage of Hard and Soft Technology Use | 173 |
| 6.7 | Relationship Between the use of AMT and Org Sales Turnover | 174 |
| 6.8 | Chi-Square Tests for Org. Sales turnover with Use of AMT | 174 |
| 6.9 | Relationship Between the Use of AMT and Profitability | 175 |
| 6.10 | Chi-Square Tests for profitability with Use of AMT | 176 |
| 6.11 | Relationship Between the use of AMT with the Organizational Performance | 176 |
| 6.12 | Wilcoxon Signed RankTest | 177 |
| 6.13 | Result of Regression Analysis: Impact of Soft & Hard Technology on Growth Sales Turnover | 178 |
| 6.14 | Summarized AMT impact on Growth Sales Turnover, Profitability and Organizational Performance | 179 |
| 6.15 | Participation and contribution of partnership | 181 |
| 6.16 | The percentage of partnership motivation | 182 |
| 6.17 | The percentage of partnership participation on each AMT implementation stages | 183 |


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| | | |
|---|---|---|
| 6.18 | Value of Significance of Strategic Partnerships Impact on Company Performance | 185 |
| 6.19 | Descriptive Statistics for Monitoring | 186 |
| 6.20 | Descriptive Statistics for Monitoring on Technoware | 187 |
| 6.21 | Descriptive Statistics for Monitoring on Humanware | 187 |
| 6.22 | Descriptive Statistics for Monitoring on Inforware | 188 |
| 6.23 | Descriptive Statistics for Monitoring on Orgaware | 189 |
| 6.24 | The Average of the level of Importance of Monitoring in each stage | 189 |
| 6.25 | Priority order of Monitoring AMT Implementation on each stage | 190 |
| 6.26 | Testing the priority order between two stages | 190 |
| 6.27 | Descriptive Statistics for Critical Success Factors | 192 |
| 6.28 | Top Five of Critical Success Factors in every stage | 192 |
| 6.29 | Descriptive Statistics for Obstacles Variable | 193 |
| 6.30 | Descriptive Statistics for Obstacles on Finance | 194 |
| 6.31 | Descriptive Statistics for Obstacles on Human Resource | 194 |
| 6.32 | Descriptive of Obstacles on Organization | 194 |
| 6.33 | Descriptive Statistics for Obstacles from External Support | 195 |
| 6.34 | Reliability and Validity Test for AMT Implementation | 196 |
| 6.35 | Reliability Test for Latent Variables | 197 |
| 6.36 | Validity Test for Indicators | 198 |
| 6.37 | Cross Loading of Initial Model | 208 |
| 6.38 | Matrix Correlation and SQR AVE | 209 |
| 6.39 | Average Variance Extracted (AVE) on Initial Model | 209 |
| 6.40 | Value of Composite reliability on Latent Variable | 210 |
| 6.41 | Cross Loading of Second Model | 212 |


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| | | |
|---|---|---|
| 6.42 | Matrix Correlation and SQR AVE of second model | 213 |
| 6.43 | AVE of the Second Model | 213 |
| 6.44 | Composite Reliability of Second Model | 214 |
| 6.45 | Results of T Statistics for inner weights | 216 |
| 6.46 | Results for outer loadings | 217 |
| 6.47 | Value of R-square | 218 |
| 6.48 | Hypotheses Testing | 229 |
| 7.1 | Comparison between Respondent Profile in Malaysian and Indonesian SME | 248 |


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## LIST OF FIGURE


| FIGURE | TITLE | PAGE |
|---|---|---|
| 2.1 | Six stages model of Technology Implementation. Kwon &Zmud Model. | 21 |
| 2.2 | Technological Life Cycle S curve Model | 22 |
| 2.3 | The S-curve of Technological Progress | 23 |
| 2.4 | Model of AMT Implementation Process | 24 |
| 2.5 | Previous Research in AMT | 36 |
| 3.1 | Resource Based View of The Firm Model | 55 |
| 3.2 | Theoretical Framework | 56 |
| 4.1 | Research Design | 70 |
| 4.2 | Path Diagram for Structural Model | 85 |
| 5.1 | The Use of AMT in Input | 95 |
| 5.2 | The Use of AMT in Transformation Process | 97 |
| 5.3 | The Use of AMT in Output stage | 97 |
| 5.4 | The Use of AMT in Environment | 98 |
| 5.5 | Indicators of AMT Implementation | 126 |
| 5.6 | Indicators of Organizational | 127 |
| 5.7 | Indicators of Critical Success Factors | 130 |
| 5.8 | Indicators of Obstacles | 131 |
| 5.9 | Indicators of Alliances | 131 |
| 5.10 | Indicators of Monitoring | 133 |


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| | | |
|---|---|---|
| 5.11 | Indicators of Performance | 134 |
| 5.12 | Initial Model of AMT Implementation | 135 |
| 5.13 | Second Order Model of AMT Implementation | 140 |
| 5.14 | Factor Loading for every Variable | 144 |
| 5.15 | Impact of AMT implementation to the performance of Malaysian SME | 148 |
| 5.16 | Relationship Between CSF and AMT implementation in Malaysian SME | 151 |
| 5.17 | Relationship Between Obstacles and AMT implementation in Malaysian SME | 153 |
| 5.18 | Relationship Between Alliances and AMT implementation in Malaysian SME | 155 |
| 5.19 | Relationship Between Monitoring and AMT implementation in Malaysian SME | 156 |
| 6.1 | The Use of AMT in the Input stage | 168 |
| 6.2 | The Use of AMT in Transformation Process | 170 |
| 6.3 | The Use of AMT in Output stage | 171 |
| 6.4 | The Use of AMT in Environment | 171 |
| 6.5 | Indicators of AMT Implementation | 196 |
| 6.6 | Indicators of Organizational Characteristics | 199 |
| 6.7 | Indicators of Critical Success Factors | 200 |
| 6.8 | Indicators of Obstacles | 202 |
| 6.9 | Indicators of Alliances | 202 |
| 6.10 | Indicators of Monitoring | 204 |
| 6.11 | Indicators of Performance | 205 |
| 6.12 | Initial Model of AMT Implementation | 206 |
| 6.13 | Second Model of AMT Implementation | 211 |


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