UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A MODEL FOR MEASURING THE EFFECTIVENESS OF CANTING WORK STATIONS IN INDONESIA'S HAND-WRITTEN BATIK INDUSTRY

SRI MAYASARI

DOCTOR OF PHILOSOPHY

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Institute of Technology Management and Entrepreneurship

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SRI MAYASARI

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

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2025

DECLARATION

I declare that this thesis entitled “A Model for Measuring the Effectiveness of Canting Work Stations in Indonesia’s Hand-Written Batik Industry” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : Sri Mayasari

Date : 30 June 2025

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	:Assoc. Prof. Dr. Zuhriah Ebrahim
Date	: 01 Aug. 2025

DEDICATION

I dedicate this thesis to the unwavering support and boundless love of my parents, Drs. R. Basyir Priyokusumo and Astuti Darmadiyah. Your sacrifices, guidance, and encouragement have been the foundation of my academic journey. This achievement reflects the values and strength you instilled in me.

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This work stands as a tribute to my family and friends, who have been my pillars of strength. Thank you for being my support system and for making this academic pursuit not only possible but also meaningful.

ABSTRACT

Batik is Indonesia's cultural heritage that is respected globally, and increasing productivity in the *Batik* industry is an effort to preserve it. Data shows that the Gross Domestic Product (GDP) has experienced a decline since 2016, with a drop of 75% from 2016 to 2020, highlighting the need for improvements in productivity. The hand-written *Batik*, is considered the most original and has high artistic value. This research explores the impact of using manual *Canting* tools in hand-written *Batik* industry on human work effectiveness by focusing on measuring mental workload. The *Batik* industry has an important role in contributing to the national economy. Lack of current model include physical and mental workload further limits the understanding of human effectiveness in this context, while in this research on the *Batik Canting* process are the limitations in comprehensively measuring mental and physical workload, as well as in implementing appropriate ergonomics at *Batik* workstations. Additionally, the exploration of mental workload in the *Canting* process remains limited, existing models also do not fully capture the unique demands of the *Canting* process, which requires high levels of technique and precision. This contribution needs to be supported by increasing productivity through developing the human effectiveness of manual *Canting* process workers. Current workload measurement models are generally not specifically designed to measure the unique mental load associated with manual *Canting* activity, and current models also do not specifically consider the impact of physical workload on worker's mental load. This research aim to provide a human effectiveness measure for manual *Canting* work system that based on ergonomic issues and mental workload. This research has four objectives: (i) defining the components in the manual *Canting* work system; (ii) analyzing the relationship between manual *Canting* work systems and ergonomic issues; (iii) developing a measurement model of the impact of the manual *Canting* work system on human effectiveness, with an emphasis on measuring the mental workload; and (iv) validating the proposed measurement model. The approach applied in this study includes various methods to achieve the predetermined research objectives. Interviews and observations for 1st objective; Nordic Body Map (NMB) survey, Rapid Entire Body Assessment (REBA), Percentage of Cardiovascular Load (%CVL), Anthropometer, and National Aeronautics and Space Administration Task Load Index (NASA- TLX) for 2nd objective; literature review and Forum Group Discussion (FGD) for 3rd objective; and validity, reliability, Spearman correlation, and regression analysis tests for 4th objective. The research results show that the manual *Canting* work system consists of four main stages (i.e Heating wax, setting the stable temperature. Manual *Canting* process until it is completed and ready for coloring). Analysis of the relationship between manual *Canting* work systems and ergonomic issues revealed a correlation between age and work experience with ergonomic problems, as well as providing recommendations in improve design of tools and equipment with the ergonomic design. This research develops a measurement model with adoption of nine dimensions of mental workload, including three new dimensions that reflect unique aspects of the manual *Canting* work system. Validation results confirm the reliability and relevance of this model in measuring the impact of manual *Canting* work systems on human effectiveness. This research guides hand-written *Batik* industry to manage the mental workload of *Canting* workers, to improve their well-being and productivity, and to support the growth and sustainability of *Batik* industry.

MODEL UNTUK MENGUKUR KEBERKESANAN STESEN KERJA CANTING DALAM INDUSTRI BATIK TANGAN INDONESIA

ABSTRAK

Batik ialah warisan budaya Indonesia yang dihormati di peringkat global, dan peningkatan produktiviti dalam industri Batik merupakan usaha untuk memeliharanya. Data menunjukkan bahawa Keluaran Dalam Negara Kasar telah mengalami penurunan sejak tahun 2016, dengan penurunan sebanyak 75% dari tahun 2016 hingga 2020, menekankan keperluan untuk peningkatan produktiviti. Batik tulis dianggap sebagai yang paling asli dan mempunyai nilai seni. Kajian ini meneroka kesan penggunaan alat Canting manual dalam industri Batik tulis terhadap keberkesanan kerja manusia dengan memberi tumpuan kepada pengukuran beban kerja mental. Industri Batik memainkan peranan penting dalam menyumbang kepada ekonomi negara. Namun, kekurangan model semasa yang merangkumi beban kerja fizikal dan mental mengehadkan pemahaman tentang keberkesanan kerja manusia. Proses Batik Canting juga menghadapi kekangan dalam mengukur beban kerja secara menyeluruh serta melaksanakan prinsip ergonomik yang sesuai di stesen kerja. Eksplorasi terhadap beban kerja mental dalam proses Canting masih terhad, dan model sedia ada belum sepenuhnya menangkap tuntutan unik aktiviti ini yang memerlukan tahap teknik dan ketelitian tinggi. Bagi menyokong sumbangan industri ini, peningkatan produktiviti melalui pembangunan keberkesanan kerja Canting manual amat diperlukan. Model pengukuran beban kerja kini tidak direka khusus untuk menilai beban mental unik dalam aktiviti Canting, dan juga tidak mengambil kira kesan beban fizikal terhadap mental pekerja. Oleh itu, kajian ini bertujuan membangunkan ukuran keberkesanan kerja manusia berasaskan isu ergonomik dan beban mental. Kajian ini mempunyai empat objektif utama: (i) mendefinisikan komponen dalam sistem kerja Canting manual; (ii) menganalisis hubungan antara sistem kerja Canting manual dan isu ergonomik; (iii) membangunkan model pengukuran kesan sistem kerja Canting manual terhadap keberkesanan manusia, dengan penekanan kepada pengukuran beban kerja mental; dan (iv) mengesahkan model pengukuran yang dicadangkan. Pendekatan yang digunakan dalam kajian ini melibatkan pelbagai kaedah untuk mencapai objektif yang telah ditetapkan. Temu bual dan pemerhatian digunakan untuk objektif pertama; tinjauan Nordic Body Map (NMB), penilaian Rapid Entire Body Assessment (REBA), Peratusan Cardiovascular Load (%CVL), Antropometer, dan National Aeronautics and Space Administration Task Load Index (NASA-TLX) digunakan untuk objektif kedua; kajian literatur dan Forum Group Discussion (FGD) digunakan untuk objektif ketiga; serta ujian kesahan, kebolehpercayaan, korelasi Spearman, dan analisis regresi digunakan untuk objektif keempat. Hasil kajian menunjukkan bahawa sistem kerja Canting manual terdiri daripada empat peringkat utama, iaitu pemanasan lilin, menetapkan suhu yang stabil, proses Canting manual, dan siap untuk pewarnaan. Analisis hubungan antara sistem kerja Canting manual dan isu ergonomik mendedahkan adanya korelasi antara umur dan pengalaman kerja dengan masalah ergonomik, serta memberikan cadangan untuk memperbaiki reka bentuk alat dan peralatan dengan pendekatan ergonomik. Kajian ini juga membangunkan model pengukuran dengan mengadaptasi sembilan dimensi beban kerja mental, termasuk tiga dimensi baharu yang mencerminkan aspek unik dalam sistem kerja Canting manual. Hasil pengesahan model menunjukkan bahawa model ini boleh dipercayai dan relevan dalam mengukur kesan sistem kerja Canting manual terhadap kerja manusia. Kajian ini memberikan panduan kepada industri Batik tulis untuk mengurus beban kerja mental pekerja, meningkatkan kesejahteraan dan produktiviti mereka, serta menyokong pertumbuhan dan kelestarian industri Batik.

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TABLE OF CONTENTS

DECLARATION
APPROVAL
DEDICATION
ABSTRACT **i**
ABSTRAK ***ii***
ACKNOWLEDGEMENT **iii**
TABLE OF CONTENTS **iv**
LIST OF TABLES **viii**
LIST OF FIGURES **xii**
LIST OF APPENDIXES **xv**

CHAPTER 1 **1**
INTRODUCTION **1**
1.1 Research Background 1
1.2 Problem Statements 5
1.3 Research Questions 10
1.4 Research Aim and Objectives 10
1.5 Research Scope 11
1.6 Significance of the Research 12
1.7 Terms Definition 13
1.8 Thesis Organisation 14

CHAPTER 2 **16**
LITERATURE REVIEW **16**
2.1 Preliminary 16
2.2 *Batik* Industry 17
2.2.1 Process in *Batik* Industry 18
2.2.2 Canting Process 24
2.2.3 Factors and Effects in *Canting* Process 25
2.2.4 Tools for Manual *Canting* Process 33
2.3 Human Effectiveness 39
2.3.1 Definition 39
2.3.2 Factors of Human Effectiveness 40
2.4 Ergonomic Issues 42
2.4.1 Musculoskeletal Disorders Symptoms (MSDs) 42
2.4.2 Work Posture 44
2.4.3 Physical Workload 45
2.4.4 Mental Workload 46

2.4.5 Anthropometrics 47
2.5 Measurement Model for Physical Factor 48
2.5.1 Rapid Entire Body Assessment (REBA) 49
2.5.2 Rapid Upper Limb Assessment (RULA) 50
2.5.3 Quick Exposure Check (QEC) 52
2.5.4 Measurement of Pulse 53
2.6 Measurement Model for Mental Factor 54
2.6.1 Objective Measurement Method 56
2.6.2 Subjective Measurement Method 56
2.6.2.2 National Aeronautics and Space Administration Task Load Index (NASA-TLX) Method 59
2.7 Existing Models in Measuring Mental Workload 61
2.8 Framework of Measurement Model 73
2.9 Statistical Methods in Ergonomic and Human Effectiveness Studies 76
2.9.1 Validity Test 76
2.9.2 Reliability Test 77
2.9.3 Spearman Correlation 78
2.10 Summary 81

CHAPTER 3 82
RESEARCH METHODOLOGY 82
3.1 Preliminary 82
3.2 Research Design 82
3.2.1 Investigation The Components in Manual *Canting* Work System and Its Relationship of *Canting* Work System With Ergonomic Issues (Objective 1) 84
3.2.1.1 Stage I: Defining The Components in Manual Canting Work System 84
3.2.1.2 Stage II: Analysing The Relationship of Canting Work System With Ergonomic Issues 86
3.2.2 Developing A Measurement Model for The Effects of Manual *Canting* Work System on Worker Effectiveness Based on Mental Workload Measure with Consideration of Physical Workload Measure (Objective 2) 96
3.2.3 Validation of The Propose Measurement Model of The Effects of Manual *Canting* Work System on Human Effectiveness (Objective 3) 98
3.3 Population and Sample 101
3.4 Variable and Operation Model of Mental Workload Measurement Questionnaire 104
3.5 Research Hypothesis 104
3.6 Summary 107

CHAPTER 4 110
THE COMPONENTS OF MANUAL CANTING PROCESS AND ITS ERGONOMIC ISSUES 110

4.1 Preliminary 110
4.2 Investigating the Components in Manual *Canting* Work System and Its Relationship of *Canting* Work System with Ergonomic Issues (Objective 1) 110
4.2.1 Defining the Components in a Manual *Canting* Work System (Objective 1 Part A) 110
4.2.1.1 Manual Canting Work System 111
4.2.1.2 Tools Used in Manual *Canting* 112
4.2.1.3 Discussion 122
4.2.2 Analyzing the Relationship of *Canting* Work System with Ergonomic Issues (Objective 1 Part B) 129
4.2.2.2 Musculoskeletal Disorder Symptoms (MSDs) 132
4.2.2.3 Work Posture 135
4.2.2.4 Physical Workload of the Workers 149
4.2.2.5 Anthropometric Data Measurement 153
4.2.2.6 Mental Workload of the Workers 160
4.3 Summary 170

CHAPTER 5 173
MEASUREMENT MODEL OF THE EFFECT OF MANUAL *CANTING* WORK SYSTEM ON HUMAN EFFECTIVENESS 173
5.1 Preliminary 173
5.2 Developing a Measurement Model of the Impacts of Facilities Component of Manual *Canting* Process on Mental Workload (Objective 2) 174
5.2.1 The Measurement Items 176
5.2.1.1 Existing Measurement Items 176
5.2.1.2 Additional Measurement Items 178
5.2.1.3 Newness 179
5.2.1.4 Item Control Process 181
5.2.1.5 Tools Condition 182
5.2.2 Result of Verification 186
5.2.3 The proposed MWL Measurement Model for Manual *Canting* Work System 186
5.3 Validating The Proposed Measurement Model of The Effect Of Manual *Canting* Work System on Human Effectiveness (Objectives 3) 189
5.4 Research Hypothesis 189
5.4.1 Pilot Survey 191
5.4.2 Result of Survey 206
5.4.3 Comparison of Regression Analysis Between Focus Sample, Pilot Sample and Actual Sample 220
5.5 Discussions 223
5.5.1 Age 223
5.5.2 Experiences 223
5.5.3 Location (used tools) 224

5.6 Summary 228

CHAPTER 6 **231**
CONCLUSION **231**
6.1 Preliminary 231
6.2 Conclusion Relative to Research Objectives 231
6.2.1 Objective 1: To investigate the components in manual *Canting* work system and its relationship of *Canting* work system with ergonomic issues 232
6.2.2 Objective 2: To Develop A Measurement Model For The Effects Of Manual *Canting* Work System On Human Effectiveness Based On Mental Workload Measure With Consideration Of Physical Workload Measure 233
6.2.3 Objective 3: To Validate The Proposed Measurement Model of The Effects of Manual *Canting* Work System on Human Effectiveness 234
6.2.4 Contributions 234
6.2.5 Benefits to The Industry Players 235
6.2.6 Future Research Works 236

REFERENCE **238**
APPENDICES **285**

LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1:	Dimension of SWAT Method (Sari, 2021)	58
Table 2.2:	Comparison of the 10 Measurements of Mental Workload	63
Table 2.3:	Level of the Correlation Coefficient (Source: Sugiyono, 2007)	79
Table 3.1:	The Research Hypotesis	104
Table 4.1:	Manual Canting Process Description	112
Table 4.2:	Tools used in Manual Canting Process	113
Table 4.3:	Relationship Between Canting Step, Its Tool and Ergonomic Issue	124
Table 4.4:	The Number of Workers at Each Location	129
Table 4.5:	Results of MSDs from The Sample Workers of Manual Canting Process	132
Table 4.6:	The Relationship between Age and Experience with Musculoskeletal Disorder Symptoms (MSDs) on Extreme Pain 50%	134
Table 4.7:	The Relationship between Age and Experience with Musculoskeletal Disorder Symptoms (MSDs) on Extreme Pain 50%	135
Table 4.8:	REBA Trunk Scoring Criteria (Fontana et al., 2005)	138
Table 4.9:	Results of Trunk Posture for manual Canting process	138
Table 4.10 :	REBA Neck Scoring Criteria (Fontana et al., 2005)	139
Table 4.11 :	Results of Neck Posture for manual Canting process	139
Table 4.12:	REBA Legs Scoring Criteria (Fontana et al., 2005)	140
Table 4.13:	Results of Legs Posture for manual Canting process	140
Table 4.14:	REBA Upper Arm Scoring Criteria (Fontana et al., 2005)	141
Table 4.15:	Results of Upper Arm Posture for manual Canting process	141
Table 4.16:	REBA Lower Arm Scoring Criteria (Fontana et al., 2005)	142

Table 4.17:	Results of Lower Arm Posture for manual Canting process	142
Table 4.18:	REBA Wrist Scoring Criteria (Fontana et al., 2005)	142
Table 4.19:	Results of Wrist Posture for manual Canting process	143
Table 4.20:	Total Score of Body Parts for Manual Canting Process	143
Table 4.21:	Table A and Load/Force	144
Table 4.22:	Table B and Coupling	145
Table 4.23:	Table C and Activity Score	146
Table 4.24:	REBA Action Level	148
Table 4.25:	Classification of Percent Cardiovascular Load (%CVL) (Tarwaka, et al., 2004)	150
Table 4.26:	Results of Calculating Percent Cardiovascular Load (%CVL)	150
Table 4.27:	Distribution of age by Percent Cardiovascular Load (%CVL)	151
Table 4.28:	Findings of Ergonomic Issues in the Manual Canting Process	152
Table 4.29:	Description of Anthropometric Dimension	153
Table 4.30:	Anthropometric Data of Chair Design of Manual Canting Process	156
Table 4.31:	Anthropometric Data in Designing Gawangan	157
Table 4.32:	Anthropometric Data in Designing Table for Stove	158
Table 4.33:	Anthropometric Data on Distance Between Chair and Wax Pan	159
Table 4.34:	Result of Weighting	161
Table 4.35:	Result of Rating	162
Table 4.36:	Result of Product Value	164
Table 4.37:	Result of Weighted Workload (WWL)	166
Table 4.38:	Average Weighted Workload (WWL)	167
Table 4.39:	NASA-TLX Score (Tarwaka, 2015)	168
Table 4.40:	Result of Mental Workload Classification Among The Workers (Manual	

	Canting Process)	168
Table 4.41:	Data Processing Conclusions from Objectives I and II	170
Table 5.1:	Linkages of Canting Step to NASA TLX Dimensions	177
Table 5.2:	Findings of Objective 1 and Objective 2	179
Table 5.3:	Newness Items	180
Table 5.4:	Item Control Process	181
Table 5.5:	Additional Measurement Formulation on the Tools Condition	183
Table 5.6:	Formulation Result of Additional Item Questionaire of the Mental	184
Table 5 7:	Formulation Result of Additional Item Questionaire of the Mental	185
Table 5.8:	Profile of the Expert in Hand-written Batik Field	186
Table 5.9:	The Research Hypothesis	189
Table 5.10:	Results of the Validity Test from the Pilot Study	195
Table 5.11:	Results of the Reliability Test from the Pilot Study	200
Table 5.12:	Level of the correlation coefficient (Source: Sugiyono, 2007)	201
Table 5.13:	Results of Spearman Correlation Test from Pilot Study	202
Table 5.14:	Summary of Spearman Correlation Test Results between MWL	203
Table 5.15:	Estimated Parameters of Regression Analysis by SPSS for the Pilot Study	205
Table 5.16:	Results of the Validity Test from Survey	210
Table 5.17:	Results of the Reliability Test from Survey	215
Table 5.18:	Results of Spearman Correlation Test from Survey	216
Table 5.19:	Summary of Spearman Correlation Test Results from Survey	217
Table 5.20:	Parameter Estimates Result of SPSS From Survey	219
Table 5.21:	Comparison of Respondent's Profile	220
Table 5.22:	The Comparison of Regression Equation Model	222

Table 5.23: Summary of the Influence of Age to Human Effectiveness 223

Table 5.24: Summary of the Influence of Experience on Human Effectiveness 224

Table 5.25: Summary of the Influence of Location on Human Effectiveness 226

Table 5.26: Data Processing Conclusions from Objectives II and III 228

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1.1:	The Manual Canting Process in the Making of Hand-written Batik	6
Figure 1.2:	Comparison of Batik Industry with Other Industries in Indonesia	8
Figure 1.3:	Average Gross Domestic Product Batik Industry	9
Figure 2.1:	Manual Canting	19
Figure 2.2:	The Process of Designing Batik Called Mola	19
Figure 2.3:	The Process of Canting Process dan Ngisen-iseni	20
Figure 2.4:	The Process of Nerusi	21
Figure 2.5:	The Process of Nembok and Blirik'I	21
Figure 2.6:	The Process Coloring or Dying	22
Figure 2.7:	The Process of Lorodan	22
Figure 2.8:	Batik Cloth	23
Figure 2.9:	Batik Wax	24
Figure 2.10:	Canting	34
Figure 2.11:	Dimension of Canting	35
Figure 2.12:	Gawangan	35
Figure 2. 13:	Wok	36
Figure 2.14:	Dye Vessel	37
Figure 2.15:	Pan	37
Figure 2 16:	Chair	38
Figure 2.17:	Work Posture Analysis Methods (Source: Briansah, 2018)	45

Figure 2.18: Proposed Framework of a Model for Measuring the Effect of Manual Canting Work Stations on Human Effectiveness in Hand-Written Batik Industry 74

Figure 3.1: Research Flowchart 83

Figure 3.2: Methodology for Objective 1 (Stage I) 85

Figure 3.3: Methodology for Objective 1 (Stage II) 86

Figure 3.4: Conceptual Model for Measuring Human Effectiveness at Manual Canting Process 97

Figure 3.5: The Illustration of Potential Relationships Based on The Hypothesis 106

Figure 3.6: Research Procedure Design 107

Figure 4.1: Percentage of Workers Based on Sampling Locations 130

Figure 4.2: Percentage of Workers Based on Age 130

Figure 4.3: Percentage of Number of Workers Based on Experience 131

Figure 4.4: Work Posture of Canting Process in Klaten, Indonesia 136

Figure 4.5: Work Posture of Canting Process in Sragen, Indonesia 136

Figure 4.6: Work Posture of Canting Process in Surakarta, Indonesia 137

Figure 4.7: Steps in Determining REBA Score (Fontana et al., 2005) 147

Figure 4. 8: REBA Scoring 148

Figure 4.9: Recommended Design of Chair for Manual Canting Process 156

Figure 4.10: Recommended Design of Gawangan 157

Figure 4.11: Recommended Design of Table for Stove 159

Figure 4.12: Recommended Distance between the Chair and Wax Pan 160

Figure 5.1: Relationship among the Research Objectives 174

Figure 5.2: Proposed MWL Measurement Model for Manual Canting Work System 187

Figure 5.3: The Illustration of Potential Relationships Based on The Hypothesis 190

Figure 5.4: Percentage of Number of Workers Based on Age 193

Figure 5.5: Percentage of Number of Workers Based on Sampling Locations 193

Figure 5.6: Percentage of Number of Workers Based on Experience 194

Figure 5.7: Percentage of Number of Respondents (Workers in Batik Industry) 207

Figure 5.8: Percentage of Number of Respondents (Workers in Batik Industry) Based on Sampling Locations in Indonesia 207

Figure 5.9: Map of Indonesia from Respondents (Workers in Batik Industry) Based on Sampling Locations in Indonesia 208

Figure 5.10: Percentage of Number of Respondents (Workers in Batik Industry) Based on Experience 208

LIST OF APPENDIXES

APPENDIX	TITLE	PAGE
Appendix B1	State of The Art	285
Appendix C1	Complaints of Musculoskeletal Disorders Symptom Data	291
Appendix C2	NASA-TLX Questionnaire	292
Appendix C3	The Population of The *Batik* Industry in Indonesia	294
Appendix D1	Anthropometry Dimension of Human	327
Appendix D2	Anthropometry Dimension Data of the Workers of Manual *Canting* Process	331
Appendix D3	Informed Consent Form 18 Workers	334
Appendix E1	Frequency Of Motif Change Hand-Written *Batik* and Complexity of Color of Pattern	353
Appendix E2	The Complexity of Pattern Hand-Written *Batik*	358
Appendix E3	Mental Work Load Questionnaire of Hand Written *Batik* Worker Before Expert Verification	364
Appendix E4	Expert Verification the Conceptual Model	370
Appendix E5	Final Measurement Item for Mental Workload	395
Appendix E6	The Interpretations of the Output Result of Spearman Correlation Test on the Pilot Survey	426
Appendix E7	The Interpretations of The Output Result of Spearman Correlation Test On The Survey	432
Appendix E8	Regression Test Results on the Focus of The Sample (18 Respondences)	436

Appendix E9	Work Measurement Melting Wax	437
Appendix E10	Statistical Test For Correlation Between Age And %CVL	438
Appendix E11	Pusat Pengurusan Penyelidikan Dan Inovasi (CRIM)	439

CHAPTER 1

INTRODUCTION

1.1 Research Background

The development of the *Batik* industry relies upon its industrial traits and is strongly associated with entrepreneurship. According to Kirzner (2015), entrepreneurship places particular emphasis on innovation, identity of possibilities, wealth introduction, outcomes for the economic system, and the entrepreneur himself as the main actor within the entrepreneurial. As the development of *Batik* business becomes a priority; there is a need to keep reinventing while keeping this priority in mind. Therefore, failures in this development of *Batik* business may cause a trickledown effect of struggles in adapting to market changes and cause a disturbance in making and distributing *Batik*. The business of *Batik* will develop if it is supported by raising the human effectiveness of the *Batik* workers. The manual *Canting* process is a work dominated by the manual activities of humans. The factor of human workload will highly affect the workers' effectiveness (Auriantika and Perdhana, 2023).

Since October 2, 2009, UNESCO has legitimized *Batik* as an original Indonesian cultural heritage, so its existence needs to be preserved and developed (Wibowo et al., 2016: Ismail et al., 2012). One way to preserve and develop *Batik* culture is by increasing the product quality of Indonesian *Batik* (Damayanti et al., 2015; Syamwil, 2017; Kurniadi et al., 2017). There are three kinds of *Batik* based on the way to create it, they are; hand-written *Batik*, *cap*, and printing. Among the three kinds of *Batik*, the most original way is the creation of hand-written *Batik*. *Batik* is a cloth which is decorated with patterns and motifs by hand the process is by incising wax into the decorated cloth by *Canting*.

The price of hand-written *Batik* is more expensive than *Batik cap* or combined. It is because the process of hand-written *Batik* needs a lot of patience and thoroughness. It needs two to three months to finish a sheet of hand-written *Batik*. Part of hand written *Batik* that needs a lot of time is the manual *Canting* process (process of incising pattern using wax onto the cloth). If it can be done faster, the productivity level of hand-written *Batik* production will be increased.

The system ranges of creating *Batik* from the layout degree to well end takes approximately one to two months. The manufacturing process consists of the design and preparation stages, the incised night stage of *Batik* with "*Canting*", colouring, and the stage of removing wax (*lorodan*). The preparation stage is the stage of preparing cloth and *Batik* motif designs. The subsequent degree is the method of giving wax or carving the wax of *Batik* with "*Canting*" which is commonly referred to as sticking. The process of throwing consists of activities, namely*: nglowong*, *isen-isen*, and *nembok*. After the stage of the process of *Canting* or carving wax into a *Batik* drawing pattern, the next step is colouring.

The stage of removing wax or finishing called *Nglorod* is the final stage of the process of making *Batik* cloth or printed *Batik* that uses a colour barrier (wax). In this stage, the whole wax is released by inserting a cloth that colour is old enough into boiling water, then rinsing it with clean water, and after that, it is aerated or dried in the shade (Kurniadi, 2017).

Except for Indonesia, other Asian countries that also have distinctive clothes drawn with *Batik* techniques are China, Malaysia, India and Thailand. The style or motif is the only thing to distinguish it from Indonesian *Batik*. China produces *Batik* which is made by many ethnic communities in southern or western China. The tribes of Miao, Bouyei, and Gejia made this traditional cloth with colouring techniques, weaving patterns, and making patterns with wax, similar to Indonesian *Batik* making. In Malaysia, there is *Batik* which has