



DEVELOPMENT OF BATIK JIG FOR HERITAGE PRESERVATION



**BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY
WITH HONOURS**

2023



**Faculty of Mechanical and Manufacturing Engineering
Technology**



DEVELOPMENT OF BATIK JIG FOR HERITAGE PRESERVATION

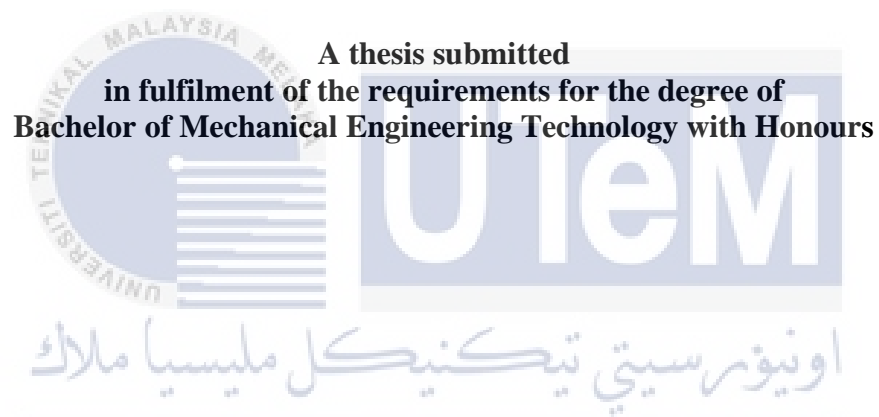
Nik Ahmad Nazran Bin Nik Ahmad Khan

Bachelor of Mechanical Engineering Technology with Honours

2023

DEVELOPMENT OF BATIK JIG FOR HERITAGE PRESERVATION

NIK AHMAD NAZRAN BIN NIK AHMAD KHAN



Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I declare that this Choose an item. entitled “Development of Batik Jig for Heritage Preservation” is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : Nik Ahmad

Name : Nik Ahmad Nazran Bin Nik Ahmad Khan

Date : 11/1/2023

اونيورسيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Mechanical Engineering Technology with Honours.

Signature : Suriati

Supervisor Name : Ts. Dr. Suriati Binti Akmal

Date : 11 Jan 2023

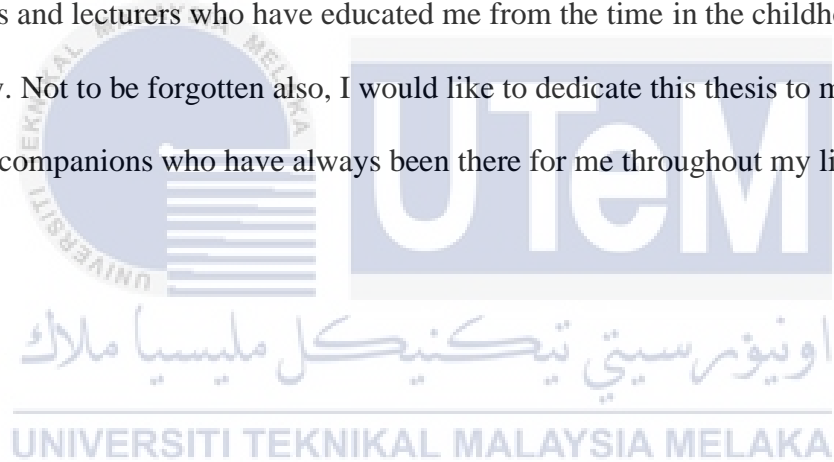


اونيورسيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEDICATION

This thesis is dedicated to my dearly loved mother, Suzana Binti Omar and my loved father Nik Ahmad Nazran Bin Nik Ahmad Khan. They have always supported and encouraged me in everything that I have been involved in and done throughout the entirety of my life without a shadow of a doubt. Additionally, I would like to dedicate this thesis to all of the instructors and lecturers who have educated me from the time in the childhood until the present day. Not to be forgotten also, I would like to dedicate this thesis to my friends and companions who have always been there for me throughout my life.



ABSTRACT

Batik is a handicraft art produced through various types of detailed techniques. In Malaysia, batik is a national cultural heritage inherited by our ancestors and has invaluable value. To this day, the batik printing industry is still concentrated in the East Coast states such as Kelantan and Terengganu. However, the country's batik industry looks increasingly gloomy due to various internal and external factors. This study is to identify the problems faced by batik entrepreneurs in Malaysia and then find solutions to overcome these obstacles. Through the survey obtained, it was found that among the problems faced by batik entrepreneurs in Malaysia is due to lack of manpower and not using the latest innovations in the process of producing batik. The batik entrepreneurs still maintain the traditional method of producing batik which is manually and a lot of manpower. This has had a negative impact on the country's batik market. Therefore, the injection of technology and innovation in the batik industry is very necessary in line with the development of technology today. Flexo printing technology plays a huge role as well as bringing evolutionary changes to the world of printing. This study will focus on the batik industry by producing a prototype of flexo printing technology to be used as a new batik printing tool while maintaining the traditional characteristics of batik. Among the reasons for choosing this technology is because it is suitable to be used to print various types of motifs and can reduce the time period of batik production and then produce batik products on a large scale. This study will perform a printing test on batik fabric through a prototype created. This is because, until today the status of the use of flexo printing technology on fabrics is still at the development and experimental stage. Therefore, it is hoped that this study can help batik entrepreneurs in Malaysia to maintain the batik industry so that it is not lost to the currents of modernization.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ABSTRAK

Batik merupakan seni kraf tangan yang dihasilkan melalui pelbagai jenis teknik yang terperinci. Di Malaysia, batik merupakan warisan budaya negara yang diwarisi oleh nenek moyang terdahulu dan tidak terkira nilainya. Sehingga ke hari ini, industri percetakan batik masih tertumpu di negeri-negeri Pantai Timur seperti Kelantan dan Terengganu. Namun, industri batik negara kelihatan semakin suram disebabkan oleh pelbagai faktor dalaman dan luaran. Kajian ini adalah untuk mengenal pasti permasalahan yang dihadapi oleh para pengusaha batik di Malaysia dan seterusnya mencari jalan penyelesaian untuk mengatasi rintangan tersebut. Melalui kaji selidik yang diperolehi, didapati bahawa antara masalah yang dihadapi oleh pengusaha-pengusaha batik di Malaysia adalah berpunca daripada kekurangan tenaga kerja dan tidak menggunakan inovasi terkini dalam proses menghasilkan batik. Para pengusaha batik masih mengekalkan kaedah penghasilan batik secara tradisional iaitu secara manual dan tenaga kerja yang banyak. Hal ini telah memberikan impak yang negatif terhadap pasaran batik negara. Oleh sebab itu, suntikan teknologi dan inovasi dalam industri batik adalah sangat perlu seiring dengan perkembangan teknologi pada masa kini. Teknologi percetakan flexo memainkan peranan yang besar serta membawa perubahan evolusi kepada dunia percetakan. Kajian ini akan memberi tumpuan kepada industri batik dengan menghasilkan prototaip teknologi percetakan flexo untuk digunakan sebagai alat percetakan batik yang baharu di samping mengekalkan ciri-ciri tradisional batik. Antara sebab pemilihan teknologi ini adalah kerana ianya sesuai digunakan untuk mencetak pelbagai jenis motif serta dapat mengurangkan tempoh masa penghasilan batik seterusnya menghasilkan produk batik pada skala yang besar. Kajian ini akan melaksanakan ujian percetakan ke atas fabrik batik melalui prototaip yang dicipta. Hal ini kerana, sehingga ke hari ini status penggunaan teknologi percetakan flexo ke atas fabrik masih pada tahap pembangunan dan percubaan. Oleh itu, diharapkan kajian ini dapat membantu pengusaha batik di Malaysia untuk mengekalkan industri batik agar tidak hilang ditelan arus pemodenan.

ACKNOWLEDGEMENTS

In the Name of Allah, the Most Gracious, the Most Merciful

To begin with, I would like to thank and praise Allah the Almighty, my Creator, my Sustainer, for everything I received since the beginning of my life. I would like to express my gratitude to my major supervisor, Ts. Dr. Suriati Binti Akmal, who is lecturer in Mechanical Engineering Technology Department (JTKM) department for her encouragement and assistance throughout my final year project.

I am also grateful and thanks to Dr Hambali Bin Boejang who is also a lecturer under the same department as Ts. Dr Suriati Binti Akmal for being my co-supervisor in guiding and constantly supported my journey in improving my project. My special thanks go to Profesor Madya Ir. Dr. Mohd Hadzley Bin Abu Bakar and Profesor Madya Ts. Dr. Muhammad Zahir Bin Hassan for all the help and support I received from them.

Apart from that, I also want to express my gratitude to all of my classmates and lecturers for their encouragement and lessons that have aided my self-development, knowledge and attitude toward achieving the objectives of this project. Special thanks to Syafiq Bakri, Abdullah Shamsubaha, Davian Ivan, Farhan Firdaus, Hiswanshah Hanapi, Ahmad Nazril, Amirul Wafiy, Fahmie Kamarudin and Izzul Hakimi for such a wonderful contribution.

Last but not least, I want to express my appreciation to my parents and family for their support of my studies and for responding to my project with recommendations and input that helped me improve the outcome of the project. Lastly, my special acknowledgement goes to Universiti Teknikal Malaysia Melaka for granting me the opportunity to pursue my study in Bachelor of Mechanical Engineering Technology. I appreciate all of your help and will not forget all of you. Thank you.

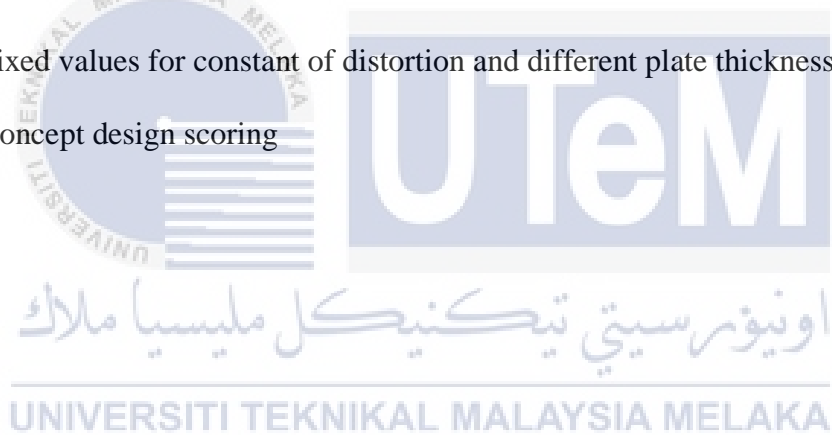
TABLE OF CONTENTS

	PAGE
DECLARATION	
APPROVAL	
DEDICATION	
ABSTRACT	i
ABSTRAK	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF SYMBOLS AND ABBREVIATIONS	xi
LIST OF APPENDICES	xii
CHAPTER 1 INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	3
1.3 Objective	5
1.4 Scope of Research	5
CHAPTER 2 LITERATURE REVIEW	6
2.1 Introduction	6
2.2 Batik Production Process	8
2.2.1 History of Batik Production	8
2.3 Challenges in Batik Industry	10
2.4 Innovations on Batik Production	14
2.5 Flexographic Printing Machine	17
2.5.1 The Flexographic Printing Process	18
2.6 Flexographic Printing Patent	23
2.6.1 Flexographic Printing Unit	23
2.6.2 Flexographic Printing Press	24
2.6.3 Flexographic Printing Apparatus and Method	25
2.6.4 Flexographic Printing Method	26
2.6.5 Flexographic Printing Process with Wet on Wet Capability	27
2.7 Formulas and Terminology	28
2.7.1 Gear Terminology and Teeth Calculation	28

CHAPTER 3	METHODOLOGY	30
3.1	Introduction	30
3.2	Flowchart of The Project	31
3.3	Batik Flexo Printing Machine Concept Generation	32
	3.3.1 Concept Design 1	32
	3.3.2 Concept Design 2	33
	3.3.3 Concept Design 3	34
	3.3.4 Concept Design 4	35
	3.3.5 Concept Design 5	36
3.4	Concept Selection	37
3.5	Material Selection	39
3.6	Analysis Method	43
CHAPTER 4	RESULTS AND DISCUSSION	45
4.1	Introduction	45
4.2	Concept Design Selection	45
4.3	Design and Mechanism	48
	4.3.1 Past Design	48
	4.3.2 New Design	51
4.4	Development of Batik Printing Machine	57
	4.4.1 Design Procedure	57
	4.4.2 Construction Procedure	60
4.5	Product Functionality and Analysis	72
	4.5.1 Main Frame Analysis	72
	4.5.2 Stamping Area on Main Frame Analysis	74
4.6	Project Limitations	75
CHAPTER 5	CONCLUSION AND RECOMMENDATIONS	76
5.1	Introduction	76
5.2	Conclusion	76
5.3	Recommendations	78
5.4	Project Potential	78
	REFERENCES	79
	APPENDICES	81

LIST OF TABLES

TABLE	TITLE	PAGE
Table 2-1	News media coverage of the challenges faced by the batik industry in Malaysia from 2014 until 2019	12
Table 3-1	Rating scheme for scoring the concept design	37
Table 3-2	Weightage scheme for the criteria	37
Table 3-3	The concept screening table for Batik Flexo Printing Machine	38
Table 3-4	Materials and Parts	39
Table 3-5	Fixed values for constant of distortion and different plate thickness	44
Table 4-1	Concept design scoring	47



LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1.1	Bad posture of batik worker (Gerimis Baiduri Batik Kota Bharu, 2022)	4
Figure 2.1	External and internal challenges in the batik industry in Malaysia and Indonesia.	10
Figure 2.2	Electric tjanting known as (A) Swanata and (B) Ladoe (Affanti & Hidayat, 2019) (Syed Shaharuddin et al., 2021)	14
Figure 2.3	A comparison of the traditional and automatic system based on the batik tjanting approach (the automatic process was adapted from (Muthi'ah, 2018)) (Syed Shaharuddin et al., 2021)	15
Figure 2.4	Schematic diagram of printing plate (Focus Label Machinery, 2016)	18
Figure 2.5	Rollers and cylinders in flexo printing unit (Ordant, 2019)	19
Figure 2.6	Flexo printing unit (Ordant, 2019)	20
Figure 2.7	Flexo printing machine working basis (Jota Machinery, 2022)	21
Figure 2.8	The inline flexographic printing machine's structural characteristics (Jota Machinery, 2022)	22
Figure 2.9	Flexographic Printing Unit patented by (Marion, 1982)	23
Figure 2.10	Flexographic Printing Press patented by (Rogge, 1983)	24
Figure 2.11	Flexographic Printing Apparatus and Method patented by (Feesler, 2002)	25
Figure 2.12	Flexographic Printing Method patented by (Salvestro, 2007)	26
Figure 2.13	Structure of plate cylinder (Salvestro, 2007)	26
Figure 2.14	Flexographic Printing Process With Wet on Wet Capability patented by (BAPTISTA & Paduan, 2011)	27

Figure 2.15 Type of diameter terminology in gear (Mfg Boyan, 2019)	28
Figure 2.16 Centre distance (Mfg Boyan, 2019)	29
Figure 2.17 Gear module (Mfg Boyan, 2019)	29
Figure 3.1 Flow chart of the project	31
Figure 3.2 Sketch for concept design 1	32
Figure 3.3 Sketch for concept design 2	33
Figure 3.4 Sketch for concept design 3	34
Figure 3.5 Sketch for concept design 4	35
Figure 3.6 Sketch for concept design 5	36
Figure 3.7 Distortion calculation	44
Figure 4.1 Isometric view of batik flexo printing machine	48
Figure 4.2 Front view of batik flexo printing machine	49
Figure 4.3 Top view of batik flexo printing machine	49
Figure 4.4 Right side view of batik flexo printing machine	50
Figure 4.5 Left side view of batik flexo printing machine	50
Figure 4.6 Result of printing using a roller prototype	51
Figure 4.7 Isometric view of batik stamping printing machine	52
Figure 4.8 Front view of batik stamping printing machine	53
Figure 4.9 Back view of batik stamping printing machine	54
Figure 4.10 Materials that were used to make a stamping bed	54
Figure 4.11 Left side view of batik stamping printing machine	55
Figure 4.12 Right side view of batik stamping printing machine	55
Figure 4.13 Top view of batik stamping printing machine	56
Figure 4.14 Isometric view of main frame	57

Figure 4.15 Isometric view of stamping section	59
Figure 4.16 Mild steel tube cutting process	60
Figure 4.17 Frame assembly before welding process	61
Figure 4.18 Frame squaring method	61
Figure 4.19 Welding process	62
Figure 4.20 Distortion occurred	62
Figure 4.21 Cross mild steel tubes were attached	63
Figure 4.22 Main frame with fabricated caster wheel	63
Figure 4.23 Drilling process	64
Figure 4.24 SKF UCP205 bearing unit	64
Figure 4.25 Spraying process of main frame	65
Figure 4.26 Aluminium profile with 45° joint point	66
Figure 4.27 Gusset element with M8 cap screw	66
Figure 4.28 Linear rail shaft system	67
Figure 4.29 150 N 300 mm linear actuator on the stamping section	67
Figure 4.30 Cross aluminium profile in the middle of frame	68
Figure 4.31 Full assembly of SCS20UU bearing unit with customized socket	68
Figure 4.32 Customized socket made of SLS for SCS20UU bearing unit	69
Figure 4.33 Drilling process to install the SKF UCP205 bearing unit	70
Figure 4.34 The main shafts were installed at the bearing units	70
Figure 4.35 Plywood corner cutting process	71
Figure 4.36 Stamping bed was installed	71
Figure 4.37 Main frame stress analysis	72
Figure 4.38 Main frame displacement analysis	73

Figure 4.39 Main frame strain analysis	73
Figure 4.40 Stamping area stress analysis	74
Figure 4.41 Stamping area displacement analysis	74
Figure 4.42 Stamping area strain analysis	75



LIST OF SYMBOLS AND ABBREVIATIONS

MDs	-	Musculoskeletal Disorders
VOC	-	Volatile Organic Compounds
CNC	-	Computer Numerically Controlled
CAD	-	Computer-Aided Design
CAM	-	Computer-Aided Manufacturing
IR3.0	-	Third Industrial Revolution



LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix 1	Gantt chart PSM 1	81
Appendix 2	Gantt chart PSM 2	82
Appendix 3	Turnitin check result	83



CHAPTER 1

INTRODUCTION

1.1 Background

Malaysia's batik industry has been in operation since the early 19th century, and it today contributes considerably to the country's economic development. Batik is a one of the kind handcrafts that is highly valued by Malaysians. Early batik practitioners were clever and creative in their understanding of materials and procedures for producing cloth designs that were suitable with the technology of the period. The advancement of batik printing in Malaysia, particularly the manufacturing and production process, is keeping pace with current developments and trends. Malaysia's batik business has grown, as have its materials and processes, creating a favourable competitive atmosphere among industries to generate some distinctiveness and creativity (Lias et al., 2020). However, based on the ergonomic studies that have been conducted to investigate the effect of manual batik production on hand-drawn batik artisans in Kelantan, Musa et al.'s (2000) revealed that 60.2% of batik workers suffered from musculoskeletal disorders (MSDs) involving pain at the shoulder, lower back, and ankle. Similarly, Yusof et al. (2013) discovered 64.5% that batik manufacturers in the nearby state of Terengganu were suffering from MSDs on their shoulders. MSDs can also be caused by repetitive movement and inadequate workstation design, according to their research (Syed Shahrudin et al., 2021).

Therefore, batik entrepreneurs are always looking for opportunities to adopt technological advances in the batik industry in order to overcome these issues. With the expertise and technology available today, a variety of sophisticated tools have come into

existence and have been adopted to produce batik. Traditional batik production in Malaysia and Indonesia has been put in the path of the Third Industrial Revolution (IR3.0) by the application of modern computer-based technology such as computer numerically controlled (CNC), computer-aided design (CAD), and computer-aided manufacturing (CAM). Other than that, electric *tjanting* also has been created to compensate for the lack of constant isothermal heating of the *tjanting*. Wood, copper, and aluminium have replaced the traditional cassava tubers as the primary material for batik stamps. Indonesian researcher in 2016 used CNC milling machines to develop an aluminium batik stamp (Syed Shahrudin et al., 2021).

After going through some innovations, the use of technology in the batik industry is still unable to overcome the problem of body aches among batik artisans. This is because the latest innovations in the batik industry are only focused on *tjanting* tools and the production of motifs design only. The best way to overcome the issues is by using flexo printing machine to print and producing batik on a large scale while reduces the manpower and saving time. According to (Ayn et al., 2018) assessment of its performance, when it comes to applying wax to fabric, the batik printer machine known as the batik Klowong machine was able to do so with great precision and accuracy while has eased up the time-consuming process of making batik (Syed Shahrudin et al., 2021). This shows that the use of technology in batik printing is very important nowadays.

Letterpress printing has evolved into flexography. Almost every type of substrate, including corrugated cardboard, cellophane, plastic, label stock, cloth, and metallic film, can be printed using this classic approach. Flexographic printing employs semiliquid inks that dry quickly. Flexography maintains its own in the face of digital printing in the fields of large orders and extended print runs, particularly for packaging and labelling.

Flexible photopolymer printing plates wrapped around revolving cylinders on a web press are used in flexographic printing. To transfer the picture to the substrate, the inked plates feature a slightly elevated image and rotate at high speeds. Flexography inks can be used to print on both absorbent and nonabsorbent materials. Printing continuous designs, such as gift wrap and wallpaper, is a good fit for flexography (Bear, 2020). This is one of the reasons why flexo printing would like to be chosen as a new innovation in the batik industry. Besides, flexography printing also can print on a wide variety of substrate materials. Flexography printing also uses cost equipment that requires little maintenance and relatively low-cost consumables. To obtain the intended outcome, a relatively simple and regulated printing method is used that requires less-trained operators. In this project, an actual product of batik flexo printing machine was designed to achieve the objective of this project which it can produce a large scale of batik fabric and sped up the time-consuming process of batik production. It is also to reduce the usage of manpower in the making of batik and also to overcome the problem of body aches among batik artisans.

1.2 Problem Statement

The batik industry in Malaysia is one of the fastest growing industries for a long time. The local batik creations and designs are among the high quality batik. Malaysian batik is very famous around the world for its variety of applied motifs and aesthetics. Malaysian batik, especially batik from Kelantan and Terengganu has attracted the attention of customers in neighboring countries such as Singapore, Thailand and Brunei. To maintain the authenticity and originality in the production of batik cloth, batik entrepreneurs and artisans still maintain the traditional methods and tools in the production of batik cloth. This has affected the quantity of batik production. Batik entrepreneurs are unable to meet the high demand for batik in the local and foreign markets. This is because the traditional methods and tools used by batik entrepreneurs to make batik cannot produce batik on a large scale.

Apart from the problem of producing batik in small quantities, batik entrepreneurs also face the problem of lack of manpower. Young people nowadays are not interested in venturing into the local batik production industry. This is because they must learn and be skilled in the use of tools and traditional methods in the production of batik. The results of the questionnaire and the study also found that many batik workers stated that they suffer from musculoskeletal disorders (MSDs) as a result of manual methods used to produce batik. The traditional method used to make batik is to stand for a long time and a fixed posture has caused pain in the shoulders, back and ankles of batik workers. **Figure 1.1** shows the batik worker standing for a long time and fixed posture during coloring the batik fabric.



Figure 1.1 Bad posture of batik worker (Gerimis Baiduri Batik Kota Bharu, 2022)

This problem in turn will affect the health of batik workers in the long run. as a result, the performance of batik workers will be burdensome and in turn will affect the quality and quantity of batik production. Quality in batik production should be emphasized to ensure that the demand for batik fabric in the local market remains at an optimal level. This will indirectly benefit the various parties involved as well as preserve the country's handicraft heritage. Therefore, this project is to produce a batik flexo printing machine that will facilitate and speed up the batik production process.

1.3 Objective

There are three objectives that will be highlighted in this project. Specifically, the objectives are as follows:

- a) To design and develop a batik printing machine that can produce a large scale of batik fabric and sped up the time-consuming process of batik production.
- b) To analyse the design of batik printing machine for batik production.
- c) To evaluate the batik printing machine with the existing technology and innovation that were used in batik industry nowadays.

1.4 Scope of Research

The scopes of this project are as follows:

- Design and develop a batik printing machine using standard parts that available in the market.
- The size of fabric that can be printed using batik printing machine is 45 inches or equal to 114.3 cm which is commonly being used in the production of batik.
- Study about the gear terminology and teeth calculation that involved in flexo printing machine.
- Study about the printing plate distortion calculation for flexo printing.
- The final product that would be produced by this batik printing machine is batik fabric with different motifs.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Malaysia is known for its handicrafts and arts. In Malaysia, crafts include forest-based, earth-based, metal-based, and textile-based crafts (Malaysian Handicraft Development Corporation). The result of this craft is also proven to be able to showcase culture, beauty, intellectual refinement as well as encompass life in the context of human values and civilization (Seminar Antarabangsa ke-3 Arkeologi, Sejarah dan Budaya di Alam Melayu, 2014) (Razali et al., 2021).

Malaysian batik has been acknowledged as one of the world's most renowned indigenous crafts by the World-Asia Pacific Craft Council (WCC-APR). Textile arts namely batik-based items have been classified as part of the Creative Arts and Culture Industry, according to the DIKN's National Creative Industry Policy (Asmah et al., 2016). For industrialized countries, this industry is also one of the key engines of economic expansion and cultural diffusion. In the context of Malaysia, DIKN defines the creative industry as the mobilization and production of individual or group abilities and talents based on creativity, innovation and technology in order to achieve economic outcomes and high income for the country with a focus on aspects of works and intellectual property in line with Malaysian culture and noble values. It can be concluded that the creative industry is centred on art for the economy that is with the involvement of talented individuals. These corporate parties give implications to the country in terms of income and national image.