

Study of Computerized-Batik Technique Using “Batik Kelowong” Machine in Batik Adelia, Bekasi

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Abstract. Batik Kelowong Machine is an innovation in batik processing that has been invented by Agus Martoyo in 2010 and currently used at Adelia Workshop, Bekasi. Differs from other tools that still relied on artisans' craftsmanship, this machine worked full-automatically by integrating Computer Aided Manufacturing system and adopting CNC (Computer Numeric System) technology, formerly used in metal and wood engraving, into the process of 'writing the outline' or 'klowongan' in batik. This research aims to study the linkages between machine's capabilities with the characters of design elements such as dots, lines, and shapes. Focus of this research is to identify the design element's characters that were produced by computerized-batik technique, conducted by studying patterns in Adelia Workshop using qualitative-descriptive methods. It is concluded that the digitalization and mechanization in Adelia Batik have not only affects the line of process, but also batik designs. By using vector-based software in design stage, designer can experiment with various techniques digitally, such as repetition and mirroring, thus affecting batik's design. Using the machine also enhances precision, neatness, and exactness of the patterns. The workshop does not have to rely on pattern and klowongan makers, thus cut off some expenses and time. In other hand, since it can only be used in the making of main outline, not for isen-isen (detail of an ornament) or tembakan (blocking the patterns with malam), batik artisans still be needed to complete the projects.

Keywords: Batik Bekasi, pattern design, technology, computerized batik

1. Introduction

Although considered as ancient traditional technique, the process in the making of a sheet of batik has been developed through centuries. Started with 'proto-batik' technique using *kwas*, the era of classical batik had reached the peak of written technique using manual tools like *canting*, that gave ways to the development of manual-printing *technique* using *tjap* in the era of 19th century's industrialization. Those two techniques, also known as 'traditional' and 'real' batiks, are still widely-practiced nowadays. In the era of modern technology, to support wide-range production, some developments have been made in batik processing, but only a few selected techniques have been considered as '*batik*'. Batik, not only as specific patterns or fabrics but also as a technique, must obey one principle: the using of *malam* as resistant medium in its resist-dye technique (Hamzuri, 1981).

Implementations of technology in batik processing have been done in numerous ways, for example electrical *canting* with integrated thermostat (P.A. Surahmat, 2009; Toto Sukatma, 2013; S.D. Tyasputri, 2013) and mechanical batik-table (Surya Utama Teknika SMA Muhammadiyah Pekalongan, 2014). One of those innovations was made by Agus Martoyo (2010) and developed by SMK 4 Jakarta, currently used at Batik Adelia, Bekasi. Differs from



other tools that still relied on the artisans' craftsmanships, this machine worked fully automatic thanks to its Computer Aided Manufacturing system. This machine was adopting CNC (Computer Numeric System) technology, which formerly used in metal and wood engraving, into the process of 'writing the outline' or '*klowongan*' in batik. Hence it made the name, which literally means 'a machine to make the main pattern'.

The study in this topic had been previously conducted by other researchers, such as Situngkir (2008) and Alga Indria (2014), whose research about *canting* machine technology had been served as a base to develop batik patterns' software application. These research has been highlighted a few points in this technique, such as the rate of neatness, precision, the linkages between types of fabric with the final results.

2. Purposes and Aims

The aims of this research are to study the linkages between machine's capabilities and characteristics of patterns, specifically in the character of design elements such as dots, lines, and shapes, to formulate design specifications that can be used in developing Batik Bekasi.

3. Methods

In conducting this research, data have been collected mainly by observation to Adelia Workshop, located on Jl. Perwira VIII no. 33 RT 004 RW 05 Kaliabang Nangka, North Bekasi, City of Bekasi, to watch the process and find the samples. Direct interview has also been held to Fauzi, technician of Batik Adelia, to find reliable data concerning the mechanical aspects of said technique. Characters of lines and shapes made by this technique is formulated by analyzing 16 batik samples that have been produced in the span time of three years, between 2013 – 2016.

4. Results

Kelowong-batik machine has been developed by Agus Martoyo in 2010, by integrating CNC system to the mechanization of automatic-batik writing. The tip of CNC-head, which usually made by metal to engrave patterns into wood or metal, is replaced with tube-heater consists of wax, completed with copper tip that could flow the liquid wax into the fabric, mimicking the tip of a *canting*. The head is attached to a flat bed, where a sheet of fabric was spread horizontally. Controlled by a mechanism that moved and stirred this head in its axis, this mechanization translates batik pattern into the movement of its tip in x (horizontal, parallel with warp thread), y (vertical, parallel with weft thread), and z (up and down) coded-numbers, resulted in the drawing of a line of wax following the pattern.



Figure 1. Kelowong Batik Machine

Specification details of this machine are listed in the table below.

Table 1. Specification of *Batik Kelowong Machine*, Batik Adelia

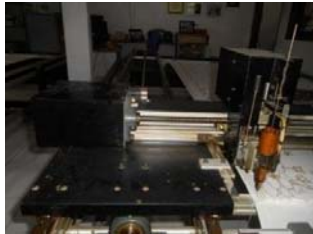
Specification		Picture
Tube Heater - Tube Material Metal alloy - <i>Canting's</i> tip copper Material - Wax <i>Kelowong</i> wax, Pekalongan type		
- Maximum axis speed 3000 mm/minutes		
Power Source and Motor - Power Source 220 VAC/50 Hz - Motor Drive Precision Stepping Motor 4 Nm - Power Consumption 500 Watt		
Design Software Program - Design Vector-based Software (CorelDraw) - CAD 3-D Software (Autocad) - CAM Vcarve Pro V5 / Mach 3 - CNC Controller PC Based		
Dimension - Length 3000 mm - Wide 1750 mm		

Figure 2. Tube heater and *canting's* tip**Figure 3.** Tube heater and motor**Figure 4.** Main circuit**Figure 5.** CNC numerical models as showed in main monitor during *klowong*-writing process

- Main Shaft
- Length 3000 m
 - Wide 1500 mm
 - Linear Motor Guide
 - Industrial Standard



Figure 6. Vertical shaft (parallel with *lungsi*/warp threads)

- Working area
- Length 2600 mm
 - Wide 1100 mm
- Types of fabric used
- Mori cotton
 - Silk



Figure 7. Horizontal shaft (parallel with *pakan*/weft threads)

Adapted from Adelia Batik's brochure, 2015

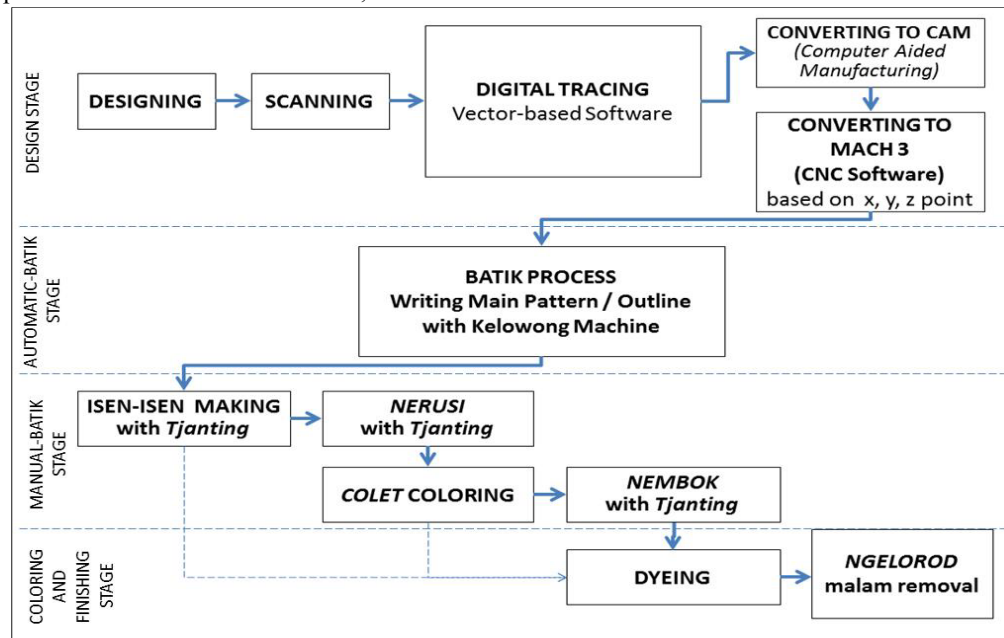


Figure 8. Batik Process in Adelia Workshop, Bekasi

The process of batik-making in Adelia Workshop, Bekasi, is conducted through several stages. Generally, it can be divided into four stages, i.e. Designing (digitally using design and computer-aided software), Automatic-Batik Drawing (using *klowongan*-batik machine), Manual-Batik Writing (using

manual technique with *canting* to make *isen-isen* and *tembokan*), and Finishing (coloring the fabric and removing wax from the fabric).

Designing is the initial stage in computerized method, and also plays the determining part in the whole process. Differs from traditional technique, while pattern was made manually and traced into fabric before the *canting* process, in this technique, pattern is made digitally. There is no need to trace pattern into fabric before the waxing/writing process, because wax was directly applied into fabric. To do this, at first the designer have to make pattern using vector-based software (Adelia Batik uses CorelDraw). If in traditional process, design had to be made manually, in this technique, design has to be converted into digital format by scanning and tracing. In this point, digital simulation is also performed, by modify the line thickness to 2.0 pt, same as the size of *canting*'s tip point and the waxline thickness, which approximately stand by 2 mm. Next step is to build the pattern into 3-D model (here, they used AutoCad software). 3-D models are needed in Computer Aided Manufacturing (CAM) to direct the movement of *canting* tip. This model later translated into CNC numerical models, consisted of x, y, and z points in Cartesian coordinate system. *Canting* tip will be moved according to the absis, where x marks the horizontal point (moving in horizontal line along the weft threads), y marks the vertical point (moving in vertical line along the warp threads), and z marks the up and down of *canting* tip. Software used in this stage was Mach3 or VCarve Pro V.5.

The next step is the main stage in the whole process: the *klowong*-writing. The fabric have to be stretched on the frame, with adequate tension to perform the writing process, which means that it have to be taut enough to hold the metal tip's movement, but not too uptight that would make the fabric tends to break. A little slack would be needed for maximum performance, since the bouncing effect on the fabric will hold the movement. Maximum size for fabric is 1,1 m x 2,6 m, with 1,1 m x 2, 33 m workspace. There is also additional 10 cm space at the end of warp side of the fabric, stitches along the edge and will be removed later, to accomodate space for horizontal shaft and wax-cartridge head.



Figure 9. 10 cm additional fabric along the edge of warp side

Type and temperature of the wax are crucial in batik process. There are certain types of wax with different characteristics that is made specifically for certain stages of batik. Wax for *tembokan* process has high melting point but easy to coagulate under lower temperature, alkali-resistant, and has thick texture that make it quite adhesive; therefore make it suitable to block a large area of fabric. It also quite difficult to remove the wax on *lorod* process, but usually this kind of wax didn't left brown trace on fabric. Wax for *klowongan* process is more or less having the same characteristics with those of *tembokan* wax, but has thinner texture, therefore it was easier to break. This type is also being used to make *isen-isen*. There is also another type that have had the most aqueous texture, consists mostly of parafin. With its characteristics, i.e. thin and delicate, easy to break, and have low melting point, it is usually used for *tembokan* and *remekan*.

Wax types also can be differed by their place of origin. Klowong wax from Principalities like Solo and Yogya are known to have thicker and more glutinous texture than those used in Coastal region, such as Pekalongan. The later type was used in Adelia Batik in their automatic-writing technique. Its liquidity is also controlled by integrated thermostat, to maintain the right temperature suitable for writing process.



Figure 10. Comparison between wax used in the making of *klowongan line* (left) and *isen-isen* (right)

Although this machine is quite capable in making *isen-isen* and *tembokan* (Indria, 2014), in Batik Adelia, these two processes are executed manually, by delegating it to the *canting*-batik makers. According to Hasan (interviewed on June 4th, 2016), it is a strategic move that is considered as effective and efficient, since making proper *isen-isen* template by software is considered too complicated and took too long time.



Figure 11. Writing process with klowong machine (left) and canting (right)

While the success rate in automatic-batik-writing is considered higher than those in manual technique, sometimes it is also happened to be failed, for example when the thermostat fails to adjust the wax temperature, that make the wax is not permeated into the back of the fabric. To ensure waxlines are executed perfectly, quality-control process are needed at the same time when *canting*-batik makers perform *nerusi*, a stage to make corrective waxline on the blank points. They also make *isen-isen* to fill in the basic patterns, and sometimes make *tembokan*, to block certain parts of patterns with wax to prevent them from being colored in the dyeing process.



Figure 12. Main pattern's outline in the shape of crocodile made by *klowong*-batik machine and Filled-out pattern with *isen-isen* made by manual writing technique

Next stage is to color the fabric, in which Adelia Batik uses chemical dye. There are two type of coloring processes being used, *celup* (deep-dyeing) using Naphtol or Rapid, and also *colet* (paint-coloring with brushes) using Rheumasol or Indigosol. Initially, Agus Martoyo also developed machine that could perform

colet mechanically, shortly after the writing process. Unfortunately, this version had been considered to have too many faults, therefore this feature have been removed on recent version, until future development. Meanwhile, the later stage such as dyeing, *nglorod* (wax-removal), and drying have not been differed from those in traditional process.

To identify character of line and dots made by klowong-batik machine, initial samples from first batik stage were taken. Main line and shapes have been applied but isen-isen have not been made.

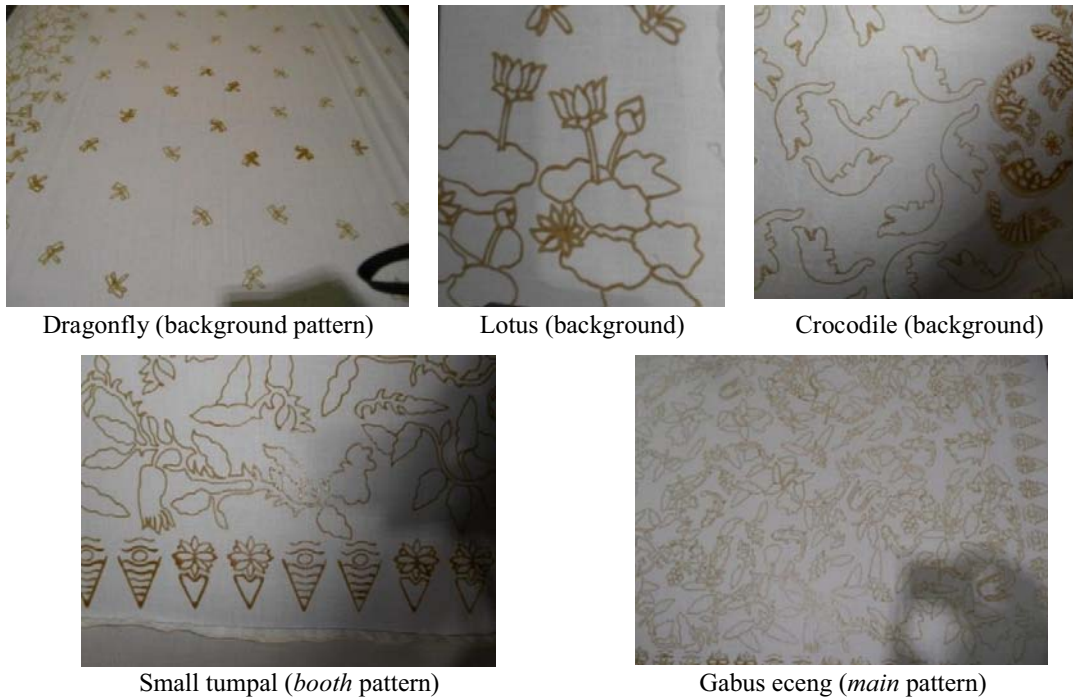


Figure 13. Samples of pattern's outline made by *klowong-batik* machine (Batik Adelia, 2015)

In Adelia Batik, isen-isen have been made using manual technique. Initial samples were taken from the fabric that has been given *isen-isen*.



Figure 14. Samples of isen-isen and background made by manual *canting* technique

Design element's characteristics could be identified as listed in this table below.

Table 2. Comparison of The Design Elements Made by Klowong Machine and Canting (Tulis)

No	Design Elements	Klowong Machine	Manual (Canting)
1	DOTS		
	Size	-	Varied
	Space between dots	-	Varied
	Neatness & Precision	-	Accumulation (thickening) of wax in big dots
	Wax-blocking and accumulation	-	Spread on the background
	Repetition	-	The inner circles may filled with big blocked dots or small lines
	Variation	-	
2	LINES		
	Thickness	Stable (app. 2 mm)	Line thickness may varied
	Space between lines	Min.3 mm on parallel lines Line angles between 30-180°	Min.1 mm on parallel lines (using 1 mm canting tip)
	Neatness & precision	- Very good on straight lines and curves, but not good on angled lines	Unstable
	Wax- thickening & accumulation	- On parallel lines with too narrow spaces inbetween - The beginning of a line - Spotted on the vertex of angled lines, jagged lines, and the start and end points of curves	Wax more accumulated on thicker line, made by repetitious strokes in short circular movements
	Variation	Straight lines, curves, angled lines	Straight lines with linear and sentripetal repetition, wavy, bold lines, curved repetition (like fins)
	Repetition	Mirrored, hal repeat, full repeat (programmed beforehand)	Varied, depends on the artisans
3	Shapes		
	Thickness	Stable on closed curves (± 2 mm), but not on flower and complex curves	1 mm – 5 mm
	Space between shapes	Min.3 mm on parallel lines. If too thin, the shapes tends to merge	Shapes are used to fill in background, so the spaces between flowers depends on other objects
	Neatness and presicion	Fine	Mistakes are found on some shapes
	Wax- thickening & accumulation	Spotted on: - the centre of flower shape - edge of flower petals (vertex) - intersection between lines and shapes - the starting point of new line when jogged with another line/curve/shape - the starting/closing point of a shape and curves - small shapes	Spotted on: - the centre of flower shape - edge of flower petals (vertex) - intersection between lines and shapes - the starting point of new line when jogged with another line/curve/shape - the starting/closing point of a shape and curves - small shapes - blocked areas
	Repetition	Patterned	Unpredictable (used to fill in the background)
	Variations		Depends on the artisan's ability

The difference in designing stage also affects the patterns. By using vector-based software, repetitive and mirrored pattern are easier to be made, as depicted on the pictures below.



Figure 15. Batiks that are made with combination of kelowong machine and manual technique

Based on that comparison, the characterization of design elements that was made by computerized and manual writing technique in Batik Adelia are:

a. Dots

With Batik Kelowong Machine, dots can be made by controlling movement and pressure on z axis. Dots that is produced by this technique are neat and precise, with relatively homogenic sizes (if wax temperatures are stable), but is not used because of effectivity reason. There was a lot of possibility that the dots would be out of target or didn't meet its standard if wax temperature or tip's pressure were not stable. This technique also limits the improvisations with *isen-isen* to fill in klowong shapes if they weren't being programmed beforehand.

Meanwhile, with *canting*, the neatness and precision of the dots cannot be guaranteed because the quality of dots depends to the artisan's ability, quality of *canting's* tip, and wax temperature. Nevertheless, this technique is considered as the best because artisans could improvise with *isen-isen* to fill in klowong shapes

b. Lines

The thickness of lines that is made by kelowong machine is relatively homogenic (if heat temperature was stable). Line-thickening could be caused by escalating temperature, while wax-accumulation could be caused by inadequate spaces between lines. Interloped lines, with space between lines $\leq 2\text{-}3\text{ mm}$, or angled lines with vertex ≤ 45 also may cause wax accumulation.

With *canting*, line thickness could be varied. It is harder to maintain control on wax temperature, that may cause the line instability. Nevertheless, *canting* technique is used to *nerusi* (make a line on the back of the fabric to revise the line where the wax was not perfectly penetrating the fabric)

c. Shape

On closed-curved shapes, wax tends to thicken on starting point, the intersection between two shapes, and small shapes Klowongan machine can make wax blocking (*tembokan*), but it is not practiced because of effectivity reason. Until now, wax blocking is done with manual technique.

d. Repetition

With klowong machine, patterns such as full repeat, half repeat, mirror, and mirror-invert repetitions can be made made neatly and precisely. Nevertheless, random repetition or improvised repetition couldn't be made. This also make manual technique is preferred to make background and *isen-isen*, because random repetition could be made with improvisation in needed areas.

5. Conclusions

The practice of computerized-batik technique by using batik klowong machine in batik production, as has been conducted in Adelia Workshop, Bekasi, has increased effectiveness and efficiencies during the process. A batik workshop does not have to rely on pattern makers and klowongan makers, thus cut off some expenses and time. Other than the line of process, it also affects batik designs. By using vector-based software in designing process, designer can experiment with various techniques digitally, such as repetition and mirroring. Using the machine also enhances precision, neatness, and exactness of the patterns. But the recent development of this machine can only be used in the making of main outline, not for isen-isen (detail of an ornament) or tembakan (blocking the pattern with malam), thus batik artisans are still needed to complete the project.

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