



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

SRI MAYASARI

DOCTOR OF PHILOSOPHY

2025



Institute of Technology Management and Entrepreneurship

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INDUSTRY**

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SRI MAYASARI



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



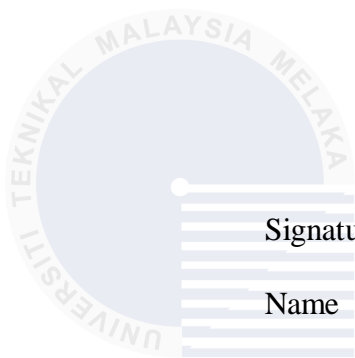
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DECLARATION

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.



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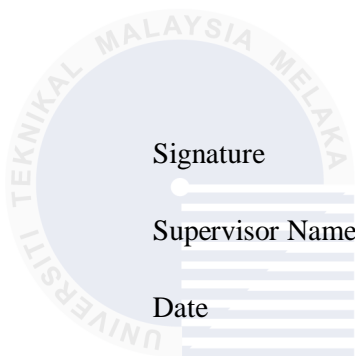
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APPROVAL

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.



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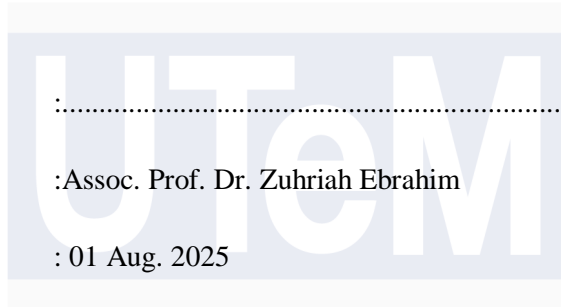
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DEDICATION

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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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, kebolehppercayaan, 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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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