



**Faculty of Manufacturing Engineering**

**DEVELOPMENT OF LEAN ENVIRONMENTAL MANAGEMENT  
INTEGRATION SYSTEM FOR SUSTAINABILITY OF  
ISO 14001: 2004 STANDARD**

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**DEVELOPMENT OF LEAN ENVIRONMENTAL MANAGEMENT  
INTEGRATION SYSTEM FOR SUSTAINABILITY OF ISO 14001: 2004  
STANDARD**

**ROBERT @ KERK SWEE TIAN**

**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 “Development of Lean Environmental Management Integration System for Sustainability of ISO 14001: 2004 Standard” 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 : .....

Date : .....

## **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 in Manufacturing Engineering.

Signature : .....

Supervisor's Name : .....

Date : .....

## **DEDICATION**

My dad,

For bringing

me to this world.

Beloved mum,

For taking good care since small and working hard for the family.

As well as precious advice and guidance in life and academic.

My concerned brother and sisters,

For giving support and bringing fun.

My dear wife for her support and understanding

My children's for their support and encouragement

## ABSTRACT

Nowadays, organizations are rapidly taking measures in integrating Environmental Management System (EMS) and lean practices in all types of environmental conditions in order to enhance their performance and efficiency. The main objective of this study is to propose a model that provides an EMS by integrating of ISO 14001:2004 standard with the lean principles that ensures the continuous improvement and sustainability for the organization in the current environment. This study develops the conceptual framework for EMS through integrated lean principles with ISO 14001. The developed model will be known as “Lean Environmental Management Integration System” (LEMIS). The developed framework will be tested in order to provide the conclusion to the study. This study conducts quantitative research to identify the answers for proposed objectives. Here, questionnaire is designed and provided to 140 managers from various organizations in Malaysia. The collected data is be tested by using SPSS tools. The findings of the study confirm that, successful integration of EMS, lean principles and ISO 14001 brings various advantages to the entire organization including employees, stakeholders, community, and customers. LEMIS performance measurement model was developed to visualize all the performance measures and involvement of all levels of employees to enhance the problem solving capability. The case study in real life implementation were used for results validation. Visual indicators helps the field workers avoid the repetition of past problem and only noticing the symptoms and quickly responded and take preventive actions. This study concludes that, integration of EMS and lean principles with ISO 14001 have ability to enhance the performance and efficiency of the organization.

## ABSTRAK

*Pada masa kini, organisasi cepat mengambil langkah-langkah dalam mengintegrasikan Sistem Pengurusan Alam Sekitar (EMS) dan amalan yang cekap di setiap jenis keadaan alam sekitar dalam usaha untuk meningkatkan prestasi dan kecekapan mereka. Objektif utama kajian ini adalah untuk mencadangkan satu model yang menyediakan EMS dengan mengintegrasikan ISO 14001: 2004 standard dengan prinsip-prinsip lean yang memastikan peningkatan berterusan dan kemampanan untuk organisasi dalam persekitaran semasa. Kajian ini membangunkan rangka kerja konsep bagi EMS melalui bersepadu prinsip lean dengan ISO 14001. Model yang dibangunkan akan dikenali sebagai " Sistem Integrasi dan Pengurusan Alam Sekitar " (LEMIS). Rangka kerja dibangunkan akan diuji untuk memberikan kesimpulan kajian itu. Kajian ini menjalankan penyelidikan kuantitatif untuk mengenal pasti jawapan untuk objektif dicadangkan. Di sini, soal selidik direka dan diberikan kepada 140 pengurus dari pelbagai organisasi di Malaysia. Data yang dikumpul diuji dengan menggunakan alat SPSS. Dapatan kajian ini mengesahkan bahawa, integrasi kejayaan EMS, prinsip lean dan ISO 14001 membawa pelbagai kelebihan kepada organisasi keseluruhan termasuk pekerja, pemegang kepentingan, komuniti, dan pelanggan. LEMIS model pengukuran prestasi telah dibangunkan untuk menggambarkan semua langkah-langkah prestasi dan penglibatan semua peringkat pekerja untuk meningkatkan keupayaan penyelesaian masalah. Kajian kes dalam pelaksanaan kehidupan sebenar telah digunakan untuk keputusan pengesahan. Petunjuk visual membantu pekerja mengelakkan pengulangan masalah lalu dan hanya perasan gejala dan cepat bertindak balas dan mengambil tindakan pencegahan. Kajian ini menyimpulkan bahawa, integrasi EMS dan prinsip lean dengan ISO 14001 mempunyai keupayaan untuk meningkatkan prestasi dan kecekapan organisasi.*

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## LIST OF ABBREVIATIONS

ASTM	-	American Society for Testing and Materials
ATMA	-	Accra Tema Metropolitan Area
BS	-	British Standards
BSI	-	British Standards Institute
CEO	-	Chief Executive Officer
CI	-	Continuous Improvement
CLD	-	Causal Loop Diagram
CSF	-	Critical Success Factor
CSR	-	Corporate Social Responsibility
EM	-	Emergency Medicine
EMAS	-	Eco-Management and Audit Scheme
EMS	-	Environmental Management System
ENGO	-	Environmental Non-Governmental Organizations
EPA	-	Environmental Protection Agency
EU	-	European Union
GATT	-	General Agreement on Tariffs and Trade
HRM	-	Human Resource Management
IEC	-	International Electrotechnical Commission
IMF	-	International Monetary Fund
ISM	-	Interpretive Structural Modelling

ISO	-	International Organization for Standardization
IT	-	Information Technology
JIT	-	Just in Time
LDCs	-	Low Developed Countries
LEMIS	-	Lean Environmental Management Integration System
MICMAC	-	Matrices Impacts Croises Multiplication Applique and Classment
MNC	-	Multinational Corporation
MS	-	Microsoft
NCR	-	Non Conformance
NIST MEP	-	National Institute of Standards and Technology Manufacturing Extension Partnership
OHSAS	-	Occupational Health and Safety Assessment Series
OHSMS	-	Occupational Health and Safety Management System
OPAC	-	Online Public Access Catalogue
PI	-	Performance Indicator
PMS	-	Performance Measurement System
QCDAC	-	Quality, Cost, Delivery, Accountability and Continuous Improvement
QMS	-	Quality Management System
SAE	-	Society Automotive Engineers
SAMB	-	Syarikat Air Melaka Berhad
SE	-	Standard Error
SPSS	-	Statistical Package for the Social Sciences
SRB	-	Sustainable Responsible Business
SSIM	-	Structural Self Interaction Matrix
TPS	-	Total Production System