

IDENTIFICATION OF KEY FACTORS AFFECTING GROWTH OF LED LIGHTING SOLUTIONS, A CASE STUDY BASED ON COLOMBO DISTRICT OF SRI LANKA

LIBRARY
UNIVERSITY OF MORATUWA, SRI LANKA
MORATUWA

By

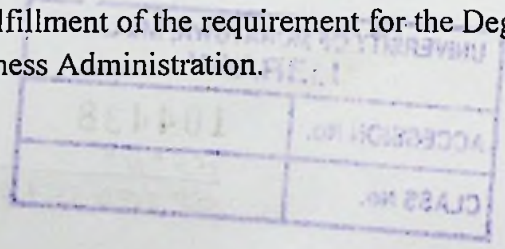
Buddhika S.B. Kondasinghe

[MBA/MOT/9013]

Supervised by

Prof. Sarath W.S.B. Dasanayaka

The Dissertation was submitted to the Department of Management of Technology of the University of Moratuwa in partial fulfillment of the requirement for the Degree of Master of Business Administration.



Department of Management of Technology
University of Moratuwa

65"11"
62:65(043)

TH

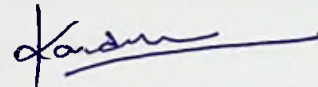


December 2011

104438

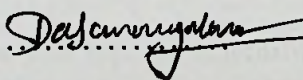
DECLARATION

"I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any University to the best of my knowledge and belief. It does not contain any material previously published, written or orally communicated by another person or myself except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for interlibrary loans, and for the title and summary to be made available to outside organizations"

Signature: ..B.S.6 

Date: ...11/01/2012

The above candidate has carried out research for the Masters/MPhil/PhD thesis/
Dissertation under my supervision.

Signature of the supervisor: .. .. Date: ..13/01/2012 ..

ABSTRACT

The main purpose of this study is to identify the key factors affecting growth of Light Emitting Diodes (LED) lighting solutions in Sri Lanka and recommend appropriate policies to develop them in a sustainable manner to improve the market acceptance for these products. This research was carried out a situational analysis of the Sri Lankan market through literature and an in-depth questionnaire survey mainly in Colombo district. The questionnaire survey was carried-out to identify key factors which effect the growth of LED business with further analysis of the qualitative aspects. This was cross checked through the structured interviews with industry experts, consumers, technical and financial decision makers, financial institutes and government regulators. The situational analysis of clusters shows that in overall there is high electricity cost in Sri Lanka. Therefore, both government and private sectors are searching low cost, low power consumption lighting solution to reduce their daily power costs and consumption. Even though there are alternative products available in the market to reduce the cost, literature shows that there is high environmental impact with those solutions. Survey responses show that there are main five key factors that are critical for the development of LED business clusters with reaming sub factors. This study only covers private and government institutes in Colombo district cluster but there are more clusters available in Sri Lanka therefore generalization of this specific sector results for other clusters may have some limitations. Compare with the benefits of LED with incandescent bulb and CFL bulbs they seem like more advantages over the traditional lighting systems. The low power consumption is the key benefit of LED solution. The efficacy of this bulb is 88% compare to traditional bulbs. But SMEs and large corporates will try to recover their investment from short period of time such as two years. Due to these issues popularizing High Bright LED lighting solution has become such a challenge in Sri Lanka. This is the first time this type of scientific study carryout in Sri Lanka to identify the key success factors affecting the increase the market acceptance of the LED business and its products. Even though there are multiple benefits of LEDs, customer acceptance for LED bulbs was identified as lagging compare to other new energy technologies. The methodology employed and the policies derived can be used as guides to similar types of green concept biased research in other countries as well.

Key words: Light Emitting Diodes; LED, Environmental Impact, Key success factors, Market Acceptance, Sri Lanka.

ACKNOWLEDGEMENT

This research dissertation was completed with the assistance, ideas, guidance and encouragement from a lot of people.

First, I wish to express my gratitude to my supervisor Prof. Sarath Dasanayake, University of Moratuwa. His knowledge of the related literature, strong managerial perspective, and willingness to exchange and shape ideas were crucial in the overall development of this study. Your contributions had been of great value to the final result. And also I would like to thank Dr. Raj Prasanna Lecturer, University of Moratuwa, for the encouragement, guidance and support extended throughout the research project.

I am greatly indebted to my wife and parents for their endless patience and for encouragement given throughout my study.

I would also like to convey my thanks to Mr. Kiththi Perera, the Chief Enterprise and Wholesales Officer of Sri Lanka Telecom and Mr. Ranith Kiriella the Deputy General Manager of Sri Lanka Telecom for sharing the literature and invaluable assistance. Further, the contribution of each and every government and private organizations who extends their support in collecting data and lending a supporting hand in every possible way is much appreciated.

Last but not least I thank all those whose names were, though not mentioned for their help and encouragement in completing this research study.

LIST OF TABLES

DECLARATION.....	I
ABSTRACT.....	II
ACKNOWLEDGEMENT.....	III
LIST OF TABLES.....	VII
LIST OF FIGURE.....	VIII
LIST OF ABBREVIATIONS.....	IX
1 Introduction.....	1
1.1 Background and Motivation Of The Study.....	3
1.2 Research Problem.....	4
1.3 Research Objectives.....	6
1.4 Research Questions.....	6
1.5 Scope Of The Study.....	6
1.6 Significance Of The Study.....	7
1.7 Research Scope And Design.....	7
1.8 Limitations Of The Study.....	8
1.9 Chapter Organization.....	9
2 Literature Review.....	10
2.1 The History Of Leds.....	11
2.2 Uses Of Silicones For Led Applications.....	14
2.2.1 Protection.....	14
2.2.2 Light Extraction.....	14
2.2.3 Forming Lenses - Optical Parts Fabrication.....	15
2.2.4 Thermal Management.....	15
2.2.5 Optical Clarity And Lumen Maintenance.....	15
2.2.6 Heat Dissipation.....	15
2.3 Applications For Silicone In Led's.....	16
2.3.1 Mobile Appliances.....	17
2.3.2 Automotive Lighting.....	17
2.3.3 Lcd Display Backlighting.....	17
2.3.4 Illumination.....	18

2.3.5	Traffic And Signal Lighting.....	18
2.4	Led Industry And Competitive Technologies.....	18
2.4.1	Understanding Popular Light Sources.....	19
2.4.2	Overview Of The Led Lighting Industry.....	20
2.4.3	Global Market Effects Of The Led Bulb-.....	24
2.4.4	Led Lighting Standards: A Push For The Led Lighting Industry.....	25
2.4.5	Changes In Led Patent Deployment.....	25
2.4.6	Led Lighting Boom In China.....	26
2.4.7	Development Trends For The Led Lighting Industry After 2010.....	28
2.4.8	Incandescent Lamp Prohibition Gives Rise To Led Bulbs.....	29
2.4.9	Slow Led Technology Advancement.....	30
2.5	New Products And Technologies In The Led Lighting Industry.....	32
2.6	Understating Drawbacks Of The Hb Leds.....	33
3	Methodology.....	37
3.1	Conceptual Framework And Operationalization.....	37
3.1.1	Information & Awareness.....	41
3.1.2	Technology.....	41
3.1.3	Financing Mechanism.....	41
3.1.4	Government Policies.....	42
3.2	Sampling Plan.....	42
3.3	Information Gathering Method.....	42
3.4	Target Population.....	43
3.5	Target Sampling.....	43
3.5.1	Government Institutes.....	44
3.5.2	Private Institutes.....	44
3.5.3	Small & Medium Institutes.....	44
3.6	Contact Method And Data Processing.....	44
3.7	Data Analysis.....	45
3.7.1	Qualitative Methods.....	45
4	Data Analysis.....	46
4.1	Information Based On Questionnaire.....	46
4.1.1	General Information.....	46
4.2	Information & Awareness.....	51

4.2.1	Awareness Of Hb Led As Low Power Consumption Light Source.....	51
4.2.2	Information Related To Carbon Credits.....	54
4.2.3	Awareness About Cost Savings.....	56
4.3	Technology Of The Hb Leds.....	57
4.4	Financing Mechanism.....	58
4.4.1	Loan Schemes Available.....	58
4.5	Government Policies.....	61
5	Conclusions And Recommendations.....	64
5.1	Findings.....	64
5.1.1	Market Situation In Led Business And Potential Market Segments.....	64
5.1.2	Factors Relate To Growth Of The Hb Led Business.....	64
5.2	Conclusions.....	70
5.3	Policy Recommendations.....	71
5.3.1	Technology.....	71
5.3.2	Marketing And Consumer Education.....	71
5.3.3	Program Design.....	73
5.4	Agenda For Future Research.....	75
5.4.1	Electron Stimulated Luminescence(Esl) Lighting Technology.....	75
	Appendix 1:Comparison Chart Led Vs. Incandescent Vs. Cfls.....	81
	Appendix 2:Understanding Led Lighting.....	83
	APPENDIX 3: QUESTIONNAIRE (ENGLISH).....	88
	Appendix 4:Potential Mercury Emissions Due To Cfls.....	94

LIST OF TABLES

Table No	Description	Page No.
Table 2.1:	Advantages of Silicones Based on Their Inherent Properties	16
Table 3.1 :	Operationalization Table.....	38
Table 4.1:	Statistic for General Information	47
Table 4.2:	Awareness of HB LED as low power consumption light source	51
Table 4.3:	Knowledge about the various properties of HB LEDs	52
Table 4.4:	Information related to carbon credits.....	55
Table 4.5:	Awareness about cost savings	56
Table 4.6:	Technology of the HB LEDs	57
Table 4.7:	Loan schemes available	59
Table 4.8:	Government tax concessions	60
Table 4.9:	Government Policies.....	61

LIST OF FIGURE

Figure 2.1:cross section of LED	10
Figure 2.2: LED Development History	11
Figure 2.3: previous Luminous Efficacy of Lamps	12
Figure 2.4: latest Luminous Efficacy of Lamps.....	13
Figure 2.5:(a) The cross-sectional of a LED (b) emission mechanism of the LED... 13	
Figure 2.6:Scale of Global LED Lighting Fixture Market, 2005-2009	21
Figure 2.7:Global LED Lighting Fixture Market Analysis - by Region.....	22
Figure 2.8:Global LED Lighting Fixture Market Analysis - by Application	23
Figure 2.10:Overseas Investment in China.....	28
Figure 2.11:Forecast of Global LED Lighting Fixture Market Scale, 2008-12.....	29
Figure 2.12:Schedule of Low-efficiency Light Source Prohibition Worldwide.....	30
Figure 3.1: Conceptual model.....	38
Figure 3.2: Target Population	43
Figure 3.3: Classification of responses for the all questions	45
Figure 4.1 Sector which respondent belongs to	48
Figure 4.2: Profession of the respondent	49
Figure 4.3: Application of lighting solution	49
Figure 4.4: Power usage of the respondent.....	50
Figure 4.5: Power usage monitoring of the respondent	50
Figure 4.6: Knowledge about amount of light emission.....	53
Figure 4.7: Knowledge about working voltages	54
Figure 4.8: Knowledge of CER program	56
Figure 4.9: Knowledge about approximate cost of LED vs. other alternatives	57
Figure 4.10: Life expectation of bulb	58
Figure 4.11: Government tax exceptions	60
Figure 4.12: Government initiatives to promote HB bulbs.....	62
Figure 4.13: reduction of hazardous elements	62
Figure 4.14: Government approach to access international CER	63
Figure 4.15: Effort taken by government to recycle CFLs	63

LIST OF ABBREVIATIONS

AC	–	Alternating Current
Asp	–	Arsenide Phosphide
CBSL	–	Central Bank of Sri Lanka
CCFL	–	Cold-Cathode Fluorescent Lamps
CFL	–	Compact Fluorescent Lamp
CFO	–	Chief Financial Officer
DC	–	Direct Current
Gaasp	–	Gallium Arsenide Phosphide
Gan	–	Gallium Nitride
GDP	–	Gross Domestic Product
GHG	–	Greenhouse Gas
HB	–	High Brightness
HID	–	High Intensity Discharge
HOD	–	Head Of The Department
HPS	–	High Pressure Sodium
LCD	–	Liquid Crystal Display
LED	–	Light Emitting Diodes
Oleds	–	Organic Leds
PSU	–	Power Supply Unit
RI	–	Refractive Index
SME	–	Small And Medium Enterprise
SPSS	–	Statistical Package for Social Sciences
SSL	–	Solid State Lighting
USA	–	United States of America