



UNIVERSITI PUTRA MALAYSIA

**LIFE CYCLE ASSESSMENT FOR MANAGING HOUSEHOLD
WASTE IN TEHRAN, IRAN**

HELEN MORABI HERAVI

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By

HELEN MORABI HERAVI

**Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Doctor of Philosophy**

March 2014

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of the Doctor of Philosophy

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March 2014

Chair: Professor Mohd Bakri Ishak, PhD

Faculty: Environmental studies

Life cycle assessment (LCA) methodology in this thesis was used to determine the optimum Recyclable Household Waste management strategy for Tehran city. The thesis targets the household waste of Tehran, and the problem was made by posing significant environmental, health hazards, and harming economies. The municipality intends to eliminate activities that have the potential to cause a non-compliance till prevent recurrence. Corrective actions have an effect on the potential problems which is a crucial issue for any major cities worldwide. Tehran is a large urban cluster, which is chosen for this study. The study also fits with the five year waste management, design of the municipality. Life cycle management (LCM) of household waste is analyzed based on direct data observations. The current research has relevance in solving real life environmental problems.

The main aim of the study was examined and recommends ways to reduce the environmental emissions of recyclable household waste operations. The goal of study to assess the environmental potential effects such, acidification; global warming , eutrophication, solid waste and water consumption per capita of household waste in the steps of storing, collecting and recycling by IMPACT2000+ Method. Type study is cradle to cradle of the LCA method.

The main objective of this thesis is studying the achievement to optimum potential environmental impacts per 200 kg capita in managing household waste. The specific objectives are the identification of the most environmentally aspects (EMS), to assess the risk of the unit processes of household waste, to analyze the inventory of unit processes, to determine the correlation between inputs and out-puts also determine the sensitivity value outputs to inputs in the life cycle, to assess potential environmental emissions and environmental impacts of three group scenario in the life cycle and, to determine of the best scenario for Tehran. The objectives focus on related sustainable development and environment issues and the current status of different environmental tools.

Database emissions were estimated by the World Health Organization (WHO) and Japan International Cooperation Agency (JICA). Life Cycle Assessment (LCI)

provides the basis for evaluating the potential environmental impacts. The thesis adopts a unique combination of analytical and field based methods. The key component is direct observations and field data collections, which is strengthened by different analysis and models. An analysis is made based on observed data and models. Both direct and indirect emissions associated with source separation practices as well as those avoided due to replacing storage bag/bin and vehicles. The categories of environmental and resource consumption that is proportional to the local and global level, mainly includes the effects of acidification, global warming, respiratory effect, solid waste and water consumption.

System boundary recyclable materials are as cradle to cradle and the separation and storage of recyclable materials has been started from homes, kerbside or buy back centers and ultimately lead to recycling factories. Functional unit is calculated based on the capita of collecting recyclable materials. Collection and storage of various types of recyclable materials used different equipment. Due to time and resource constraints, this LCA evaluates the potential impacts storage bags and vehicle collection in the recyclable household waste, a 57% door-to-door service, 34% kerbside sorting, and 9% buyback centers by work sheets.

An effective source separation management system is needed in Tehran since the generated recyclable materials are separated in the kerbside without any control and hasn't had a materials recovery facility (MRF)/Transfer Stations (TS). Waste (MSW) produced in Tehran was 7,000 metric tons per day. Currently, Tehran produces more than 2.5 million tonnes of waste every year. Waste analysis was carried out in all of the 22 Tehran regions, the results shows that 32% of waste is recyclable. Waste source separation promotes the use of reachable waste and reduce environmental and health risks as well as the national capital.

Several waste source separation schemes were implemented in Tehran regions, including: Tehran waste management organization currently promote and support initiative waste source separation programs of the buyback center, door-to-door service and kerbside sorting. Most local authorities have practiced forms of reclamation in past years. Source separation schemes were established in 1995 by contractors that currently covenant its surplus to participating local and government contractors in developing their long-term strategy.

These containers are located in various places around the main city of the region – Tehran. There are 22 regions where people can bring their pre-separated recyclable materials. The collected materials, in principle, are going to be sold to recycling companies and then to the market.

In this thesis source separation alternative were investigating an environmental impact and process risk. Waste source separation is concluded that there is a high risk of recycling due to lack of quality control of the product. The thesis concludes with a series of actions for municipal waste management. With detailed literature review, original data analysis, and has been able to provide in-depth analysis of the research problem and has provided recommendations. The alternative scenarios were compared through the IMPACT 2000+Method (Excel file of Gabi software; ver 2.1)

and these comparisons were carried out from the global warming, human respiratory, acidification, eutrophication, water consumption, and solid waste points of view.

In total, nine different scenarios were developed as alternatives on management system of the recyclable household and hotspot analysis is made considering its environmental impacts. Impacts on respiration, BOD, Total N, acidification, global warming is calculated based on these nine scenarios. Storage, collection of recyclable materials and recycling processes were considered in these scenarios. According to the comparisons, sensitive analysis and emission burden model, in all nine scenarios, total emissions are consistently lower when plastic bag is used rather than paper bags.

To perform each of the suggested scenarios will depend on the decision policies. It is recommended developing a kerbside with High Density Polystyrene (HDPE) blue bins and exciting buy back centers programs in the near future. A kerbside system by HDPE blue bin by using mini-truck is the more environmentally preferable alternative and process has lower risk. Recommendation, used on mini-truck and kerbside collection are the most commonly used source separation systems, that are perform in worldwide.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PENILAIAN KITARAN HAYAT BAGI MENGURUSKAN SISA ISI RUMAH DI TEHRAN-IRAN

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Kaedah Penilaian Kitar Hayat (LCA) dalam penyelidikan ini telah digunakan untuk menentukan secara optimum strategi pengurusan kitar semula sisa isi rumah di Bandar Tehran. Tesis ini tertumpu kepada sisa isi rumah dan juga masalah yang timbul daripada tindakan penjagaan alam sekitar, risiko kesihatan dan ancaman ekonomi. Majlis perbandaran lebih memilih untuk menolak aktiviti yang berpotensi menyebabkan ketidakpatuhan sehingga sampai ke tahap mengelakkan daripada pengulangan kembali. Tindakan pembetulan member kesan kepada masalah-masalah yang berpotensi iaitu menjadi isu penting kepada mana-mana ibu kota secara global.

Tehran adalah kelompok bandar besar sebagaimana dipilih untuk penyelidikan ini. Penyelidikan ini juga berpadanan dengan corak pengurusan sisa selama lima tahun oleh majlis perbandaran. Pengurusan kitar hayat adalah system pengurusan sisa isi rumah yang dianalisa berdasarkan data pemerhatian secara terus. Penyelidikan terkini menunjukkan kesesuaian dalam penyelesaian masalah alam sekitar yang nyata.

Tujuan utama penyelidikan ini adalah untuk menyelidik dan mencadangkan cara untuk mengurangkan pelepasan kepada alam sekitar melalui pengoperasian sisa isi rumah yang boleh dikitar semula. Sasaran penyelidikan ini adalah untuk menilai kesan alam sekitar yang berpotensi seperti pengasidan; pemanasan global dan eutrophication, kaedah penyimpanan sisa pepejal dan penggunaan air per kawasan sisa isi rumah, pengumpulan serta kitar semula melalui kaedah *IMPACT2000+*. Jenis penyelidikan ini berasal dari kaedah LCA.

Objektif utama tesis ini adalah untuk menyelidik pencapaian kepada potensi kesan-kesan alam sekitar yang optimum per 200 kg kapasiti dalam pengurusan sisa isi rumah. Objektif-objektif khusus adalah menentukan aspek paling mesra alam (EMS), menyelidik risiko setiap unit pemprosesan sisa isi rumah, menganalisa senarai unit pemprosesan, menentukan hubungan antara kemasukan dan pengeluaran serta nilai kepekaan pengeluaran kepada kemasukan dalam kitar hayat, menilai potensi pelepasan kepada alam sekitar dan kesan alam sekitar terhadap tiga kumpulan scenario dalam kitaran hayat dan menentukan scenario terbaik bagi Tehran.

Pangkalan data pelepasan telah dianggarkan oleh Pertubuhan Kesihatan Sedunia (WHO) dan Agensi Kerjasama Jepun dan Antarabangsa (JICA). Penyenaraian kitar hayat (LCI) menyediakan tapak untuk penilaian kepada kesan-kesan alam sekitar yang berpotensi. Tesis ini mengadaptasi gabungan unik analisis dan kaedah lapangan. Komponen kunci adalah pemerhatian secara terus dan pengumpulan data lapangan dimana kekuatannya terletak kepada perbezaan analisis dan model. Analisa dilakukan berdasarkan data pemerhatian dan juga model. Kedua-dua pelepasan sama ada secara langsung atau tidak langsung digabungkan dengan tindakan pengasingan daripada sumber dan pengelakkan tindakan tersebut disebabkan penukaran penyimpanan beg/tong serta kenderaan. Kategori alam sekitar dan penggunaan sumber yang berkadar terus dengan tahap tempatan dan global termasuk kesan pengasidan, pemanasan global, kesan pernafasan, sisa pepejal dan penggunaan air.

Sistem kesempadanan kitar semula barangan adalah berasal dari pengasingan dan penyimpanan barangan kitar semula telah bermula dari rumah, di kaki lima atau di pusat penebusan dan khususnya diterajui oleh kilang-kilang kitar semula. Unit kefungisian dikira berdasarkan kapasiti pengumpulan barangan kitar semula. Pengumpulan dan penyimpanan pelbagai jenis barangan kitar semula menggunakan peralatan berbeza. Disebabkan kekangan masa dan sumber, LCA ini menilai kesan potensi penyimpanan beg dan kenderaan pengumpulan sisa isi rumah yang dikitar semula iaitu 57% dari perkhidmatan pintu ke pintu, 34% dari kutipan di kaki lima dan 9% dari pembelian di pusat penebusan.

Sistem pengurusan pengasingan sumber yang berkesan diperlukan di Tehran disebabkan barangan kitar semula yang terhasil kini diasingkan di kaki lima tanpa pemantauan dan ketiadaan kemudahan pemerolehan kembali barangan (MRF)/stesen pemindahan (TS). Di Tehran, secara purata 7,000 tan metric sisa dihasilkan setiap hari bagi setiap kawasan bandar. Terkini, lebih daripada 2.5 juta tan sisa dihasilkan secara tahunan di Tehran. Berdasarkan analisa sisa yang dilakukan, 32% adalah sisa yang boleh dikitar semula. Promosi pengasingan sumber yang boleh dikitar semula dijangka akan membantu dalam aktiviti kitar semula dan penghindaran pencemaran alam sekitar disamping kehilangan modal Negara.

Pelbagai skim telah dilaksanakan untuk pengumpulan barangan kitar semula oleh organisasi pengurusan sisa di Tehran iaitu di lokasi yang berbeza dan dibahagikan kepada tiga kumpulan; pusat penebusan, perkhidmatan pintu ke pintu dan pengasingan di kaki lima menjadi inisiatif yang digunapakai di Bandar Tehran dalam hal pengasingan sumber. Kebanyakan badan berkuasa tempatan telah mempraktikkan pelbagai bentuk tuntutan selama beberapa tahun yang lepas. Skim pengasingan sumber telah dibangunkan pada tahun 1995 oleh kontraktor-kontraktor swasta dan kerajaan dalam pembangunan strategi jangka panjang.

Bekas-bekas ini terletak di beberapa lokasi sekitar bandar utama di Tehran. Terdapat 22 kawasan di mana penduduk boleh membawa sendiri barangan kitar semula yang separa terasing. Barangan terkumpul secara prinsipnya akan dijual kepada syarikat-syarikat kitar semula dan seterusnya ke pasaran.

Alternatif pengasingan sumber dalam tesis ini telah dikaji berdasarkan kesan alam sekitar dan risiko pemprosesan. Pengasingan sisa daripada sumber dapat dirumuskan

bahawa aktiviti kitar semula ini mempunyai risiko yang tinggi disebabkan kurangnya pengawasan kualiti produk. Rumusan daripada tesis ini adalah siri-siri tindakan untuk pengurusan sisa. Senario-senario alternative dibandingkan melalui Kaedah Impak 2000+ (fail Excel daripada perisian Gabi; versi 2.1) dan perbandingan ini dilakukan berdasarkan pandangan pemanasan global, pernafasan manusia, pengasidan, eutrophication, penggunaan air, dan sisa pepejal.

Secara keseluruhan, sembilan senario berbeza telah dibangunkan sebagai alternative system pengurusan barangan isi rumah yang boleh dikitar semula dan analisa titikpanas dijalankan dengan mengambil kira kesan alam sekitar. Kesan kepada pernafasan, BOD, jumlah N, pengasidan dan pemanasan global dikira berdasarkan 9 senario tersebut. Penyimpanan, pengumpulan barangan yang boleh dikitar semuladan dan proses kitar semula turut diambil kira. Berdasarkan perbandingan, analisa kepekaan dan model bebanan pelepasan, jumlah pelepasan adalah rendah secara konsisten pada kesemua sembilan senario apabila beg plastic digunakan jika dibandingkan dengan beg kertas.

Susunan kedudukan kesan alam sekitar daripada alternative yang dipilih bergantung kepada keputusan polisi lain. Dicadangkan alternative pengasingan sumber untuk masa hadapan adalah tong biru Politen ketumpatan tinggi (HDPE) di kaki lima dan juga pusat penebusan kembali. System tong biru HDPE di kaki lima dengan penggunaan trak mini adalah alternative alam sekitar yang bersesuaian disamping risiko pemprosesan adalah rendah. Dicadangkan agar penggunaan trak mini dan pengumpulan di kaki lima adalah sistem pengasingan sumber yang menjadi aktiviti kebiasaan di seluruh dunia. Untuk jangka masa yang panjang, secara amnya pengurusan sisa isi rumah yang boleh dikitar semula ini sangat bergantung kepada keputusan politik.

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To my family and best wishes for long life, health and happiness

To my dear father that I'm looking forward to seeing him

Last but not least, I gratefully acknowledge kind support provided by UPM members

I certify that a Thesis Examination Committee has met on 27 March 2014 to conduct the final examination of Helen Morrahi Heravi on her thesis entitled "Life Cycle Assessment for Managing Household Waste in Tehran, Iran" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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DECLARATION

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TABLE OF CONTENTS

	Page
ABSTRACT	i
ABSTRAK	iv
ACKNOWLEDGMENTS	vii
APPROVAL	viii
DECLARATION	x
LIST OF TABLES	xv
LIST OF FIGURES	xix
LIST OF ABBREVIATIONS	xxiv
LIST OF SYMBOLS	xxv

CHAPTER

1	INTRODUCTION	1
	1.1 Problem statement	2
	1.2 Significant of the study	3
	1.3 Research questions	4
	1.4 Study objectives	5
	1.5 Organization of the thesis	5
2	LITERATURE REVIEW	7
	2.1 Introduction	7
	2.2 Sustainable development	7
	2.3 Life cycle assessment concepts	8
	2.3.1 Goal and scope	9
	2.3.2 Life cycle inventory	11
	2.3.3 Life cycle impact assessment	12
	2.3.4 Life cycle interpretation	24
	2.4 Household waste hierarchy	25
	2.4.1 Household waste storage	27
	2.4.2 Collection systems	27
	2.4.3 Material recovery facilities (MRFs)	28
	2.4.4 Direct collection and transportation	29
	2.4.5 Main models of recycling	30
	2.5 The problems associated with household waste hierarchy	30
	2.5.1 Occupational hazards and environmental aspects	31
	2.5.2 GHG emissions in waste management systems	34
	2.6 Previous studies on the household waste using LCA approach	35
	2.6.1 Previous studies on the storage bag/bin	35
	2.6.2 Previous studies on the collection systems	36
	2.6.3 Previous studies on the collection and transportation vehicles	38
	2.6.4 Previous studies on the recycling options	38
	2.7 Multi-critical decision making	42
	2.8 Summary	43

3	MATERIALS AND METHOD	44
3.1	Introduction	44
3.2	Scope	44
3.2.1	Location and site description	44
3.2.2	Allocation of the management system	46
3.2.3	Storage	47
3.2.4	Collection systems	48
3.2.5	MRF plant	54
3.2.6	Road transportation	55
3.2.7	Recycling technologies	56
3.3	Environmental management method	66
3.4	Risk assessment method	68
3.5	Data collection methods	70
3.5.1	Data quality goals	70
3.5.2	Identifying data sources and types	71
3.5.3	Developing a data collection worksheet and checklist	73
3.5.4	Assumptions about data	73
3.6	Life cycle assessment method	80
3.6.1	Goal and scope	80
3.6.2	Life cycle inventory	82
3.6.3	Life cycle impact assessment (LCIA results)	86
3.6.4	Life cycle interpretation	87
3.7	Limitations and uncertainties	88
3.8	Completeness, consistency and sensitivity check	88
3.8.1	Validity of input-output data	88
3.8.2	Verification of valid data	89
3.8.3	Reliability of input-output data	89
3.9	Multi-critical decision making	92
3.10	Summary	97
4	RESULT OF TEHRAN HOUSEHOLD WASTE	98
4.1	Introduction	98
4.2	Life cycle environmental management	99
4.3	Life cycle risk assessment	113
4.4	Life cycle inventory	130
4.4.1	Household waste composition and amount in Tehran	130
4.4.2	System expansion and allocation	139
4.4.3	Inventory emissions of the unit process	148
4.5	Life cycle inventory analysis	152
4.5.1	Sensitivity unit processes to the input hotspots	152
4.5.2	Sensitivity unit processes to the output hotspots	154
4.5.3	Correlation between input-output in life cycle perspective	157
4.6	Life cycle impact assessment	159
4.6.1	Midpoint indicator analysis of the unit processes	159
4.7	Avoided emissions burden model of the unit process	161
4.8	Summary	179

5	DISCUSSION AND INTERPRETATION TEHRAN SCENARIOS	180
5.1	Introduction	180
5.2	Continual improvement of managing household waste	180
5.3	Control hazards and threats of managing household waste	183
5.4	Life cycle inventory analysis of Tehran scenarios	189
5.4.1	Sensitivity scenario alterations	189
5.4.2	Inventory analysis of Tehran group scenarios	191
5.5	Impact assessment of Tehran scenarios	200
5.5.1	Midpoint indicator analysis of Tehran group scenarios	200
5.6	Avoided emission burdens model of Tehran scenarios	205
5.7	Uncertainty of the results	212
5.7.1	Inventory uncertainty	212
5.7.2	Uncertainty in the impact assessment	213
5.8	Summary	214
6	CONCLUSION AND RECOMMENDATION FOR FUTURE	216
6.1	Introduction	216
6.1.1	Environmental management conclusion and recommendation	216
6.1.2	Risk assessment conclusion and recommendation	218
6.1.3	Inventory analysis conclusion and recommendation	221
6.1.4	Impact assessment conclusion and recommendation	228
6.1.5	Decision making conclusion and recommendation	230
6.2	Significant contributions of the research	233
6.3	Suggestions for future work	237
	REFERENCES	236
	APPENDIX A	240
	APPENDIX B	249
	BIODATA OF STUDENT	273
	LIST OF PUBLICATIONS	274

LIST OF TABLES

Table	Page
2.1 Life cycle stages and unit processes	26
3.1 Types of vehicles and their groups	72
3.2 Checklist of issues and potential of the heterogeneous (contradictions)	74
3.3 Type of the containers in the recyclable management and their characteristics	77
3.4 Specification of the collecting vehicles	78
3.5 Reliability results of storage bag	89
3.6 Reliability results of collecting waste	90
3.7 Reliability results of recycling facilities	90
3.8 Reliability statistics on environmental aspects	90
3.9 Summery item statistics on environmental aspects	91
3.10 Reliability results of risk process	91
3.11 Summery statistic items of risk process	92
4.1 Characterization results for the Tehran household waste [kg- emissions year ⁻¹], considering a life cycle perspective	150
4.2 Normalization results for the Tehran household waste [kg- emissions person ⁻¹ capita ⁻¹ year ⁻¹], considering a life cycle perspective	151
4.3 Normalized data for the Tehran storage process [kg-emissions person ⁻¹ capita ⁻¹ year ⁻¹], considering a life cycle perspective	155
4.4 Normalization means results in the Tehran collection [kg-emissions person ⁻¹ capita ⁻¹ year ⁻¹], considering a life cycle perspective	156
4.5 Normalization means value results for the Tehran recycling facilities [kg-emissions person ⁻¹ capita ⁻¹ year ⁻¹], considering a life cycle perspective	156
4.6 The correlation between environmental emissions, consumption and aspect code in the storage process (n=13) [kg-emission person ⁻¹ capita ⁻¹ year ⁻¹]	157

4.7	The correlation between environmental emissions, consumption and aspect code in the recycling process (n=17) [kg-emission person ⁻¹ capita ⁻¹ year ⁻¹]	158
4.8	Midpoint results for the Tehran storage process [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹], considering a life cycle perspective	159
4.9	Midpoint results for the Tehran collection [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹], considering a life cycle perspective	160
4.10	Midpoint results for the Tehran recycling [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹], considering a life cycle perspective	161
4.11	$(\sum x^2)^{1/2}$ score of option <i>i</i> with respect to criterion <i>j</i> storage bag/bins [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	162
4.12	Construct normalized decision matrix ($r_{ij} = x_{ij} / (\sum x^2_{ij})$) storage bag/bin [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	163
4.13	Ideal solution A* storage bag/bin [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	164
4.14	The negative ideal solution A' storage bag/bin [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	165
4.15	$(\sum x^2)^{1/2}$ score of option <i>i</i> with respect to criterion <i>j</i> collection systems [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	168
4.16	Construct normalized decision matrix ($r_{ij} = x_{ij} / (\sum x^2_{ij})$) collection systems [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	169
4.17	Ideal solution A* collection system [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	170
4.18	The negative ideal solution A' collection system [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	171
4.19	$(\sum x^2)^{1/2}$ score of option <i>i</i> with respect to criterion <i>j</i> recycling bag/bins [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	174
4.20	Construct normalized decision matrix ($r_{ij} = x_{ij} / (\sum x^2_{ij})$) recycling facilities [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	175
4.21	Ideal solution A* recycling facilities [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	176
4.22	The negative ideal solution A' [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	177
5.1	Assessing of failure modes in the life cycle of household waste	186

5.2	Assessing of failure modes in the life cycle of household waste	187
5.3	Identified actions leading to improvement of waste source separation	188
5.4	Normalization results for the Tehran scenarios relative to the annual environmental emissions [kg-emissions person ⁻¹ capita ⁻¹], considering a life cycle perspective	193
5.5	Bound on SO ₂ emissions from three group scenarios in a life cycle perspective [kg-SO ₂ person ⁻¹ capita ⁻¹ year ⁻¹]	194
5.6	Bound on NO _x emissions from three group scenarios in a life cycle perspective [kg-NO _x person ⁻¹ capita ⁻¹ year ⁻¹]	195
5.7	Bound on CO ₂ emissions from three group scenarios in a life cycle perspective [kg-CO ₂ person ⁻¹ capita ⁻¹ year ⁻¹]	195
5.8	Bound on CH ₄ emissions from three group scenarios in a life cycle perspective [kg-CH ₄ person ⁻¹ capita ⁻¹ year ⁻¹]	196
5.9	Bound on N ₂ O emissions from three group scenarios in a life cycle perspective [kg-N ₂ O person ⁻¹ capita ⁻¹ year ⁻¹]	197
5.10	Bound on CO emissions from three group scenarios in a life cycle perspective [kg-CO person ⁻¹ capita ⁻¹ year ⁻¹]	197
5.11	Bound on NMVOC emissions from three group scenarios in a life cycle perspective [kg-NMVOC person ⁻¹ capita ⁻¹ year ⁻¹]	198
5.12	Bound on PM _{2.5} emissions from three group scenarios in a life cycle perspective [kg-PM _{2.5} person ⁻¹ capita ⁻¹ year ⁻¹]	198
5.13	Bound on BOD emissions from three group scenarios in a life cycle perspective [kg-BOD person ⁻¹ capita ⁻¹ year ⁻¹]	199
5.14	Bound on Total N emissions from three group scenarios in a life cycle perspective [kg-Total N person ⁻¹ capita ⁻¹ year ⁻¹]	200
5.15	Normalization mean and Std. Deviation results for the Tehran group scenarios A,B and C [kg-equivalent person ⁻¹ capita ⁻¹], considering a life cycle perspective	201
5.16	Bound on the acidification emissions from three group scenarios in a life cycle perspective [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	202
5.17	Bound on the global warming emissions from three group scenarios in a life cycle perspective [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	203

5.18	Bound on the respiratory effect emissions from three group scenarios in a life cycle perspective [kg-equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	203
5.19	Bound on the BOD ₅ emissions from three group scenarios in a life cycle perspective [kg- equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	204
5.20	Bound Total N emissions from three group scenarios in a life cycle perspective [kg- equivalent person ⁻¹ capita ⁻¹ year ⁻¹]	205
5.21	$(\sum x^2)^{1/2}$ score of option i with respect to criterion j scenarios in a life cycle perspective[kg -equivalent person ⁻¹ capita ⁻¹]	207
5.22	Construct normalized decision matrix ($r_{ij} = x_{ij} / (\sum x^2_{ij})$) scenarios in a life cycle perspective[kg -equivalent person ⁻¹ capita ⁻¹]	208
5.23	The ideal solution A*scenarios in a life cycle perspective [kg -equivalent person ⁻¹ capita ⁻¹]	209
5.24	The negative ideal solution A' scenarios in a life cycle perspective [kg -equivalent person ⁻¹ capita ⁻¹]	210

LIST OF FIGURES

Figure	Page
1.1 Challenges and problems in Tehran household waste	3
1.2 Thesis organization	6
2.1 Life cycle methodology (ISO14040)	8
2.2 Traditional life cycle analysis	10
2.3 New life cycle analysis based on the cradle-to-cradle concept	11
2.4 Example of the classification and characterization step in LCA	17
2.5 System boundaries of the waste collection section of the model	35
3.1 Twenty two regions of Tehran's municipality	45
3.2 Life cycle foreground of household waste	47
3.3 Storage points by types of containers in Tehran	48
3.4 Work flow in the buyback centre	49
3.5 Process flow diagram of separation of the buyback center	50
3.6 Buyback center in Tehran	50
3.7 Workflow in door to door service	51
3.8 Process flow diagram of door-to-door service	52
3.9 Workflow in the kerbside sorting	53
3.10 Process flow diagram of separation process in the kerbside sorting	53
3.11 Vehicle collections of motor three wheels and pickup truck in door-to-door service and kerbside sorting	54
3.12 Process separation process	55
3.13 Separating of ferrous metal by the magnet in the recycling station	55
3.14 Transporting of waste to the plant	56
3.15 Waste paper recycling model	58

3.16	The produced paper from waste paper in the recycling station	59
3.17	Workflow of the waste paper recycling	59
3.18	Processing in HDPE recycling model	61
3.19	Drying of HDPE in the recycling station	61
3.20	Workflow of the waste HDPE recycling	62
3.21	Waste plastic bag recycling model	63
3.22	Mixing of the plastic bag in the recycling station	64
3.23	Workflow of the waste plastic bag recycling	65
3.24	Product description of kraft paper bag	75
3.25	Product description of HDPE (8 liter) bin	75
3.26	Scenarios of paper bags for source separation programs	79
3.27	Scenarios of plastic bag for source separation programs	79
3.28	Scenario of HDPE bin for source separation programs	80
3.29	System boundary of recyclable household waste system	82
3.30	Input and output processes in the life cycle inventory	85
3.31	Holistic method in the life cycle assessment	96
4.1	Exposure in the aspect codes by industrial process in the life cycle	102
4.2	Exposure in the aspect codes by types of the aspect code in life cycle	103
4.3	Consequence of the aspect codes by industrial process in the life cycle	104
4.4	Consequence of the aspect codes by types of aspect code in life cycle	105
4.5	Probability of the aspect codes by industrial process in the life cycle	106
4.6	Probability of the aspect codes by types of aspect code in life cycle	107
4.7	Environmental scores of the aspect codes by industrial process in the life cycle	108
4.8	Environmental scores of the aspect codes from aspect code in life cycle	109

4.9	Kind of distribution of the aspect codes by industry and process in life cycle	110
4.10	Kind of distribution of the aspect codes by types of environmental aspect in life cycle	111
4.11	Kind of situations of the aspect codes by industrial and process in the life cycle	112
4.12	Kind of situations of the aspect codes by types of aspect code in the life cycle	113
4.13	Risk consequence in the industry and process	153
4.14	Risk consequence in types of risk	117
4.15	Risk probability in the industry and process	118
4.16	Risk probability of types of risk	119
4.17	Risk exposure in the industry and process	120
4.18	Risk exposure in the types of risk	158
4.19	Risk scores in the industry and process	122
4.20	Risk scores in types of risk	123
4.21	Legal requirements in the industry and process	124
4.22	Legal requirements in types of risk	125
4.23	High risk in the industry and process	126
4.24	High risk in types of risk	127
4.25	Medium risk in the industry and process	128
4.26	Medium risk in the types of risk	128
4.27	Low risk in the industry and process	129
4.28	Low risk in the types of risk	130
4.29	Electricity usages between industrial processes (per tonne ⁻¹ year ⁻¹)	140
4.30	Fuel usages by industrial processes (per tonne ⁻¹ per year ⁻¹)	181
4.31	Energy usages in collection services of household waste (MJ gal ⁻¹)	144

4.32	Flow diagram of the group scenario A for Tehran	145
4.33	Flow diagram of the group scenario B for Tehran	146
4.34	Flow diagram of the group scenario C for Tehran	147
4.35	Hotspots in the aspect codes by unit process	153
4.36	Hotspots in the aspects codes by the consumption	154
5.1	Identified environmental aspects in the life cycle	181
5.2	Hotspots in aspect codes by nine scenarios for the environmental impacts such as acidification, global warming, BOD and Total N	182
5.3	Hotspots in aspect codes by the nine scenarios for the aspect codes of the respiratory effect	183
5.4	Identified risk in the life cycle	185
5.6	Hotspots in aspects codes in the environmental impacts of respiratory effect	191
6.1	Sensitivity of the cycle to environmental aspects	217
6.2	Sensitivity of the cycle of environmental risks	219
6.3	Midpoint impact categories between storage equipments of household waste [kg-equivalent capita ⁻¹]	222
6.4	Midpoint impact categories between recycling facilities of storage bag [kg-equipment capita ⁻¹ year ⁻¹].	223
6.5	Midpoint impact categories between collection systems of household waste [kg-equivalent capita ⁻¹]	224
6.6	Sensitivity unites process to aspect codes	225
6.7	Sensitivity aspect codes to consumption	225
6.8	Correlation between input-outputs of storage	226
6.9	Correlation between input-outputs of recycling	227
6.10	Sensitivity aspect codes to the consumption in the nine scenarios	227
6.11	Sensitivity scenarios to the aspect codes	228

6.12	Lower bounds of midpoint impacts categories between three group scenarios Tehran household wastes [kg-equivalent person ⁻¹ capita ⁻¹]	229
6.13	Upper bounds of midpoint impacts categories between three group scenarios Tehran household wastes [kg-equivalent person ⁻¹ capita ⁻¹]	230
6.14	Avoided emission burden of group scenarios Tehran household wastes [kg-equivalent person ⁻¹ capita ⁻¹]	231
6.15	Avoided emission burden of paper bag group scenarios Tehran household wastes [kg-equivalent person ⁻¹ capita ⁻¹]	231
6.16	Avoided emission burden of HDPE bin group scenarios Tehran household wastes [kg-equivalent person ⁻¹ capita ⁻¹]	232
6.17	Avoided emission burden between nine scenario Tehran household wastes [kg-equivalent person ⁻¹ capita ⁻¹]	233
6.18	Percentage of midpoint impact categories between storage bags of household waste [kg-equivalent person ⁻¹ capita ⁻¹]	235
6.19	Percentage of midpoint impact categories between recycling facilities [kg-equivalent person ⁻¹ capita ⁻¹]	236
6.20	Percentage of midpoint impact categories between collection systems of household waste [kg-equivalent person ⁻¹ capita ⁻¹]	237
6.21	Dimensions-weights and standards for suggested 660(litter) blue containers	238
6.22	Dimensions-weights and standards for suggested 1100(litter) blue containers	239

LIST OF ABBREVIATIONS

BOD	Biological oxygen demand
CO	Carbon monoxide
COD	Chemical oxygen demand
CO ₂	Carbon dioxide
EPA	United States Environmental Protection Agency
ISO	International Standards Organization (International Organization of Standardization)
KWh	Kilowatt-hour
LCA	Life cycle assessment
LCI	Life cycle inventory
LCIA	Life cycle impact assessment
LCM	Life cycle management
MJ	Mega joule
NO ₂	Nitrogen dioxide
SETAC	Society of Environmental Toxicology and Chemistry
SO ₂	Sulfur dioxide
GWP	Global warming potential
ODP	Ozone depleting Potential
POCP	Photochemical ozone creation potential
AP	Acidification potential

LIST OF SYMBOLS

A' Negative ideal solution

A^* Positive ideal solution



CHAPTER 1

INTRODUCTION

The rubbish that generated as individuals in homes and which local council is obliged to collect and dispose on our behalf was known as household waste (Waite, 1995). Clearly, if collection program is the one-sort, all recyclable collect as a commingled type, that a single container is the most efficient option. Usually, one-sort systems employ kerbside collection. It is theoretically possible to operate a drop-off or a buyback program that accepts all recyclable mixed together (Lund, 2001). The choice between wheeled carts, as used in Tehran or a bag depends on the collection behaviour of people (separate collection or co-collection). The alternative, a series of smaller containers, would have to be stored in the home until collection day, taking up valuable space. Rectangular boxes are preferred over round buckets by both participants and collection crews; in addition to ease of collection, they are less susceptible to being blown away by high winds. They are somewhat more expensive, however. Citizens are major solid waste producers and significant quantities of recyclable materials can be removed by the contractors of governmental. Home storage of the recyclable materials needs to be considered. Apartments typically have small kitchens and limited storage space. Commingled collection is generally advisable under such settings-one storage container takes up less space than three. Residents would then deliver the commingled recyclable materials to the set-out point, where they may be required to sort the materials into appropriate bins or place them in a single large container. Each multifamily situation will present unique challenges.

Creative, flexible approaches to the collection may be more appropriate than a strictly prescriptive approach. Recyclable material collection systems were designed for the residential sector in Tehran, it is critical to understand what can be efficiently recovered from the waste stream of each establishment. Industry typically recycles a large amount of pre-consumer scraps around Tehran. Kerbside separation refers to the process by which the collector receives commingled recyclable and separates them into refuse during the act of putting them into a vehicle. Residential recycling has always been the process that starts at the home. The responsibility for keeping recyclables out of the refuse bin and sorting the materials is with the residents. The efficiency of the mixed refuse processing Tehran's systems is high enough to recover a sufficient quantity of recyclable to meet program goals and mandates at an affordable price. The mixed refuse processing might be a good solution for some cities. This research is only expressed in emissions from the waste of HDPE plastic bins, plastic and paper bags, and focus on the discussion of potential environmental impacts. Emissions are different in different waste management practices.

The aim of sustainable management is more segregated recyclable materials from garbage value through lower energy usage and lower environmental impacts. In general, short-term goals for a recycling program will be oriented toward planning for decrease of the effects of the system. These will include monitoring a recycling plan; determining which storage equipment's will initially be targeted and how the

residential sector of the community will be served. Long term goals will usually pertain to the attainment of a mandated or self-imposed reduction impact system management of waste (UNEP/SETAC, 2005). Life cycle assessment is the process of assessing the environmental burdens associated with a product. LCA is assessing the impact of the energy and material uses and releases to the environment. LCA identify and evaluate opportunities to affect environmental improvements (SETAC, 2001). Indefensible activities understand an open loop system as a cradle to grave that will not extend and has one day to come to a conclusion. Sustainable waste management should be changed from the traditional life cycle analysis (cradle-to-grave) scheme to a new (cradle-to-cradle) scheme without a disposal (El-Haggar, 2007). The municipality dose so in the context of increasingly stringent legislation. The development of economic policies and other measures that foster environmental protection, and increased concern expressed by interested parties about environmental matters and sustainable development (ISO, 2006). This thesis assesses the environmental burdens associated with both a storage bag/bin and kinds of vehicle by identifying and quantifying energy and materials used and wastes released into the environment to assess the impact of those, to identify and evaluate opportunities to affect environmental improvements by the life cycle assessment method.

1.1 Problem Statement

The main cause of making the waste management service problems was made by posing significant environmental, health hazards, and harming economies. Tehran municipality, a pioneer in the process of obtaining ISO14001 standardized certification .In supplement, all associations, companies, organizations, and bodies are anticipated to comply with the provisions of these guidelines and principles. As a community of approximately 22 regions, the Tehran municipality experiences a wide-range of challenges related to the significant environmental, source consumption, technical issues, harming economics, and health hazards of its systems. Technical issues and source consumption difficulties often interfere with vehicle types and can adversely affect significant environments. In addition, preventing harming economics will enhance their benefits and lead to more productive, successful programs and decreasing the rate of non-compliance. With respect to the issue, the Tehran municipality identified the environmental aspects of its management system, in 22 regions of Tehran. Identify aspects are considered the inputs and outputs, activities, products and services. In this regards, Tehran municipality have focused on the household waste collection that can prevent environmental impact and human risks. Sorting can cause serious dangers, especially when segregation products from hospital waste are involved. Unfortunately, these items cause serious human injury that including, injuries, property damage and/or environmental damage. The municipality intends to continuously improve the quality of the household waste system through the use of the corrective and preventive actions and management system. The municipality intends to eliminate activities that have the potential to cause a non-compliance till prevent recurrence. Corrective actions have an effect on the potential problems. The municipality shall take action

to eliminate the causes of potential non-compliance in order to prevent their occurrence. LCA is a versatile decision-making tool to quantify the overall environment impacts of its service. Figure 1.1 shows the challenges in Tehran household waste.

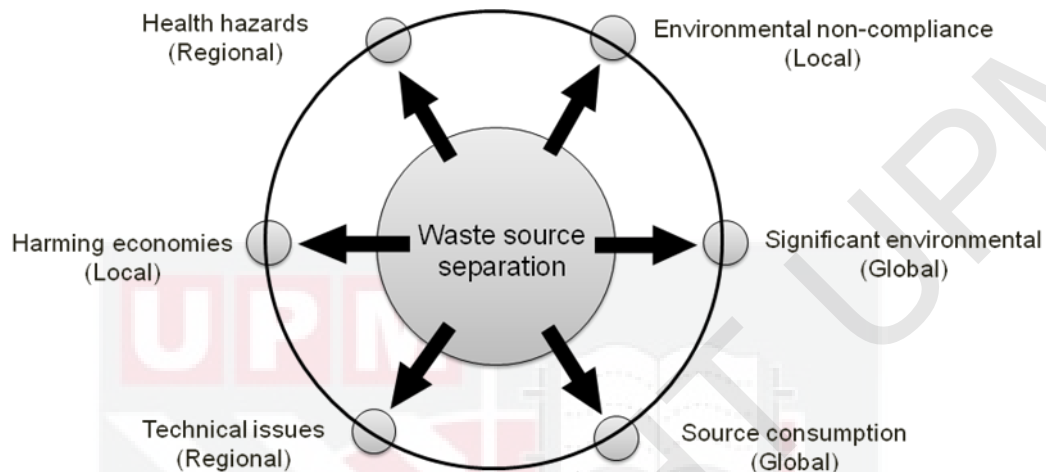


Figure 1.1 Challenges and problems in Tehran household waste

1.2 Significant of The Study

Pickup truck and motor three wheeled vehicles are the backbone of the collection systems of recyclable household waste in Tehran, and therefore they constitute a very important element of the collection system. Tehran's waste management organization in most areas monitored performance of contractors in order to try to make the process more efficient. Assessment of potential the emitted burdens of scenarios for selecting the best scenarios show significant of study. What is needed an innovation to help solve problem to reduce the potential of environmental impacts in scenarios. The reasons for the importance of the study including:

- a. Stops the problem of shifting environmental impacts
- b. Enables minimizing of secondary effects of a new design service, process or product
- c. Enable reducing of environmental pollution and resource use
- d. Using environmental management, including LCA, can often improve profitability
- e. Can help to understand of true and total monetary and environmental costs of manufacture and design of the product, process or service
- f. Demonstrate transparency and corporate credibility to stakeholders and customers.

Strengths of LCA including:

- (1) Study the consumption or production of resource in the similar products.
- (2) Provide a inventory from same perspective in data source and usage
- (3) Improve a product or a input-output by a life cycle assessment
- (4) Quantifying of the environmental impacts with a product, process or service in the same perspective
- (5) Study of the holistic and comprehensive with a product, process or service
- (6) Decision about a product ,process or service with attention to cradle-to-grave a life cycle
- (7) Stop of shifting environmental impacts to elsewhere in life cycle.
- (8) LCA is time-less, meaning that the time period over which the product is considered is the entire life-span of the product (e.g., from the product's creation to its final disposal).
- (9) The problem of how to allocate environmental impacts of multi-functional processes among functions or products is still controversial.

Weakness of LCA including:

- (1) Results obtained can be specific and it can be difficult to extrapolate out to all industries
- (2) Availability inventory data
- (3) The best estimates are required
- (4) Data collection is time-consuming and costly
- (5) Uncertainties in the estimate of emissions
- (6) Uncertainties in life cycle assessment methods

1.3 Research Questions

The collection systems involve municipal waste collection vehicles that emissions burdens generated by them in the environment. The main goal is to provide the best services with the least impact on human health and environmental effects. LCA can help lead to the development of new products, processes, or activities to reduce emissions and resource consumption to solve problems. In this regard, the following issues are stated:

- (1) How does the environmental aspects effect on the system management during produce the storage bag/bin or recycling facilities?
- (2) How does the risk of processes, effect on the system management during produce the storage bag/bin or recycling facilities?
- (3) Is there a relationship between the amounts of inputs and out-puts in the life cycle?
- (4) Is there a difference in the optimal levels of the environmental emissions and environmental impacts across the three group scenarios?
- (5) Is there a difference in the distance between current scenarios to designed scenario whit attention to the exciting seven criteria? Which scenario is the best?

1.4 Study Objectives

General objective

The main objective of the thesis is to achieve the optimum potential environmental impacts per capita recyclable household waste and risk of the process for managing recyclable household waste.

Specific objective

The purpose of setting specific objectives is to determine what we want to do for achieving the objective of the life cycle. Scope contains all parts that have significance to the environment. Thereby the main points are focused to it are:

- (1) To identify and assess the environmental aspects ,input and outputs of the recyclable household waste in the life cycle
- (2) To assess the risk of the recyclable household waste system in the life cycle
- (3) To analyze the inventory of the unit processes including to determine the correlation between inputs and out-puts and to determine the sensitivity value outputs to inputs in the life cycle
- (4) To assess potential environmental emissions and environmental impacts in the three group scenario in the life cycle
- (5) To rank of the scenarios for determining the best performance of household waste in the life cycle

1.5 Organization of The Thesis

In chapter one, in order to identify all inputs within the scope of application of LCA, is explained enough concern about any product, service, or process in the proposed comprehensive quality management system. In chapter two, with attention to the scope of this thesis, is explained an LCI was completed for all the activities. For each unit process, and to increase data quality, all data were investigated and all official documents and declarations of similar companies were used to compare ere source consumption and environmental pollution of waste management. In embarking on LCA, there is no absolutely right or wrong approach based on priority. The methodology explained in ISO 14040 is one of the several methods of its expression. In chapter three, with attention to the aim of the thesis that is on the selecting of the best scenario for Tehran household waste, in this application, the research findings were used for decision making. In chapter four, in order to managing of activities relating to organizations with attention to assess potential of environmental impacts of the life cycle of household waste and determine factors affecting the system with the aim of ranking them, was used the following method for the purpose of identification of quantitative factors affecting the assessment of the life cycle in unit processes. Figure 1.2 shown thesis organization. In chapter five, was designed nine scenarios for managing of household waste in Tehran with the aim of ranking them. In chapter six with attention to results of decision making in last chapter purpose the best scenario for managing of household waste Tehran.

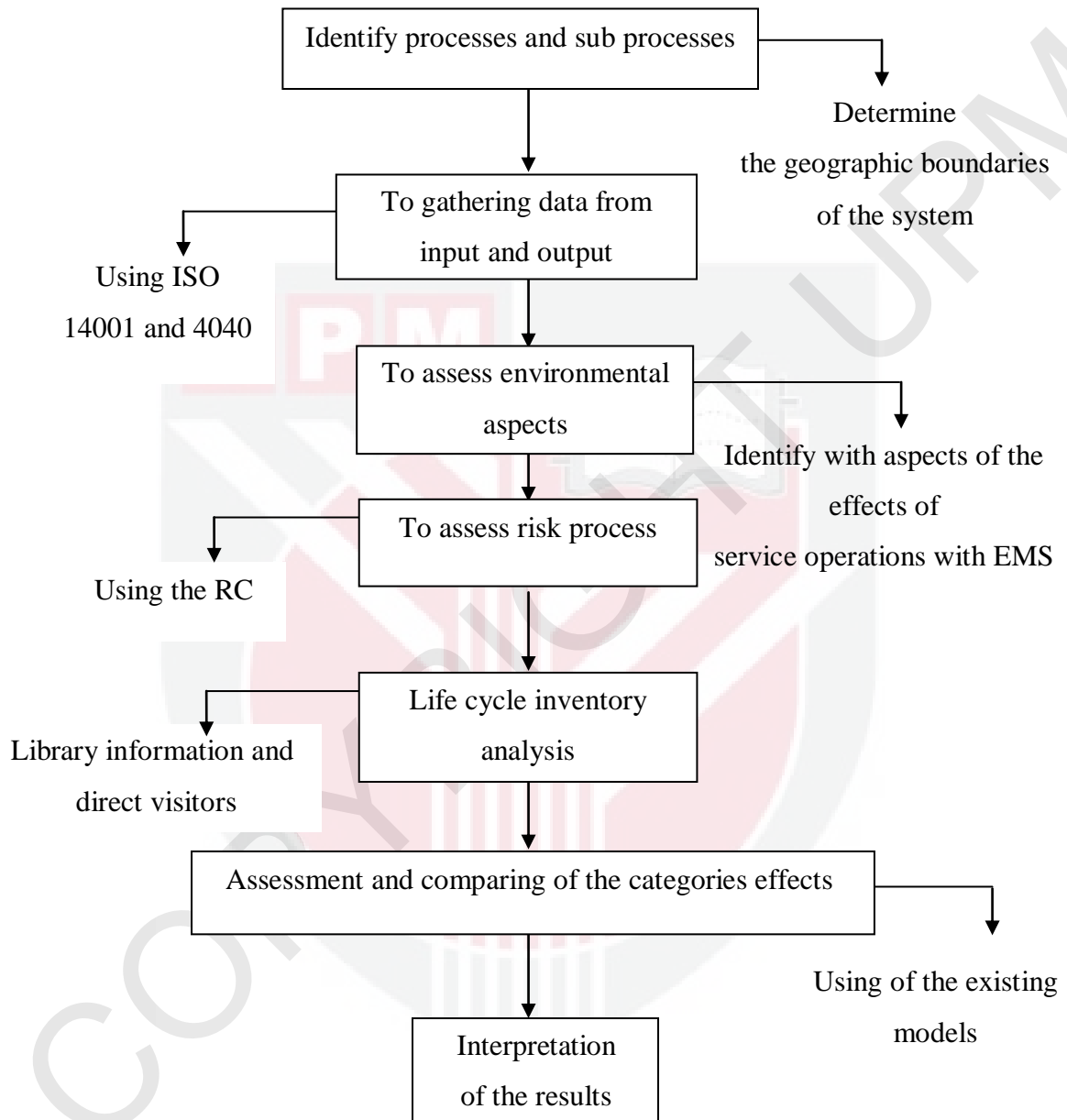


Figure 1.2 Thesis organization

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