

Interpretive and Dynamic Modeling of Waste Management and Sustainability in Organizational Context

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Interpretive and Dynamic Modeling of Waste Management and Sustainability in Organizational Context

by

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Certificate

This is to certify that Thesis entitled “**Interpretive and Dynamic Modeling of Waste Management and Sustainability in Organizational Context**” being submitted by **Mrs. Aarti Singh** to the Indian Institute of Technology Delhi for the award of the degree of Doctor of Philosophy (Ph.D.), is a record of bonafide original research work carried out by her. She has worked under our guidance and supervision, and has fulfilled the requirements for the submission of the thesis, which has attained standard required for a Ph.D. degree of the Institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

In the dynamic business environment, customer preferences have been changed which required modified products with improved manufacturing this arises the need of changing business models. In this view, development of effective sustainability performance and waste management system is of paramount importance. Hence, the significance of this study comes into depiction. Exploring the waste management and sustainability aspects and their interaction in the context of Indian organizations is the primary objective of the research work. This study has been conducted in five phases, which have been designed in nine chapters in the thesis. After exploring the existing context specific literature, the research objectives and questions have been outlined in research phase one. It has been stated; this study seeks to develop the conceptual framework of waste management and sustainability for investigating the dynamics of waste management and sustainability interaction for the selected organizations. This study adopts mix-method approach ranging from numerous qualitative methods to interpretive modeling methods, case studies and systems methodologies, to provide methodological rigor to this study.

The extensive literature review of the waste management and sustainability area has been conducted to identify essential indicators of the areas. The sustainability has been studied by considering stakeholders as the fourth dimension of sustainability. The crucial factors of waste management and sustainability have been verified from the expert's opinion. These verified waste management and sustainability factors have been considered for forming general conceptual frameworks which can guide the hierarchal paths for achieving waste management and sustainability in the organization. These frameworks help in identifying the driving and dependent factors for waste management and sustainability independently which use to drive waste management and sustainability in the organization. There is a very limited mechanism available to transform information into a hierarchy which helps in identifying main drivers for an organization. Thus, TISM found to be most appropriate for this task. The hierarchical paths obtained stimulate for achieving waste management and sustainability in the organization by indicating significant factors. Where Governmental directives and governmental initiatives are the driving factors and wastivity, environmental pollution and social acceptability are the dependent factors of waste management and sustainability in the organization. These conceptual frameworks

have been further taken for empirical validation through perceptual study with the help of opinion surveys in the research phase two.

In the research phase three, a detailed case study has been conducted to reinterpret the empirical findings in the real-life case settings of waste management and sustainability independently. Going beyond the re-interpretation of conceptual models for the case organization, the case study for waste management and sustainability explore the relationships between strategic interventions and strategic performance factors with the help of illustrating the partial FSS. In the light of raise, maintain and reduce the factors, some of the strategic interventions have been recommended for each waste management and sustainability in the case organization.

For broadening the horizons of study from qualitative and case research methods, it has gone to find linkage between waste management and sustainability theoretically through SAP-LAP linkages and empirically by using DEMATEL analysis in phase four. This combination strengthens the analysis and also help in finding the causal relationship among waste management and sustainability in the organization. The common waste management and sustainability factors merge in the study for detecting the combined effect. In this phase of study government act as a causal element which also validates the TISM outcome. Hence, waste act as a causal element to drive sustainability in the organization.

To analyze the behavior of sustainable organization by investigating the effect of waste management on sustainability in the system the systems dynamics methodology has been used in phase five. “System dynamics (SD) methodology’ has been applied in case contexts to capture the dynamism of sustainability in the organization. To achieve the impact of waste management over sustainability SD model has been developed, which have been simulated to see the likely future results. Causal-loop diagrams, stock and flow diagrams, and charts have been used to capture the system behavior and dynamics.

In the last phase, i.e., research phase six the synthesis of the findings and results have been carried out. As the waste management and sustainability issues are highly contexted specific, an attempt is made to present generalized frameworks to showcase some general indicators of both aspects. Some of the research findings are: government play a crucial role in managing waste and achieving sustainability in the organization; waste management affects environmental aspect of organization sustainability which indirectly affects the social acceptability of the organization. High waste contents lead to economic decay in the organization which may leads destroy the social

image of the organization and reduces customers in the long run. The strategic interventions should be planned in the light of existing factors, which should give feedback for corrective actions and development of new sustainability plans.

The study has made contributions to the body of knowledge as well as to the management, and those have been highlighted in the last phase of the study. In a nutshell, this study can be considered as a milestone in the waste management and sustainability research in the Indian context seeding the roots of integrating waste management and sustainability through dynamic, holistic, effective and strategic interventions which boost up sustainability in the organization.

सार

गतिशील कारोबारी माहौल में, ग्राहक वरीयताओं को भी बदल दिया गया है, जो कि बेहतर विनिर्माण के साथ संशोधित उत्पादों की आवश्यकता है, जिससे व्यवसाय मॉडल बदलने की आवश्यकता पैदा होती है। इस दृष्टि से, प्रभावी स्थिरता प्रदर्शन और अपशिष्ट प्रबंधन प्रणाली का विकास सर्वोपरि है। इसलिए, इस अध्ययन का महत्व चित्रण में आता है। अपशिष्ट प्रबंधन और स्थिरता पहलुओं की खोज करना और भारतीय संगठनों के संदर्भ में उनकी बातचीत अनुसंधान कार्य का प्राथमिक उद्देश्य है। यह अध्ययन पाँच चरणों में आयोजित किया गया है, जिसे थीसिस में नौ अध्यायों में डिजाइन किया गया है। मौजूदा संदर्भ विशिष्ट साहित्य की खोज के बाद, शोध के उद्देश्यों और प्रश्नों को शोध चरण एक में उल्लिखित किया गया है। यह कहा गया है; यह अध्ययन अपशिष्ट प्रबंधन के वैचारिक ढांचे को विकसित करने और चयनित संगठनों के लिए अपशिष्ट प्रबंधन की गतिशीलता और स्थिरता जांच चाहता है। यह अध्ययन कई गुणात्मक तरीकों से लेकर व्याख्यात्मक मॉडलिंग के तरीकों, केस स्टडी और सिस्टम मेथोडोलॉजी से लेकर मिक्स-मेथड एप्रोच को अपनाता है, ताकि इस अध्ययन को पद्धतिगत कठोरता प्रदान की जा सके।

क्षेत्रों के आवश्यक संकेतकों की पहचान करने के लिए अपशिष्ट प्रबंधन और स्थिरता क्षेत्र की व्यापक साहित्य समीक्षा की गई है। हितधारकों को स्थिरता के चौथे आयाम के रूप में देखते हुए स्थिरता का अध्ययन किया गया है। अपशिष्ट प्रबंधन और स्थिरता के महत्वपूर्ण कारकों को विशेषज्ञ की राय से सत्यापित किया गया है। इन सत्यापित अपशिष्ट प्रबंधन और स्थिरता कारकों को सामान्य वैचारिक ढांचे बनाने के लिए माना गया है जो संगठन में कचरा प्रबंधन और स्थिरता प्राप्त करने के लिए पदानुक्रम पथ का मार्गदर्शन कर सकते हैं। ये फ्रेमवर्क स्वतंत्र रूप से कचरा प्रबंधन और स्थिरता के लिए ड्राइविंग और आश्रित कारकों की पहचान करने में मदद करता है जानकारी को पदानुक्रम में बदलने के लिए बहुत सीमित तंत्र उपलब्ध है जो किसी संगठन के लिए मुख्य ड्राइवर्स की पहचान करने में मदद करते हैं। इस प्रकार, इस कार्य के लिए TISM सबसे उपयुक्त पाया गया। महत्वपूर्ण कारकों को इंगित करके संगठन में अपशिष्ट प्रबंधन और स्थिरता को प्राप्त करने के लिए प्राप्त पदानुक्रमित पथ उत्तेजित करते हैं। जहां सरकार के निर्देश और सरकारी पहल ड्राइविंग कारक हैं, पर्यावरण प्रदूषण और सामाजिक स्वीकार्यता संगठन में अपशिष्ट प्रबंधन और स्थिरता के निर्भर कारक हैं। ये वैचारिक रूपरेखा आगे अनुसंधान चरण दो में राय सर्वेक्षणों और लिए लिया गया है।

अनुसंधान चरण तीन में, अपशिष्ट प्रबंधन और स्वतंत्र रूप से स्थिरता को वास्तविक जीवन में अनुभवजन्य निष्कर्षों की पुनर्व्याख्या करने के लिए एक विस्तृत मामले का अध्ययन किया गया है। केस संगठन में वैचारिक मॉडल की पुनः व्याख्या, आंशिक एफ.एस. एस की मदद से रणनीतिक हस्तक्षेप और

रणनीतिक प्रदर्शन कारकों के बीच संबंधों का पता लगाता है। कारकों को बढ़ाने, बनाए रखने और कम करने के लिए, कुछ रणनीतिक हस्तक्षेपों की सिफारिश की गई है।

गुणात्मक और मामले अनुसंधान विधियों से अध्ययन के क्षितिज को व्यापक बनाने के लिए, यह सैद्धांतिक रूप से SAP-LAP लिंकेज का उपयोग किया गया है। अनुभव चरण चार में DEMATEL विश्लेषण का उपयोग करके कचरा प्रबंधन और स्थिरता के बीच संबंध को खोजा गया है। इस संयोजन विश्लेषण को मजबूत बनाने के लिए कचरा प्रबंधन और स्थिरता के बीच संबंध कारण खोजा गया है। आम कचरा प्रबंधन और स्थिरता कारकों अध्ययन में गठबंधन और प्रभाव का पता लगाया है।

अपशिष्ट प्रबंधन में कचरा प्रबंधन का स्थिरता पर प्रभाव जानने के लिए सिस्टम डायनेमिक्स कार्यप्रणाली का उपयोग चरण पांच में किया गया है। सिस्टम डायनामिक्स (एस.डी) कार्यप्रणाली 'मामले संदर्भों में संगठन में स्थिरता की गतिशीलता को पकड़ने के लिए लागू की गई है। एसडी मॉडल में कचरा प्रबंधन के प्रभाव को विकसित किया गया है जो की अपेक्षित भविष्य के परिणाम को देखने के लिए इस्तेमाल किया गया है। कारण-पाश आरेख, स्टॉक और प्रवाह आरेख, और सिस्टम व्यवहार और गतिशीलता को पकड़ने के लिए चार्ट का उपयोग किया गया है।

अंतिम चरण में, अर्थात्, शोध चरण निष्कर्षों और परिणामों के संश्लेषण को अंजाम दिया गया है। अपशिष्ट प्रबंधन और स्थायित्व के मुद्दों को अत्यधिक संदर्भ विशिष्ट किया गया है। शोध के कुछ निष्कर्ष इस प्रकार हैं: सरकार कचरे के प्रबंधन और अनुसंधान में स्थिरता प्राप्त करने में एक महत्वपूर्ण भूमिका निभाती है। कचरा प्रबंधन जो परोक्ष रूप से अनुसंधान की सामाजिक स्वीकार्यता और अनुसंधान स्थिरता के पर्यावरणीय पहलू को प्रभावित करता है। अधिक कचरे के फलस्वरूप अनुसंधान में आर्थिक क्षय होता है, जो अनुसंधान की सामाजिक छवि को क्षय करता है और लंबे समय में ग्राहकों को कम करता है। मौजूदा कारकों के मद्देनजर रणनीतिक हस्तक्षेप की योजना बनाई जानी चाहिए, जो सुधारात्मक कार्यों और नई स्थिरता योजनाओं के विकास के लिए प्रतिक्रिया दे।

अध्ययन में ज्ञान बढ़ाने और साथ ही प्रबंधन के लिए योगदान दिया है। संक्षेप में, ये अध्ययन भारतीय संदर्भ में कचरा प्रबंधन और स्थिरता अनुसंधान में एक मील का पत्थर है, जो अनुसंधान में कचरा प्रबंधन को समग्र, प्रभावी और गतिशील करता है और सामाजिक छवि में स्थिरता को बढ़ावा देता है।

CONTENTS

Content	Page No.
<i>Certificate</i>	<i>i</i>
<i>Acknowledgements</i>	<i>iii</i>
<i>Abstract</i>	<i>v</i>
<i>Contents</i>	<i>ix</i>
<i>List of Figures</i>	<i>xvii</i>
<i>List of Tables</i>	<i>xix</i>
<i>List of Appendices</i>	<i>xxi</i>
<i>Nomenclature</i>	<i>xxiii</i>
Chapter 1: Introduction	1
1.1 Introduction	1
1.2 Background of Research	3
1.3 Motivation of the Study	4
1.4 Research Objectives	6
1.5 Research Questions	6
1.6 Scope of the Study	7
1.7 Methodology Overview	8
1.8 Organization of the Thesis	9
1.9 Expected Knowledge Outcomes	12
1.10 Concluding Remarks	13
Chapter 2: Literature Review	15
2.1 Introduction	15

2.2 Scope of Literature Review	17
2.3 Methodology of Literature Review	17
2.4 Waste : A Concept	18
2.5 History Evolution of Waste Management	18
2.6 Literature Review on Waste Management	20
2.7 Factors for Defining Waste Management in the Organization	24
2.8 Sustainability: A Concept	30
2.9 Historical Evolution of Sustainability in the Organization	31
2.10 Literature Review on Sustainable Organization	33
2.11 Factors for Defining Sustainability in the Organization	38
2.12 Key Issues Culled Out	44
2.12 Research Gaps and Directions	46
2.13 Concluding Remarks	48
Chapter 3: Research Design and Methodology	49
3.1 Introduction	49
3.2 Theoretical Basis: Why Waste Management and Sustainability Integration	50
3.3 Conceptual Research Framework	51
3.4 Research Propositions	54
3.5 Research Phases	56
3.6 Research Methodology	59
3.6.1 Research Methodology for Exploratory Study	59
3.6.3 Research Methodology for Cross-validation	61
3.6.4 Research Methodology for Inter-linking the Domains	61
3.6.4 Research Methodology for Future Dynamics of Framework	63
3.6.5 Justification of Methodology Chosen	64
3.6.6 Sampling for Data Collection	66
3.8 Roadmap of the Study	67

3.9 Concluding Remarks	69
Chapter 4: Context of the Study	71
4.1 Introduction	71
4.2 Selection of the Context	71
4.3 Global Growth Trends of Waste Management and Sustainability in Context of the Organizations	73
4.3.1 The Global Trend of Waste Management	73
4.3.2 The Global Trend of Sustainability	76
4.4 Indian Growth Trends of Waste Management and Sustainability in Context of the Organizations	99
4.4.1 Indian Trend of Waste Management	81
4.4.2 Waste Management and Sustainability Relationship	83
4.4.3 Indian Trend of Sustainability	84
4.5 Concluding Remarks	86
Chapter 5: Exploratory Study	87
5.1 Introduction	87
5.2 Objective	88
5.3 Research Methodology for Exploratory Study	88
5.3.1 Content Analysis	90
5.3.2 Total Interpretive Structural Modeling	90
5.3.3 Empirical Factors Verification and TISM Models Validation	92
5.4 Exploratory Study for Waste Management in Organizations	93
5.4.1 Identification of Waste Management Factors related to Organizations	94
5.4.2 Verification of Waste Management Factors	96
5.4.3 TISM Development for Waste Management Factors (TISM-I)	97
5.4.4 Validation of Waste Management TISM	98

5.5 Exploratory Study for Sustainability in the Organizations	102
5.5.1 Identification of Sustainability Factors related to Organizations	102
5.5.1.1 <i>Environmental Aspect</i>	102
5.5.1.2 <i>Societal Aspect</i>	103
5.5.1.3 <i>Economic Aspect</i>	104
5.5.1.4 <i>Stakeholders Aspect</i>	105
5.5.2 Verification of Sustainability Factors	106
5.5.3 TISM Development for Sustainability Factors (TISM-II)	109
5.5.4 Validation of Sustainability TISM Model (TISM-II)	109
5.6 Concluding Remarks	112
 Chapter 6: Organizational Case Study	 115
6.1 Introduction	115
6.2 Objective	116
6.3 Methodology	117
6.3.1 SAP-LAP Framework	118
6.3.2 TISM Development	119
6.3.3 Flowing Stream Strategy	120
6.3.4 SAP- LAP Linkages Framework	120
6.4 Case Study of IHL Hotel from Leading Conglomerate	121
6.5 Case Study of IHL Hotel for Waste Management	122
6.5.1 Identify and Categorize Waste Management Factors as Situation-Actor-Process-Learning- Action- Performance in the Case Company	122
6.5.2 Develop the Hierarchical Relationship among the Waste Management Factors in the Case Organization and Analyze it through Partial FSS	123
6.5.3 Identify Strategic Actions Aspiration for Managing Waste in the Case Organization by Using SAP- LAP Linkages Framework	126
6.6 Case Study of ITC Hotel for Sustainability	129
6.6.1 Identify and Categorize Sustainability Factors as Situation-Actor-Process-Learning- Action- Performance in the Case Organization.	129
6.6.2 Develop the Hierarchical Relationship Between the Sustainability Factors in the Case Organization and Analyze it through Partial FSS	130
6.6.3 Identify Strategic Actions Aspiration for Managing sustainability in the Case Organization by Using SAP- LAP Linkages Framework	133

6.7 Discussion	137
6.8 Concluding Remarks	138
Chapter 7: Waste Management and Sustainability: Interrelating Two Domains	141
7.1 Introduction	141
7.2 Objective	142
7.3 Methodology of the Study	142
7.3.1 SAP- LAP Linkages Framework	144
7.3.2 Decision-Making Trial and Evaluation Laboratory (DEMATEL)	144
7.4 Analyzing the Waste Management and Sustainability Integration in the Organizational Context	145
7.5 Identifying Causal-Effect Relationship among Waste Management and Sustainability in the Organizational Context	153
7.6 Discussion	156
7.7 Conclusion	157
Chapter 8: System Dynamics Modeling Of Waste Management and Sustainability	159
8.1 Introduction	159
8.2 Methodology of the Study	160
8.3 System Dynamics Modeling for a sustainable conglomerate ITC	162
8.4 Model Testing Simulation and Results	177
8.5 Discussion	186
8.6 Concluding Remarks	187

Chapter 9: Synthesis and Conclusion	189
9.1 Introduction	189
9.2 Key Research Findings	190
9.3 Triangulation	192
9.3.1 Method Triangulation	192
9.4 Revisiting Research Propositions	195
9.5 Major Recommendations and Implications	197
9.6 Significant Research Contributions	199
9.7 Limitations	200
9.8 Scope for Future Research	201
9.9 Concluding Remarks	202
<i>References</i>	205
<i>Appendices</i>	A-1 – A-17

LIST OF FIGURES

Figure No.	Caption	Page No.
1.1	The Essence of Waste Management Hierarchy	2
1.2	Organization of the Thesis	10
3.1	Conceptual Research Framework	53
3.2	Dynamic Linkages in Conceptual Framework	54
3.3	Research Phases	57
3.4	Flow Diagram Depicting Process of Exploratory Study	60
3.5	Research Methodology for Inter-linking the Domains	62
3.6	System Dynamics Modeling Process	64
3.7	Roadmap of the Study	68
4.1	Industrial Waste Management Share	75
4.2	Global Waste Categorization	76
4.3	Rise in Reporting Instruments	77
4.4	Trends in Sustainability Reporting	77
4.5	The Growth Trends in Mandatory Vs. Voluntary Instruments	78
4.6	Trends in Sustainability Reporting in Largest Companies per Country	78
4.7	Number of Instruments by Issuing Bodies	79
4.8	Focused Issues in Sustainability	80
4.9	Increase in Indian Waste Volume in Million Metric Tonne	81
4.10	Total Indian Waste Distribution in 2017	82
4.11	Top Waste Management Trends Defining Waste Management Market	82
4.12	The Current Indian Waste Recycling Rate Out of Total Percent of Waste	83
4.13	The reporting provision in Indian organizations	85
5.1	Conceptual Framework for Exploratory Study	89

5.2	Initial TISM for Waste Management without Interpretation	98
5.3	Validated TISM for Waste Management	101
5.4	TISM for Sustainability in the Organization without Interpretation	108
5.5	Final TISM Model for Sustainability in the Organization	112
6.1	Conceptualization of Case Development	117
6.2	SAP-LAP framework	118
6.3	TISM for Waste Management in the IHL Hotel	124
6.4	Strategic Direction Diagram of Waste Management for Managing Waste in the IHL Hotel	125
6.5	Sustainability TISM for IHL	131
6.6	Strategic Direction Diagram for Sustainability in IHL	132
7.1	Conceptualization of Mixed Method for Linking Waste Management and Sustainability	143
7.2	The Network Relation Map	154
7.3	The Cause-Effect Relationship	155
7.4	The Impact Relationship Map	156
8.1	System Dynamics Modeling Process	161
8.2	The Sub-System Diagram of Waste Management and Sustainability Integration	164
8.3	Causal Loop Diagram for Waste Management and Sustainability Integration	165
8.4	The Social Aspect loop	166
8.5	The Diagram for Social Aspect Subsystem	167
8.6	Economic loop	168
8.7	The Stock and Flow Diagram for Economic Aspect Subsystem	168
8.8	The Environmental Aspect Loop	170
8.9	The Stock and Flow Subsystem Diagram for Environmental Aspect	170

8.10	The Waste Management Loop	172
8.11	The Stock and Flow Diagram for Waste Management Aspect Subsystem	172
8.12	The Stakeholder Loop	173
8.13	The Stock and Flow Diagram for Stakeholder Aspect Subsystem	174
8.14	Stock and Flow Diagram for Waste Management and Sustainability	176
8.15	Sensitivity for Waste	179
8.16	Sensitivity of people satisfaction	179
8.17	Sensitivity for Social Acceptability	179
8.18	Sensitivity for Organizational Economy	179
8.19	Sensitivity for Governmental Aspect	179
8.20	Sensitivity for Organizational Energy	179
8.21	Dynamics of Sustainability Indicators for ITC	180
8.22	Effect of Waste over Environmental Aspect of Sustainability	181
8.23	Effect of Waste over Environmental Aspect of Sustainability	181
8.24	Dynamic Behavior of Social Aspect	183
8.25	Dynamic Behavior of Economic Aspect	183
8.26	Dynamic Behavior of Environmental Aspect	184
8.27	Dynamic Behavior of Stakeholder Aspect	185
8.28	Dynamic Behavior of Optimistic Scenario	186
8.29	Dynamic Behavior of Pessimistic Scenario	186

LIST OF TABLES

Table No.	Caption	Page No.
2.1	Waste Management Intent in the Organizations	29
2.2	Definitions of Sustainability	32
2.3	Models for Sustainable Organization	34
2.4	Explanation of Sustainability in Organizations	36
3.1	Limitations of Existing Frameworks and studies	51
3.2	Research Methods used in Research Phases	65
3.3	Sampling Techniques for Research Phases	67
5.1	The t-Test Analysis of Waste Management Factors	96
5.2	Result of Hypothesis Testing	99
5.3	The t-Test Analysis of Sustainability Factors	106
5.4	Result of Hypothesis Testing	109
6.1	Defining Waste Management Factors in Case Organization	122
6.2	Strategic Action for Waste Management in the IHL Hotel	125
6.3	Assessment Matrix in IHL Hotel	126
6.4	Self-Interaction Matrixes between Various Elements of Framework	126
6.5	Cross-Interaction Matrixes between Various Elements of Framework	127
6.6	Defining Sustainability Factors in Case Organization	130
6.7	Strategy Alignment Matrix for Sustainability in IHL	132
6.8	Assessment Matrix for sustainability in IHL Hotel	134
6.9	Self-Interaction Matrixes between Various Elements of Framework	134
6.10	Cross-Interaction Matrixes between Various Elements of Framework	135
7.1	Elements of SAP- LAP Framework	146
7.2	Assessment Matrix of the study	147

7.3	Self-Interaction Matrixes between Various Elements of Framework	148
7.4	Cross-Interaction Matrixes between Various Elements of Framework	150
8.1	Integrated factor for defining the effect of waste management on sustainability in the ITC Organization	162
9.1	Method Triangulation for Waste management and Sustainability Factors and their Relationships	194

LIST OF APPENDICES

Appendix No.	Title	Page No.
I (a)	Questionnaire Waste Management related Factors	A-1
I (b)	Working Details for Development of TISM-I for Waste Management related Factors	A-8
II (a)	Questionnaire for Sustainability related Factors	A-11
II (b)	Working Details for Development of TISM-II for Subscriber related Factors	A-20
III	Working Details for Development of Waste Management related Factors in IHL Hotel	A-23
IV	Working Details for Development of Sustainability related Factors in IHL Hotel	A-24
V	DEMATEL Analysis of Waste Management and Sustainability Factors	A-26
V (A)	The average matrix X for Waste Management and Sustainability Factors	A-26
V (B)	Influence Matrix D for Waste Management and Sustainability Factors	A-27
V (C)	The Total-Influence Matrix T for Waste Management and Sustainability Factors	A-28
V (D)	The Analyses of Matrix T for Waste Management and Sustainability Factors	A-29
VI	STELLA Stock and Flow Equations for SD Model	A-30

NOMENCLATURE

CAGR	Compound Annual Growth Rate
CLD	Causal Loop Diagram
CSR	Corporate Social Responsibility
CPCB	Indian Central Pollution Control Board
DEMATEL	Decision-Making Trial And Evaluation Laboratory
EKC	Environmental Kuznets Curve
EPA	The Environmental Protection Agency
FHWA	Federal Highway Administration
FSS	Flowing Stream Strategy
GDP	Gross Domestic Product
ISM	Interpretive Structural Modeling
LCA	Life Cycle Approach
MoEF	Ministry of Environment & Forests
NDCs	Nationally Determined Contributions
NEAMA	Indian National Appraisal and Monitoring Authority
NEP	National Environmental Policy
R&D	Research and Development
SD	System Dynamics
SDM	Sustainable Development Mechanism
SDGs	Sustainable Development Goals
SPCB	State Pollution Control board
SPSS	Statistical Package for Social Science
STELLA	Structural Thinking Experimental Learning Laboratory with Animation

TISM	Total Interpretive Structural Modeling
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
WCED	World Commission on Environment and Development