

Advanced & Emerging Communications Technologies Series

Green IT Strategies and Applications

Using Environmental Intelligence

Bhuvan Unhelkar



CRC Press
Taylor & Francis Group
AN AUERBACH BOOK

Green IT Strategies and Applications

Using Environmental Intelligence

Advanced and Emerging Communications Technologies Series

Series Editor-in-Chief: Saba Zamir

ADSL: Standards, Implementation, and Architecture, Charles K. Summers

After the Y2K Fireworks: Business and Technology Strategies, Bhuvan Unhelkar

Electronic Bill Presentment and Payment, Kornel Terplan

Fiber Optics Illustrated Dictionary, Julie K. Petersen

Green IT Strategies and Applications : Using Environmental Intelligence,
Bhuvan Unhelkar

Handbook of Emerging Communications Technologies: The Next Decade, Rafael Osso

Intranet Performance Management, Kornel Terplan

Mobile Enterprise Transition and Management, Bhuvan Unhelkar

Multi-Domain Communication Management Systems, Alex Galis

Protocols for Secure Electronic Commerce, Second Edition, Mostafa Hashem Sherif

The Telecommunications Illustrated Dictionary, Second Edition, Julie K. Petersen

Web-Based Systems and Network Management, Kornel Terplan

Green IT Strategies and Applications

Using Environmental Intelligence

Bhuvan Unhelkar



CRC Press

Taylor & Francis Group

Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business
AN AUERBACH BOOK

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

© 2011 by Taylor & Francis Group, LLC
CRC Press is an imprint of Taylor & Francis Group, an Informa business

No claim to original U.S. Government works
Version Date: 20110727

International Standard Book Number-13: 978-1-4398-3781-8 (eBook - PDF)

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the author and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The authors and publishers have attempted to trace the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged please write and let us know so we may rectify in any future reprint.

Except as permitted under U.S. Copyright Law, no part of this book may be reprinted, reproduced, transmitted, or utilized in any form by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying, microfilming, and recording, or in any information storage or retrieval system, without written permission from the publishers.

For permission to photocopy or use material electronically from this work, please access www.copyright.com (<http://www.copyright.com/>) or contact the Copyright Clearance Center, Inc. (CCC), 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400. CCC is a not-for-profit organization that provides licenses and registration for a variety of users. For organizations that have been granted a photocopy license by the CCC, a separate system of payment has been arranged.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

Visit the Taylor & Francis Web site at
<http://www.taylorandfrancis.com>

and the CRC Press Web site at
<http://www.crcpress.com>

Prabhavati

Contents

Forewordxix

Preface.....xxi

Readers xxiii

Mapping to a Workshop..... xxv

Contents and Chapter Summariesxxvii

Language.....xxix

Acknowledgmentsxxxii

Endorsements (In Praise of *Green IT Strategies and Applications*) xxxiii

Author xxxv

PART A STRATEGIES AND APPLICATIONS

1 Green IT Fundamentals: Business, IT, and the Environment3

Key Points 3

Introduction..... 3

The Environment Today..... 6

Information Technology and Environment 9

Business and Environment14

Green Enterprise Characteristics15

Green Vision17

Green Strategic Points18

Green Value18

Green IT Opportunity.....19

Challenges of a Carbon Economy 22

Environmental Intelligence25

Business Intelligence25

Application in Environmental Domain..... 26

Envisioning the Green Future 29

Discussion Points 30

References 30

2	Green IT Strategies: Drivers, Dimensions, and Goals.....	35
	Key Points	35
	Introducing Green Strategies	35
	Green Strategic Mindset.....	37
	Philosophical Considerations in Green IT Strategy	39
	Green IT Strategies: Range of Impact	41
	Green Strategic Alignment	46
	Proactive Green Strategies.....	47
	Reactive Green Strategies.....	47
	Green IT Strategies Mix.....	47
	Green IT Drivers.....	48
	Costs (Energy, Operational)	50
	Regulatory and Legal.....	50
	Sociocultural and Political	52
	Enlightened Self-Interest	53
	Responsible Business Ecosystem	54
	New Market Opportunities	56
	Green IT Business Dimensions (Factors).....	56
	Economy.....	56
	Technologies	58
	Processes	59
	People	60
	Developing an ERBS	61
	Wide-Ranging Considerations in ERBS.....	63
	Steps in Developing an ERBS	64
	Green Business Objectives	65
	Strategy Descriptions.....	66
	Policy-Based Conditions.....	67
	Resource Requirements.....	68
	Transformation Plan/Timelines.....	68
	Iterations and Risks	68
	KPIs in Green Strategies.....	69
	Additional KPI Examples	72
	Discussion Points	72
	Action Points.....	73
	References	73
3	Environmentally Responsible Business: Policies, Practices, and Metrics	77
	Key Points	77
	Introduction	78
	Policies and Practices in ERBS.....	81
	Lean Impact on Green	83
	Environmental Areas Covered.....	85
	Breadth of Environmental Policies (Areas Covered).....	85
	Depth of Environmental Policies (Intensity of Coverage)	87
	Length of Environmental Policies (Duration of Coverage)	87

Green Values in Practice.....	89
Green Practice: A Balancing Act	90
Mobility and Environment	92
Advantages to Environment.....	93
Challenges to Environment	93
Relating Environmental Business Policies to Goals	94
Renewable Energy Resources	96
Mind Map for the Role of a Chief Green Officer (CGO).....	98
Environmental Practices.....	99
Green IT Metrics and Measurements.....	101
Carbon Metrics Coverage.....	103
Green IT Measurement Challenges	106
Framework for Green IT Metrics.....	107
Measuring the Carbon Footprint of Your Organization.....	109
Measuring Operational Costs in Your Organization.....	110
Green Balanced Scorecard.....	110
Green IT Readiness and CMM.....	113
Context Sensitivity and Automation in Green IT Measures	115
Discussion Points	117
Action Points.....	118
References	118
4 Green Assets: Buildings, Data Centers, Networks, and Devices.....	121
Key Points	121
Introduction.....	122
Green Assets.....	124
Building and Facility Management	126
Green IT Hardware.....	127
Green Data Centers	130
Data Center Building—Design, Layout, and Location	132
Data Center ICT Equipment—Server Strategies.....	133
Data Strategy and the Carbon Emitting Bit.....	135
Data Servers Optimization.....	136
Data Servers Virtualization	137
Physical Data Server Organization and Cooling	139
Cloud Computing and Data Centers	140
Networking and Communications Infrastructure.....	141
End-User Devices.....	143
Smart Meters in Real Time	143
Managing Devices for Central Green Services	146
Devices and Organizational Boundaries for Measurements	147
Mobile Devices and Sustainability	148
Discussion Points	151
Action Points.....	151
References	151

5	Green Business Process Management: Modeling, Optimization, and Collaboration	153
	Key Points	153
	Introduction.....	154
	Green Business Process Management.....	156
	Green Reengineering.....	157
	Green Processes: Individual, Organizational, and Collaborative	159
	Green BPM and Standards.....	161
	Green Business Analysis	164
	Green Requirements Modeling	165
	Green IT Governance	167
	Green Business Processes—Incremental Complexity	169
	Green Business Applications	171
	Modeling Green Business Processes (UML, BPMN)	171
	Quality of Service (QoS) and Green Business Processes.....	172
	Documenting Process Goals	173
	Achieving Green BPM	173
	Green Mobile Business Processes	174
	Environmental—Economic Mobile Use.....	176
	Environmental—Technical Mobile Use.....	177
	Environmental—Process Mobile Use	177
	Environmental—Social Mobile Use	179
	Example—Digital Library GPR.....	179
	Conclusion.....	181
	Discussion Points	181
	Action Points.....	182
	References	182
6	Green Enterprise Architecture, Environmental Intelligence, and Green Supply Chains.....	185
	Key Points	185
	Introduction	186
	Green Enterprise Architecture	187
	Views of Green Enterprise Architecture	189
	Green Enterprise Architecture—Categories of Requirements	190
	Green IT and Organizational Systems	192
	Organizational Systems	192
	External Systems.....	193
	Infrastructure	193
	Green Solutions Architecture	193
	Evolving Green Systems Architecture.....	195
	Aspects of Green Solutions Architecture	196
	Cloud Computing	197
	Virtualization	198
	Smart Networks.....	198
	Real-Time Decision Making.....	198

Alignment.....	199
Optimization	199
Integration.....	199
Contents and Integration with Service-Oriented Architecture	199
Green Supply Chain Management	202
Mobility in Green Supply Chain Management	204
Building Environmental Criteria into Supplier Contract Conditions	204
Green Portals in Green Enterprise Architecture	205
Business Intelligence and Green IT	206
The Environmental Intelligence Domain	208
Environmental Intelligence Systems' Evolving Complexity	209
Communication Channels in Environmental Intelligence	211
Environmental Intelligence Implementation with Web Services.....	212
Environmental Intelligence with Mobility	213
An Example of Green Enterprise Architecture	215
Discussion Points	216
Action Points.....	217
References	217
7 Green Information Systems: Design and Development Models.....	219
Key Points	219
Introduction.....	219
Describing a GIS.....	220
Phases in a GIS Development and Deployment.....	220
Features of GIS.....	221
Modeling and Architecture GIS—Requirements, Design, Implementation, and Testing.....	222
GIS Requirements.....	223
Green Organizational Portal.....	224
Regulatory Standards Portal	224
Stakeholders/Actors.....	225
Databases.....	226
Package Diagrams and System Scope	226
Use Case Diagram for GOP.....	227
Use Cases for “Green Organizational Portal”	233
Use Cases for “Emissions Benchmark Maintenance Use Case Diagram”	236
Class Diagram for GOP	238
Sequence Diagram for “Emissions Check”	240
Class Diagram for RSP	241
Sequence Diagram for “Setting Standard Emissions Value”	241
State Machine Diagrams for “Emission Report” and “Emission Standard Value” Objects.....	241
Implementation Diagrams for GIS.....	241
GIS—Technical Requirements.....	245
Discussion Points	246
Action Points.....	246

8	Sociocultural Aspects of Green IT.....	247
	Key Points	247
	Introduction.....	248
	Green IT's Social Impact.....	250
	Learning Organization.....	250
	Green Social Stakeholders	251
	Role-Based View of Green IT.....	253
	Green User Practices	256
	Attitude and Subjectivity in Green IT.....	257
	Green IT Ethics and Code of Conduct	259
	Privacy and Security of Green Information	261
	Green Washing	262
	Communications in Green Transformation Projects	262
	Green IT Project—Channels of Communication	263
	Green HR and Changing Organizational Structures	264
	Green-Collar Workers: Roles and Skill Sets	267
	Skills Framework for Information Age (SFIA) and Green HR	267
	SFIA Skill Set and Green Roles.....	269
	Green Virtual Communities	271
	Discussion Points	272
	Action Points.....	272
	References	272
9	Green Enterprise Transformation Roadmap	275
	Key Points	275
	Introduction.....	276
	Green Enterprise Transformation.....	277
	Influence of Economic Dimension on GET	279
	Influence of Technical Dimension on GET.....	279
	Influence of Process Dimension on GET	280
	Influence of Social Dimension on GET	280
	Transforming the Individual, Organizational, and Collaborative Processes	281
	A Green ICT Framework	283
	Equipment Lifecycle.....	284
	Procurement.....	284
	Recycle and Reuse.....	285
	Disposal of ICT Systems	285
	End-User Computing.....	285
	Enterprise and Data Center.....	286
	Data Center ICT Equipment	287
	Data Center Environmentals.....	287
	Networking and Communications.....	287
	Outsourcing and Cloud Computing	288
	Software Architecture	288
	IT for Enterprise	288
	Governance and Compliance	289
	Teleworking and Collaboration	289

Business Process Management.....	289
Business Applications	290
Carbon Emissions Management.....	290
Attitude.....	290
Policy	291
Practice	291
Technology.....	291
Metrics.....	292
The Green Transformation Process.....	292
Organizational Focus Areas for GET	293
Configuring a GET Road Map	295
GET Program: Roles and Deliverables	295
Setting Up a Business Transformation Office (BTO)	296
Forming Transformation Work Areas	297
Green IT Project Roles.....	297
Green Enterprise Transformation Champion (GTC).....	298
Business Architect and Variations	298
Technical Architect and Variations	299
Business Partners	299
Green IT Auditors	300
End-Users	300
IT Managers.....	300
Business Managers.....	300
IT Governance.....	300
Corporate Governance.....	301
Green IT Transformation—Deliverables.....	301
GET: Diagnosis Phase.....	302
Challenges	303
Challenges	303
Challenges	306
Challenges	306
GET: Planning and Scoping Phase.....	309
Pilot Project.....	310
Enterprise Lifecycle Plan	310
Input.....	312
Output.....	312
Challenges	312
Planning for End-User Efficiencies.....	312
Deliverables.....	314
Input.....	314
Output.....	314
Challenges	314
Enterprise IT Data Center Efficiencies	316
Deliverables.....	316
Input.....	316
Output.....	316
Challenges	317

Planning for IT as a Low-Carbon Enabler for the Enterprise	317
Deliverables	319
Input	319
Output	319
Challenges	319
GET: Enactment Phase	319
Technology-Driven Enactment	320
Customer Relationships Management	321
Supply Chain Management (SCM)	321
Human Resource and Payroll Systems	321
Business Partner's Systems	321
Integration	322
Data Migration	322
Business Process-Driven Enactment	322
GET: Review and Measure Phase	323
Discussion Points	323
Action Points	324
References	325
10 Green Compliance: Protocols, Standards, and Audits	327
Key Points	327
Introduction	327
Protocols and Standards	328
United Nations Framework Convention on Climate Change (UNFCCC, Rio)	329
Kyoto Protocol	329
Greenhouse Gas Protocol	330
Copenhagen	330
The ISO 14000:2004 Family of STANDARDS	331
ISO 14001	332
Government Initiatives	332
Compelling Regulation	332
USA Energy Star—1992	334
EPEAT—Electronic Product Environmental Assessment Tool	334
EU RoHS—Restriction of Hazardous Substances Regulations	335
EU WEEE—Waste Electrical and Electronic Equipment Regulations	335
Industry and Vendor Initiatives	335
Green Grid—2007	336
CSCI—Climate Savers Computing Initiative	336
IT Vendor Initiatives	336
Global Reporting Initiative	336
Green IT Audits	337
Audit Types	339
Green IT Audits—Approach, Maturity, and Comparison	342
Undertaking Green IT Audits	342
Audit and Use of Carbon Emissions Management Software	343
Comparative Audits	344

Conclusion	344
Discussion Points	345
Action Points.....	345
References	346
11 Emergent Carbon Issues: Technologies and Future	347
Key Points	347
Introduction.....	347
Future Carbon Landscape.....	348
Green ICT and Technology Trends.....	350
Cloud Computing.....	350
SaaS	353
Nanotechnologies.....	353
Quantum/Trinary Computing.....	354
New Renewable Energies	354
ISO—New and Upgraded Standards.....	354
Security and Legal.....	354
Ecodesign.....	355
Biomimicry	355
Green ICT—Business and Economic Trends.....	356
Dichotomy of Developing Economies	358
Collaborative Environmental Intelligence	358
Discussion Points	361
References	361

PART B CASE STUDIES

12 Case Study in Applying Green IT Strategies and Applications to a Hospital.....	365
Key Points	365
GoodMead Hospital	365
Preliminary Green Investigation	366
Green Business Objectives.....	367
SWOT of GoodMead Hospital.....	368
Strengths	368
Weaknesses.....	369
Opportunities	370
Threats.....	370
Strategic Concerns of Management.....	371
Steps in Developing a Hospital's ERBS.....	372
Green Transformational Elements.....	373
The Green Transformation Project.....	374
Social Dimension in Hospital GET.....	377
Technology Changes in Hospital	377
Applying Mobile Technologies in GET.....	378
Doctors.....	379
Nurses.....	379

Patients	379
Suppliers (e.g., Pharmacies)	379
Lessons Learned in Implementing Green IT Strategies	380
13 Case Study in Applying Green IT Strategies to the Packaging Industry	381
Key Points	381
AuPack Scenario	381
AuPack's Green IT Strategies	383
SWOT of AuPack in Green Context	385
Green IT Strengths	385
Green IT Weaknesses	386
Green IT Opportunities	386
Green IT Threats	386
Diagnosis in AuPack	387
Planning for GET	388
Economic Dimension in AuPack	389
Technical Dimension in AuPack	390
Process Dimension in AuPack	391
Social Dimension in AuPack	391
Enactment of GET for AuPack	391
Review of GET for AuPack	393
Lessons Learned in GET for AuPack	393
14 Case Study in Applying Green IT Strategies and Applications to the Telecom Sector	395
Key Points	395
ZeeTel Telecom Scenario	395
Strategic Approach to Green ICT	398
SWOT of ZeeTel—Environmental Context	400
Strengths	400
Weaknesses	401
Opportunities	401
Threats	401
Motivators and Dimensions	402
Diagnosing the “As Is” State	402
Planning	404
Enterprise Data Center Transformation Plan	405
Enacting GET for ZeeTel	406
Data Center Changes in GET	407
Next-Generation Networks in GET	407
Equipment Lifecycle	407
Attitude and Training	408
Review and Measure	408
Conclusions	408
References	408

**Appendix A The Environmentally Responsible Business Strategies (ERBS) Research
 Project Survey..... 409**

Appendix B Case Study Scenarios for Trial Runs 419

Appendix C Green IT Measurements from a CEMS.....423

Abbreviations 427

Green Glossary.....429

Index433

Foreword

Green IT means many things to many people, but most definitions boil down to two key aspects: internal and external. The first of these refers to the lowering of the energy consumption and carbon footprint of the IT process itself, and the second refers to the use of IT to lower the energy consumption and carbon footprint of the whole organization. This book examines both.

Not so long ago, sustainability was a fringe issue. Environmentalism was the preserve of “greenies” or “techies.” Now these issues are mainstream.

Green IT is a natural result of the world’s increasing interest in all things sustainable. The term did not exist 5 years ago—now it is an essential part of any discussion about the role of IT in the modern world. IT is pervasive in business and society, and it is closely linked with sustainability.

Sustainability is, ultimately, about ensuring that we take out no more than what we put into a closed system—an organization, a society, or a planet. How do we ensure this? We need to measure inputs and outputs. How do we measure them? Invariably, it is IT systems that provide the metering capabilities. IT is also used as the data repository and as the reporting tool. IT systems are intrinsic to the measurement and management of sustainability on both a local scale and a global scale.

Internal Green IT is becoming an important issue for many reasons. Data center power bills are soaring as electricity prices go up, and increased processing power means hotter processors, which means more cooling. At the same time, tough economic circumstances are putting a greater focus on running costs, and power consumption as a component of these costs is becoming more visible. Environmental reporting requirements are becoming more stringent, and there is an increased awareness across business and society of the unsustainability of many current consumption patterns.

Rising electricity costs mean that more and more IT departments are including power costs in their operating budgets as metering capabilities and measurement techniques improve. Power consumption will become a very significant component of the cost of enterprise computing in the next few years. Even if organizations are unable to directly measure their IT power consumption, they are often aware that it is too high and should be lowered if possible.

There are many well-documented ways of reducing IT’s power consumption, such as server and storage virtualization and consolidation, “Green PCs,” thin clients, and so on. Internal Green IT is important. By various measures, IT is responsible for 2%–3% of the world’s carbon emissions, which puts it on par with the airline industry. In some IT-intensive industries, such as banking, it can constitute well over half of all electricity consumed. Lowering or reducing the growth rate

of IT's energy consumption is a worthwhile activity. Thus, reduction in IT's energy consumption would have a significant effect on the big picture.

The disciplines, technologies, and methodologies of internal Green IT are reasonably well known, but not so widely discussed is IT's enabling effect—its ability to reduce an organization's carbon footprint by facilitating more efficient and less carbon-intensive work practices—teleconferencing instead of flying or commuting, improved supply chain management, the use of IT systems to replace carbon-intensive applications, IT-enabled energy reduction systems, smart metering, and so on. That is what we might call external Green IT.

IT has always been an enabling technology. Computers by themselves are nothing more than pieces of metal and plastic, and software nothing more than magnetized dust on a hard disk. IT systems exist to help individuals and organizations perform better—they are a means to an end. Just as IT can bring greater efficiencies to business processes, automate direct marketing campaigns, or improve the manufacturing efficiencies, so can it help reduce an organization's carbon footprint—both within and outside the IT department.

Technology, and especially IT, is the key to a more sustainable future. From smart metering in the home to international carbon trading systems, it is IT-based systems that make it all work. IT-based systems are used to design renewable energy platforms and run waste management facilities.

This book addresses all these issues. Unhelkar takes a holistic and pragmatic view of sustainability and Green IT, examining every aspect of Green IT and the way it can be implemented. This reflects the passion for and knowledge of these issues by the author. Unhelkar is particularly good at mixing the theoretical with the practical: discussing the ideas and demonstrating their use. That is this book's great strength.

This book also discusses the corporate responsibilities of organizations in a market-driven economy. Increase in profits, reduction in costs, application of innovations in business, adherence to governance standards, regulatory metrics and measurements, process management, environmental intelligence, and the sociocultural aspects of a business are all neatly intertwined with Green IT issues. Green IT is not treated as a separate silo of technology; this book shows Green IT as an integral part of reducing the environmental impact of all business activities. It looks at the facilities, processes, and people that can all be brought together to reduce the overall impact of business activities on the environment.

The bottom line in being more sustainable is greater efficiency. It is no coincidence that this is also the bottom line in success in business. The two go hand-in-hand. And more often than not, it is the effective use of IT that is the key to success. That is what this book will help you do.

Graeme Philipson
Wollongong, Australia

Graeme Philipson is one of the world's leading Green IT consultants. His company Connection Research developed the Green IT Framework, a system for identifying the different components of Green IT, and the Green IT Readiness Index, a benchmarking methodology for quantifying the maturity of Green IT within an organization. He was the founding editor of *MIS Magazine* and is a former research director with consultancy Gartner.

Preface

Profits versus carbon, customer services versus carbon, competition versus carbon, regulations versus carbon. For too long, the carbon reduction debate has pitched good environmental outcomes against good business outcomes. Yet the reality, however, is that best business practice delivers both good business outcomes and environmental benefits. Many CEOs are either looking to show leadership or leading in carbon reduction because it is good for their businesses.

The carbon reduction debate is changing. In the context of the environment, the questions revolve around what the strategies, policies, and objectives of a business should be. What are the green drivers a business should anticipate, and what are the motivational levers? CEOs are asking what they should measure and how they should report their attempts at green transformations to get the best business outcomes. How will enterprise architecture change when a Carbon Emissions Management Software (CEMS) tool is implemented? What are the risks a business will encounter as green strategies are developed and implemented? What are the risks to a business from a lack of environmental consciousness within the business?

These are some of the practical questions answered in this book. While respecting the contrary views within the carbon reduction debate, this book focuses pragmatically on the activities and tasks, roles and deliverables, and metrics and measurements that enable an organization to sensibly reduce its carbon footprint because of the business benefits achieved through good environmental outcomes.

The scope for carbon reduction is large. Therefore, Green IT, as discussed in this book, is not restricted to IT alone. Instead, Green IT (technology, communications, information, policies, procedures, governance, risk, audit, compliance, strategy, service levels, performance management, and more) is discussed in an all-encompassing manner covering a wide range of issues in environmental sustainability. Such an approach utilizes the resources available to a business in a unified (holistic) approach toward the environment to form a resulting environmental intelligence (EI) and keep business goals closely meshed with the environmental goals. This intelligence imbues the organization with a green value system that is highly relevant to the future carbon economy.

The discussion in this book is an opportunity to tap into this intelligence. It is a journey of transformation, expansion, and application of the resident business intelligence in a way that will benefit both the business and the environment. This is an invaluable discussion to have in today's business world, which is fraught with risks, regulations, and customer preferences—all impacted by environmental considerations.

The application of business intelligence to enhance the environmental credentials of a business can be formalized into the concept of EI. EI can be understood as the use of the organization's systems, applications, contents, processes, architectures, and designs to transform the organization.

This book also examines the areas of *Business Transformation* and associated aspects of *Change Management* in the context of the environment.

The ideas expressed in this book are a judicious combination of research (as a PhD project over the past three years), the practical experiences of the author as a consultant and trainer in the area of Green IT, and the scholarly and business insights of select colleagues who see the future profitability and sustainability of businesses aligned with environmental outcomes. Thus, you will find a substantial literature review, many statistical survey results, and insights gained within this book. This is a highly pragmatic and *practical* book that is written to demonstrate the role of EI within a business, particularly environmentally responsible business strategies (ERBS).

The practical aspect of this book comes from the fact that it demonstrates how ERBS can be implemented in an organization through modifications, upgrades, redeployment, and optimizations of existing systems and processes, together with systems and processes that are new to Green IT. This book discusses environmental issues from multiple and varied angles. These angles include the technologies that create carbon emissions, the technologies that can be used in reducing the organization's carbon footprint, the impact of carbon emissions on business, the existing and upcoming compliance requirements by business, and the role that business and society can play in utilizing IT in a green way. The sociopolitical challenges of environmentally responsible business are also discussed, together with strategies to ameliorate them.

This book aims to incorporate business intelligence, as used by business systems, technologies, and people, into environmental intelligence. This book also provides the roadmap for green business transformation using existing business intelligence. Finally, it also provides views on the future direction of Green IT.

Readers

Many types of readers interested in environmental issues from a business perspective will find this book interesting:

- (a) *Decision makers*: Strategic decision makers in the industry who are involved in the process of improving their business operations and services to become environmentally responsible. This book includes advice on measurements to back their decisions and for transformation within and from outside the business.
- (b) *Technologists*: The technical leaders of the organization, including IT managers, development managers, data center directors, and network managers. Such technologists will find the discussions in this book, especially Chapters 3, 4, and 6, highly relevant. Of focus is the application of various strategies and techniques to optimize the use of hardware and upgrade the *processes, measurements, and reporting* on the organization's environmental performance.
- (c) *Developers*: Those involved in design, development, and testing of Carbon Emissions Management Software (CEMS). Chapter 7 in this book has detailed UML-based requirements and an initial design for such a system that is directly relevant to developers.
- (d) *Trainers and Teachers*: This book is organized in a way that is highly conducive to industrial training and higher degree courses. The discussion points, action points, and case studies are highly relevant in this regard. The discussion topics can also be used for interactive discussions within a classroom environment.
- (e) *Academics*: The rapidly increasing body of researchers and academics who are exploring various ways of incorporating environmental strategies in business. The chapters in this book are based on literature reviews that provide the scholarly background for the discussions in technologies and business intelligence for the environment. The social, cultural, political, and legal aspects of environmental compliance will also be of interest to non-IT researchers. For academic teachers, each chapter is organized with an introduction, detailed discussion, relevant summaries, and discussion topics.

Mapping to a Workshop

The book has material that can be divided into a two-day training course or workshop that can be delivered in public or as an in-house customized training, as shown in the following table.

Mapping of the Chapters in This Book to a Two-Day Workshop				
Day	Session	Presentation and Discussion Workshop Topic	Relevant Chapters	Comments
1	8:30 a.m.–10:00 a.m.	Green IT strategies and policies	1, 2, 3	Covers drivers and dimensions of change; approach to policies, their deployment, and green metrics
	10:30 a.m.–12:00 a.m.	Green IT and data centers; devices; Green enterprise architecture	4, 6	Virtualization; smart meters; optimization; interfaces between existing systems (CRM, ERP) and new carbon systems
	1:30 p.m.–3:00 p.m	Green business process management	5	Process reengineering as applicable to Green IT
	3:30 p.m.–5:00 p.m.	A case study	12–14 (any one)	
2	8:30 a.m.–10:00 a.m.	Green enterprise transformation	9	In-depth business transformation process framework for Green IT
	10:30 a.m.–12:00 a.m.	Carbon Emissions Management Software (CEMS) design; Green HR	7, 8	UML-based models of a CEMS; rewards/motivation and structure of Green HR
	1:30 p.m.–3:00 p.m.	Green IT audits, laws, and standards	10	ISO 14001 and related standards. Audits
	3:30 p.m.–5:00 p.m.	Second case study	12–14 (any one)	

When used in an academic course, this book forms a 13-week teaching exercise for graduate-level study, with each chapter corresponding to a lecture topic, supported by practical group work based on the case studies.

Contents and Chapter Summaries

This book has 14 chapters. This first part of the book is made up of 11 chapters that discuss Green IT within a business a context, whereas the second part provides 3 supporting case studies. Each chapter in the first part is laid out in the following form: title, keypoints, main body of the chapter, summary, and discussion topics. Each chapter is interspersed with sidebars and concludes with action points that provide step-by-step guidance on implementing the discussions. Each chapter also includes detailed referencing, a comprehensive index, meanings of acronyms, and keywords, figures, tables, and appendices that are invaluable for practitioners. The following table provides a brief overview of each chapter.

<i>Chapter</i>	<i>Description</i>
Part A—Strategies and Applications	
Chapter 1	Green IT Fundamentals: Business, IT, and the Environment
Chapter 2	Green IT Strategies: Drivers, Dimensions, and Goals
Chapter 3	Environmentally Responsible Business: Policies, Practices, and Metrics
Chapter 4	Green Assets: Buildings, Data Centers, Networks, and Devices
Chapter 5	Green Business Process Management: Modeling, Optimization, and Collaboration
Chapter 6	Green Enterprise Architecture, Environmental Intelligence, and Green Supply Chains
Chapter 7	Green Information Systems: Design and Development Models
Chapter 8	Sociocultural Aspects of Green IT
Chapter 9	Green Enterprise Transformation Roadmap
Chapter 10	Green Compliance: Protocols, Standards, and Audits
Chapter 11	Emergent Carbon Issues: Technologies and Future

<i>Chapter</i>	<i>Description</i>
Part B—Case Studies	
Chapter 12	Case Study in Applying Green IT Strategies and Applications to a Hospital
Chapter 13	Case Study in Applying Green IT Strategies to the Packaging Industry
Chapter 14	Case Study in Applying Green IT Strategies and Applications to the Telecom Sector

The following appendices provide supporting information.

<i>Appendix</i>	<i>Description</i>
Appendix A	The Environmentally Responsible Business Strategies (ERBS) Research Project Survey
Appendix B	Case Study Scenarios for Trial Runs
Appendix C	Green IT Measurements from a CEMS

Language

The author firmly believes in gender-neutral language. However, in order to maintain the simplicity of reading *she* and *he* have been used freely. Terms like *user* and *manager* represent roles and not people. We may play more than one role at a given time—such as *consultant*, *academic*, and *analyst*. As a result, the semantics behind the theory and examples may change depending on the role you are playing, and should be kept in mind as you read this book. “*We*” throughout the text primarily refers to the reader and the author—you and me. Occasionally, *we* refers to the general business or the ICT community, depending on the context.

Critiques

Critiques of this work are welcome. The author will be grateful to you for your comments, feedback, and criticisms, as they surely will add to the overall knowledge available on mobility and mobile transitions. A very big *thank you* to all readers and critics in advance.

Bhuvan Unhelkar

Acknowledgments

Warren Adkins
Akshai Aggrawal
Prasanta K. Banerjea
Adriana Beal
Siddharth Bhargav
Dave Curtis
Julian Day
Yogesh Deshpande
William Ehmcke
Abbass Ghanbary
Tushar Hazra
R. Kinjal
Anand Kuppuswami
Amit Lingarchani
Mohammed Maharmeh
Girish Mamdapur
Javed Matin
Vikas Mehrunkar
San Murugesan

Dale Nott
Christopher Payne
Graeme Philipson
Amit Pradhan
B. Ramesh
Norbert Raymond
Prashant Risbud
Zahra Saeed
Manan Shah
Nawaz Sharif
Keith Sherringham
Vivek Shrinivasan
Chitra Subramaniam
Louis Taborda
Amit Tiwary
Bharti Trivedi*
Sanjay Vij
Mindy Wu
Houman Younessi

In addition to the names above, the author is also extremely grateful to the students, colleagues, and friends at the University of Western Sydney, University of Technology Sydney, DD University (Nadiad India), Gujarat University (SVIT India), and Gujarat Technological University (GTU) for their valuable inputs, research opportunities, comments and criticisms, and practical experiences. My heartfelt thanks to all these wonderful people spread across the globe.

*Bharti Trivedi needs special mention for undertaking a noted PhD that provided an important backdrop to this book. Her assiduous research, meticulous reporting, and also some editorial help—all balanced with her family responsibilities—have been invaluable in the completion of this work.

xxxiv ■ Acknowledgments

My special thanks also to Graeme Philipson and William Ehmcke for their support. They are contributing to the field of Green IT and enterprises, particularly in the area of the Green IT readiness index and the Green enterprise transformation frameworks. Their permission to use some of their material is highly appreciated.

Finally, thanks to my family, Sonki, Keshav, and Asha, and extended family, Chinar, Girish, and Amit. This book is dedicated to a beloved person who came into my family before me and left quickly and softly, hardly making any footprints. Perhaps she loved the Earth too much to toddle (let alone tread) over it!

Endorsements (In Praise of *Green IT Strategies and Applications*)

The foremost reason I would buy this book is because it does not separate and thereby alienate business efficiency from carbon efficiency. That is an excellent approach to take toward carbon reduction in a market-driven economy.

Warren Adkins
Sydney, Australia

This book brings together the research on environmental sustainability with its practice in real life. The value of this book comes from this synergy of research and practice. The practical approaches in this book find support in the robustness associated with doctoral-level research.

Akshai Aggrawal
Vice Chancellor, Gujarat Technological University India;
and Associate Professor and Interim Director,
School of Computer Science
University of Windsor, Canada

Unhelkar has been on the panel of judges for the Consensus GreenTech Awards since their inception two years ago. He has also been a judge of the Consensus Software Awards for nine years. His passion for Green IT and environmental sustainability is well known—and is reflected in the pages of this book. This is a must-have book for anyone associated with efforts at reducing carbon emissions and understanding the key issues affecting the future of our planet.

Julian Day
MACS MAICD, Founder and CEO,
Consensus Group; Past Chair
QESP (Quantitative Enterprise Software Performance) Australia

The new economy is the green economy where cost and carbon savings are unified. My own experience in leading and promoting the development of an enterprise-class energy consumption monitoring and environmental impact analysis platform has convinced me that management of carbon footprint is an integral part of business—not an add on. Precisely the theme that comes out again and again through the chapters of this excellent book on Green IT strategies authored by Dr. Unhelkar.

Ramin Marzbani, AMSRS, FMA, EPTS
Director, Event Zero Pty Limited (Creators of Greentrac)

San Murugesan
Professor of Information Systems and IT Management
Multimedia University, Malaysia

For too long, the carbon emissions debate has pitched good environmental outcomes against good business outcomes when, in reality, the two are synonymous. It is refreshing to see a business-focused pragmatic and practical approach to delivering business outcomes through good environmental practice.

Keith Sherringham
Independent business consultant
Author of Cookbook for Shareholder Value and Market Dominance
Sydney, Australia

This book expresses very well the basic idea that carbon efficiency is not an isolated activity but, rather, implicit in running a lean and efficient business. The discussions on carbon efficiency of Green IT in this book span almost all the dimensions of an enterprise—strategies and policies, architecture and design, social [and] legal standards, and audits. A must read for any business embarking on the journey of Green enterprise transformation.

Aditya Ghose
Professor, Director of Decision Systems Lab
School of Computer Science and Software Engineering
University of Wollongong, Australia

Author



Dr. Bhuvan Unhelkar (BE, MDBA, MSc, PhD; FACS) has more than two decades of strategic as well as hands-on professional experience in the information and communication technologies (ICT) industry. As a founder of *MethodScience.com*, he has notable practical consulting and training expertise in business analysis (use cases, BPMN), software engineering (object modeling, Agile processes and quality), Green IT (environment), enterprise architecture (including SOA), project management, collaborative web services, and mobile business. His domain experience includes banking, financial, insurance, government, as well as telecommunication organizations, wherein he has created industry-specific process maps, quality strategies, and business transformation approaches. For the past few years, Dr. Unhelkar has been actively involved in researching Green IT and the environment—and its application in practice. He has supervised a PhD in the area of Environmentally Responsible Business Strategies (by B. Trivedi) and also set up and delivered a two-day training course approved by the Australian Computer Society titled “Green IT Design and Implementation” (delivered around Australia through Connection Research/Envirability). He is a winner of the Consensus IT professional award and the IT writer award under the “best author” category.

Apart from authoring this book, Dr. Unhelkar has published/presented the following in relation to Green IT:

Trivedi, B., and Unhelkar, B. (2009), Extending and Applying Web2.0 and beyond for environmental Intelligence, *Handbook in Research on Web 2.0, 3.0 and x.0: Technologies, Business*

- and Social Applications* (Edited by San Murugesan), Published by Information Science Reference, USA, chapter no 43.
- Trivedi, B., and Unhelkar, B. (2009), Semantic Integration of Environmental Web Services in an Organization, Selected in ICECS 2009 Conference held at Dubai 28th to 30th Dec 2009, to be published in *IEEE Computer Society Journal*.
- Unhelkar, B., editor, the *Handbook of Research in Green ICT: Technological, Methodological and Social Perspectives*, IGI Global, Hershey, PA, USA. Edited. In press (close to 50 chapters contributed globally).
- Unhelkar, B., Cutter Benchmark Review (CBR) (2009), Creating and Applying Green IT Metrics and Measurement in Practice, *Green IT Metrics and Measurement: The Complex Side of Environmental Responsibility*, 9(10): 10–17.
- Unhelkar, B., and Trivedi, B. (2009) “Managing Environmental Compliance: A Techno-Business Perspective,” *SCIT (Symbiosis Centre for Information Technology) Journal*, ISSN 0974–5076, Sep, 2009, paper ID: JSCIT09_015.
- Unhelkar, B., and Trivedi, B. (2009) “Merging Web Services with 3G IP Multimedia systems for providing Solutions in Managing Environmental Compliance by Businesses,” *Proceedings of the Third International Conference on Internet Technologies and Applications (Internet Technologies and Applications, ITA 09)*, 8–11 Sep, 2009, Wrexham, North Wales, UK.
- Unhelkar, B. and Trivedi, B. (2009), “Role of mobile technologies in an Environmentally Responsible Business Strategy,” in *Handbook of Research in Mobile Business: Technical, Methodological and Social Perspectives*, 2nd Edition (Edited by B. Unhelkar), IGI Global Publication, Hershey, PA, USA.
- Unhelkar, B., and Dickens, A. (2008), Lessons in implementing “Green” Business Strategies with ICT, *Cutter IT Journal*, Vol. 21, No. 2, February 2008, Cutter Consortium, USA.
- Unhelkar, B., and Philipson, G. (2009), “Development and Application of a Green IT Maturity Index,” ACOSM2009—The Australian Conference on Software Measurement (ACOSM), Nov. 2009.

Dr. Unhelkar earned his doctorate in the area of “object orientation” from the University of Technology, Sydney, in 1997. Subsequently, he designed and delivered course units such as Global Information Systems, Object Oriented Analysis and Design, Business Process Reengineering, and IT Project Management in the industry as well as across universities in Australia, China, and India. He led the Mobile Internet Research and Applications Group (MIRAG) at the University of Western Sydney, where he is also an adjunct associate professor. He has authored/edited 16 books in the areas of collaborative business, globalization, mobile business, software quality, business analysis, business processes and the UML and has extensively presented and published papers and case studies.

Apart from Green IT, many other industrial courses developed by Dr. Unhelkar have now been delivered to business executives and IT professionals globally (in Australia, USA, Canada, UK, China, India, Sri Lanka, New Zealand, and Singapore). Training courses delivered through MethodScience are consistently ranked highly by the participants.

Dr. Unhelkar is a sought-after orator, a fellow of the Australian Computer Society (elected to this prestigious membership grade in 2002 for his distinguished contribution to the field of information and communications technology), a life member of Computer Society of India, Rotarian at St. Ives (Paul Harris Fellow), Discovery volunteer at NSW parks and wildlife, and a previous TiE Mentor.

STRATEGIES AND APPLICATIONS

A

Chapter 1

Green IT Fundamentals: Business, IT, and the Environment

If you lose touch with nature you lose touch with humanity.

J. Krishnamurti's Journal, April 4, 1975

Key Points

- A strategy for Green IT forms part of and aligns to an overall business strategy.
- Astute business sees Green IT as organizational best practices that lowers costs, provides better customer service, and improves business operations.
- The practical discussions within this book on the alignment of business and environmental outcomes are underpinned by industrial research.

Introduction

An indisputably winning argument behind the implementation of Green IT* initiatives is based on business efficiency. This is the same reason why businesses strive to be lean, improve their quality, and reengineer their processes. Thus, while myriad reasons abound for why an organization should become green, the one reason that is beyond reproach is that “a green business is synonymous with an efficient business.” When a reduction in carbon is allied with the economic drivers of a business, the search for justifying the costs to optimize business processes and virtualized

* The term IT implies information, technology, and communications domain. Occasionally, the term ICT is used—especially in emphasizing the communications aspect of IT.

data servers become relatively straightforward. A close synergy exists between a lean and a green business. In fact, in most cases, they are complimentary. This synergy between lean and green has immense potential to benefit both, the business and the environment. Add effectiveness to this compliment of lean and green and there begins a comprehensive journey toward environmental consciousness by business.

Green IT (also referred to as Green ICT or Green computing) has been defined or described by several sources including Murugesan (2008), Lamb (2009), Unhelkar (2010a and 2010c, 2011). Green IT definition appears in Wikipedia, 2010 as well. But it is the definition of Murugesan (2008) that is particularly comprehensive: “the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems (such as monitors, printers, storage devices, and networking and communications systems) efficiently and effectively with minimal or no impact on the environment.” This definition can be interpreted as serving an organization’s attempt to achieve economic viability and improve system performance and use, while abiding the social and ethical responsibilities. Lamb (2009) simplifies this definition: “Green IT is the study and practice of using computing resources efficiently.” Thus, Green IT includes the dimensions of environmental sustainability, the economics of energy efficiency, and the total cost of ownership, which includes the cost of disposal and recycling.*

This opening chapter of this book on Green IT strategies and applications expands the aforementioned theme. Carbon efficiency has to be imbibed in the overall efficiency and effectiveness of the organization. The equation of a market-driven economy is not eschewed in this philosophy but, rather, strengthened. Increasing the value and reducing the costs, the hallowed mantra of a lean organization, is investigated deeply only to discover that reduction in carbon, in so many ways, is closely aligned to reduction in costs. Seen from a better business perspective, carbon consciousness can be incorporated as an integral part of the mainstream business strategy, rather than as an “add on” to the core business. The time to explore, investigate, and experiment with the existing and future technologies and processes that can be used to dual advantage—business efficiency *and* carbon efficiency—has never been more appropriate.

The approach set in this chapter of alignment of business strategy and Green IT strategy permeates the chapters of this book. Subsequent chapters in this book delve into various areas of green business that includes management, processes, architecture, intelligence, and metrics—to name but a few. The basic philosophy adhered to throughout these discussions is that business goals need not be eschewed for the sake of carbon efficiency. The crucial connection between the business and carbon domain is expounded here through the dimensions of technologies, processes, people, and economy. Long-lasting environmental strategies are not treated in isolation from the corresponding business considerations. Through the discussions of strategies, policies, practices, and metrics, these discussions strive for an enduring impact of carbon considerations on the individual, organization, industry sectors, and even governments. This is so because starting right with an individual’s attitude and working life style, Green IT is shown to affect the way the business is organized, its underlying infrastructure, and the formulations of its regulatory policies. Government rules and regulations, carbon offsets and carbon trading underpin both legal and economic requirements, which, in turn, are shaping the businesses of now and the future.

The market-driven philosophy of businesses, thus far, has worked *against* the environment. This is obvious because the free market economies started with the basic premise of profit,

* For more definitions of Green IT see: Cameron (2009), Chen and Boudreau (2008), Dedrick (2009), Fuchs (2008), Murugesan (2007, 2008), Poniatowski (2010), and Velte, Velte, and Elsenpeter (2008).

which, perhaps, got translated into profit *at any cost*. Besides that, reflecting different views, a strong consensus is currently missing and has led to formation of camps along political and economic lines. Therefore, those aspects of society and life that belonged to the “common good” suffered. The environment did not belong to a particular organization, a particular profit making entity. The sanctification of profits lead to dilution of attention to everything that was outside the organizational boundary—and the environment was indeed outside the organizational boundary. Major effort in the environment domain, in the last decade, has been to shake this erroneous yet unflinching belief that anything that happens outside of *my* organization is none of my concern. Not only is the environment with the seemingly unending pumping of emissions of great concern for corporate social responsibility, but studied closely, it also offers hitherto unknown opportunities. Creative ways of looking at the environmental challenge opens up opportunities to examine processes for collaboration, take stock of the inventory and infrastructure for optimization, and explore the possibilities of new business streams. Needless to say, multiple disciplines, skills, and imaginative capabilities need to synergize to explore this unknown. As Yousif (2009) in his keynote *Towards Green IT*, says, “serious collaboration between technologists, developers, researchers, consumers and politicians is needed to achieve green and sustainable ICT.”

With a focus on the business and the environmental domain working *together*, the need to debate on *real* cause of climate change also starts fading. There is less pressure to ascertain the exact cause of climate change and more freedom to start merging sensible business strategies with the environmental strategies. Abstaining from the philosophical debate on the occurrence of climate change (not that such debate is not important; but my focus here is purely business-technology nexus and environmental value to business), frees up precious business time and energy to focus on environmentally responsible business strategies (ERBS) around a very practical viewpoint: “*an efficient business, by default, is also a environmentally-efficient business.*”

Thus, what starts becoming prominent is the age-old quest of businesses to improve their efficiencies and effectiveness. An efficient business will, in most cases, emit less carbon in the environment. For example, an efficient data center will not only reduce the operational expenses of an organization’s IT department, but will also be environmentally responsible. Another example would be that of an efficient airline management process. Checking-in passengers quickly and accurately, or sidestepping certain “bureaucratic” steps within ticketing, will invariably reduce the carbon generated by these processes. This can be the result of highly optimized data entry using mobile devices, obviating the need for any printing in the process or simply automated, digital authorization. Apart from the operational efficiencies that also eliminate the carbon wastage points, similar arguments also apply for the organization’s long-term strategic assets and infrastructures including building and facilities, furniture and equipments, vehicular fleets, inventories, supply chains, human resources, and the overall administration of the business.

Standards, processes, governances, intelligences, business solutions, applications, data warehouses, and myriad of other technology and business elements are brought to bear on business efficiency. The ensuing discussions not only demonstrate the need to and the approach for such collaboration amongst these various business elements but also demonstrate the results from that effort through the use of metrics and measurement. Moving beyond the technology focus of Green IT, this book explores the many dimensions of business that lie beyond Green IT and that affect its carbon footprint in a substantial manner. The end result is a discussion of issues that affect the overall environmental performance of an organization to achieve a Green Enterprise that meets the needs of the various stakeholders.

The Environment Today

As mentioned earlier, whether human activity is the cause of change in the environment or not becomes a background conversation to improving business and achieving environmental outcomes in the process. It is this business-driven collaborative path that opens opportunity for corporate action.

While the cause for climate change can be investigated Pachauri, R.K. and Reisinger, that cause in itself need not be the deciding factor in undertaking Green IT initiatives. For example, if only the facts are considered (and not necessarily the philosophical discussion as to who is creating this climate change), then it is plain and obvious that the Earth as it stands (or revolves) now *will* run out of coal and oil. This also implies that the source for plastics and related chemicals will dry up; but the pollution and wastage generated from these plastics will remain with us. Thus, in a way, the closing scene of this play is known. What is required is astute business innovation to see that when the curtain falls the actors and the audience still have food, air, and water.

Figure 1.1 shows that the information technology (IT) affects business, which, in turn, influences the society and the overall environment in which the business exists.

For example, IT in business makes use of massive computing and networking technologies that require large and dedicated data centers. The location of these data centers and the people who work in them are all socially affected by this use of IT by business. Furthermore, as the social fabric gets disturbed, it in turn affects the overall environment in which the society exists. Finally, there is also a direct influence of IT on the society and environment—*independent of its influence on business.*

This direct influence of IT is seen in the massive proliferation of household gadgets, use of computers in schools and hospitals, the popularity of social networking, and the high level of communications technology (such as a GPS) in vehicles.

Despite this huge popularity of IT, it appears as if the corresponding environmental considerations of the impact of IT's usage have lagged behind substantially within business strategies. Events, such as the global financial crises (GFC, 2009) Shah, A. (2010), British Petroleum's oil leak in the Gulf of Mexico, and the Icelandic volcanic ash have further exacerbated this lack of

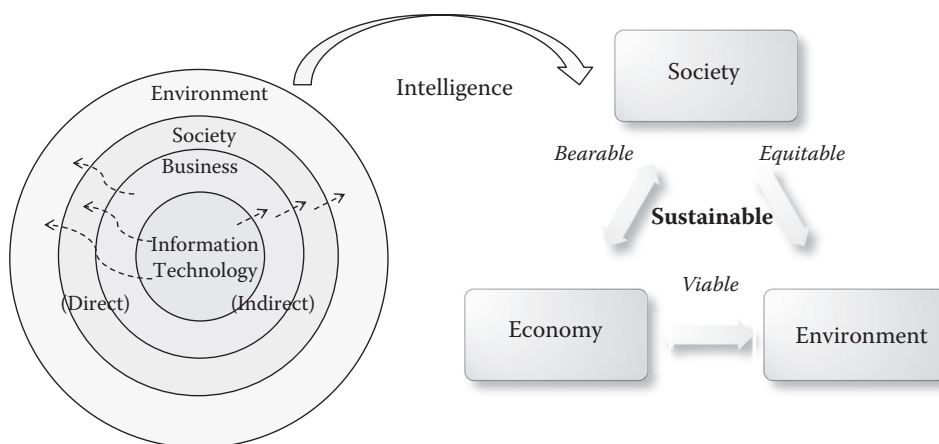


Figure 1.1 Information technology influences business, society, and environment—lead up to the sustainable triangle.

environmental considerations in business strategies. On the one hand, the CEO strapped for cash is asking about the environmental initiatives: “why?” or “what is in it for me?,” and on the other hand, these global events are screaming for incorporation of environmental consideration as a part of normal enterprise risk management. For example, if carbon emission is considered holistically by business, then even the risks associated with the aforementioned disasters could have been ameliorated through forward planning, risk mitigation strategies, and effective governance.

The answer to the question of “why?” (should I undertake carbon reduction strategies if they are going to cost me in the short term) lies in observing how closely the risks associated with a business is tied to its carbon generation. Businesses that generate carbon and pollute the atmosphere are unlikely to be sustainable in the long run, whereas green businesses that use IT intelligently add substantially to their risk management repertoire and are most likely to be successful businesses both now and in the future.

This viewpoint is depicted on the right side in Figure 1.1, wherein the sustainable triangle of an organization is shown to be made up of a balance between society–economy (how much can the society bear?), economy–environment (is the environmental initiative viable?), and society–environment (is the environmental consideration equitable?). The quest for the answers to these questions forms the basis of *this* Green IT initiative—and its fundamental principle is to have the economic, social, and environmental factors in balance.

This holistic, balanced approach to the business *and* the environment is strongly repeated through the thought processes of various consulting practitioners and researching academics (Unhelkar, 2011). The varied viewpoints in that handbook range from the need to optimize supply chain processes, switching off computers when not in use, and designing low-carbon emitting microprocessor chips to creating long-term awareness about the environmental protocols and standards, incorporating carefully construed carbon metrics and measurements, and changing attitudes of users and employees through education and training.

A comprehensive Green IT strategy fully utilizes technology resources, reengineers processes, and uses the positive attitude of people in bringing about environmental consciousness in the daily activities of the business. The Green IT metrics and measurements support the justification of all the green enterprise transformation actions (Bell and Morse, 2008). Due consideration is also given in this holistic approach to the “soft” factors relating to people, their attitudes, and the socio-cultural influence of Green IT. The transformation process also includes a model of the current objectives and strategy of the organization as well as a model of the future state of an organization from an environmental perspective. Eventually, the transformation process leads the organization to change systematically its state from where it is to the future state.

The strategy, policy, and practice relating to Green IT are concepts that change at varying levels within an organization. For example, the formation of the initial Green IT strategy will be a collaborative, dynamic effort that will stabilize and provide sound basis for formulation of Green IT policies. These policies, in turn, are practiced within the organization with various levels of intensity and attitude. Thus, the dynamicity of Green IT strategy, policy, and practice imply an ongoing learning and coordination of various faculties of the organization to come up with eco-innovations within and across the organization. Nidumolu, Prahalad, and Rangaswami (2009) have in fact equated sustainability with innovation stating that such eco-innovative approach will lay the groundwork for these organizations to stay ahead in the next economic upturn (at the end of this recession). This is the intelligence aspect of the environmental initiative. For example, a dynamic Green IT strategy would ensure that the tacit knowledge within the organization’s people is connected with the explicit knowledge within the data warehouse to produce intelligence

that is used in environmental management of the organization (Unhelkar and Tiwary, 2010). Hercheui (2011) has further outlined the role played by knowledge management tools in fostering Green ICT related change in organization.

This learning and its dissipation includes efficient ways of organizing production and consumption, improved design of products to reduce their carbon emissions, creative and optimized supply chains, optimized inventory processes, and excellence in customer service from an environmental perspective.

Thus, a specific green knowledge management domain emerges within the organization that supports the entire organization in its Green IT initiatives and, eventually, becomes an integral part of the organization.

As Jonathan Lash and Fred Wellington advise businesses in their *Harvard Business Review* article (2007), “Companies that manage and mitigate their exposure to climate-change risks, while seeking new opportunities for profit, will generate a competitive advantage over rivals in a carbon-constrained future.” The effect of environmental issues on businesses is not just limited to “feeling good” or handling regulatory compliance; instead, this effect is reflected directly in the share prices of companies on the stock exchange. Similarly, when making purchasing, leasing, or outsourcing decisions, many customers have begun to take into consideration the company’s current environmental records and initiatives, and their future plans (Ambec and Lanoie, 2008; Brown, 2008).

Developing a comprehensive approach to an environmental strategy is not limited to the formulation of the strategy and corresponding policies for Green IT. A roadmap and plan for formal transition from the current state of an enterprise to a green enterprise through a staged transition process is also required (such a roadmap and its enactment is detailed in Chapter 9). The green enterprise transition results in a long-term, sustainable business that is a “lean” business with energy efficiency and optimized processes. This transitioning to a green enterprise needs to be further validated and justified through supporting return on investment (ROI) metrics and related carbon measures (discussed in detail in Chapter 3). The results of these green measurements should be part of a company’s annual report that makes it obligatory to report the carbon performance of the organization to its stakeholders and shareholders. The end result of such a unified approach is that the environmental strategy finds support across an organization, addressing technology, processes, architecture, and metrics. Thus, a carefully construed strategy for Green IT is a crucial enabler for an organization’s overall transition toward an environmentally sustainable business.

The following are some of the specific ways in which a comprehensive Green IT strategy is beneficial to an organization:

- Incorporates environmental issues within the business strategies in way that is complimentary to each other.
- Demonstrates the importance of environmental issues as one of the “core” business issues rather than merely “good to have” add on.
- Explores the possibilities of enhanced green performance to discover and develop new business opportunities.
- Expands the technologies of Business Intelligence for the purpose of reducing the organization’s carbon footprint—leading into what is called *Environmental Intelligence* (EI) (Unhelkar and Trivedi, 2009; Wrexham and Cutter, 2009; Unhelkar and Tiwary, 2010).
- Applies the concepts of carbon efficiency to business processes leading up to Green business process management (Green-BPM) and Green business process reengineering (GPR).

- Develops the idea of the carbon footprint of collaborative business processes (Unhelkar, Ghanbary, and Younessi, 2009) that cut across multiple organizations and approaches to improve that collective carbon footprint.
- Proposes a Green enterprise architecture (GEA) that builds on the technologies of Web Services/Service Oriented Architecture and Cloud computing.
- Discusses the importance of people, their attitude, and approaches to Green IT that would bring about a positive change without condemnation.
- Expands on the role on Green HR including the training and positioning of roles and responsibilities in the green space.
- Expands on the vital role of business leadership in bringing about positive green change across the organization.
- Presents the legal and political aspects the international protocols on greenhouse gases (GHGs).
- Argues for the use of ISO 14001 family of standard for the environment within the organization.
- Discusses metrics and measurements related to carbon data with an aim of understanding and mitigating the sources of carbon generation within and outside the organization.
- Incorporates the use of mobile technologies and smart metering for real-time measurements and use of carbon data.
- Discusses and advises on the use of Carbon Emissions Management Software (CEMS) in the context of carbon metrics, measurements, and reporting.
- Outlines the approach to Green IT audits for reporting and compliance.
- Explores the futuristic issues impacting environmental performance of an organization.

As is seen by the above list, a Green IT strategy offers a lot more value to the organization that goes beyond the confines of IT per se. The offerings of Green IT strategies and policies, together with an approach to implementing them in practice, are studied, modeled, explored, and reported under the umbrella of green business strategies. Thus, a green business strategy can also be called an ERBS (Unhelkar, ERBS, Cutter Report, 2010c).

An environmentally responsible business strategy (ERBS) is a judicious combination of business and environmental goals of the organization. The synergy among business, technology, and environment can be achieved by viewing the organization holistically as an environmentally conscious organization. This is quite a different approach as compared with the piecemeal approach to Green IT, or the one that focuses on the “quick runs” that result in some immediate impact on reducing the carbon footprint of an organization, but does not provide long-term green value to the organization.

Information Technology and Environment

As mentioned earlier, IT is an inseparable, integral part of modern business. In fact, IT is so closely intertwined with business processes that it is difficult to imagine any modern core business process sans IT. In addition to being an integral support to business processes, IT particularly with communications technologies, is a creative cause for many new and wide-ranging business interactions. The maxim “Business *is* IT” is even more relevant in today’s heavily analyzed, networked, and interconnected world of business. It is impossible to imagine a typical banking, insurance, and hospital or airline process without IT. The synergy between business and IT implies that growth in business also implies corresponding growth in IT. This, in turn, also implies greater IT-based carbon generation.

Jain (2011) mentions studies that show the effects of IT usage on the environment (Erdmann and Hilty, 2004; Plepys, 2002). These studies specifically indicate the various levels at which IT affects the environment. An initial level of impact is associated with production, use, and disposal of IT hardware that affects the environment directly. The subsequent level of impact is caused by the effect of IT on the changes in structure and behavior. Plepys (2002) describes a rebound effect that is the result of widely available and plentiful IT resources used in excessive quantities in lieu of other resources. This IT effect on carbon footprints can be seen in global trade transcending organizational and regional boundaries. For example, the decree by European Union (EU) is binding to all organizations operating within the Union to comply with their carbon benchmarks. This, in turn, implies that the service providers from other regions need to be carbon compliant in order to trade with organizations in the EU.

Verticals such as financials, travel, and hospitals are all affected fundamentally by IT and its emissions. While these industries are themselves not IT, still there is hardly any transaction in them that can be conducted without IT being an integral part of it. The process of getting a quote for an insurance cover, the process of buying an airline ticket, and the process of checking the availability of a doctor all have information and communications technology at their base. Each process requires an underlying database (or data warehouse), a means of communication (the Internet together with all its add-ons), user interfaces, data and transaction security, and the overall user experience considerations. Therefore, modeling, examining, and optimizing any of these processes requires due considerations of all IT elements. Changes to the technical systems and database aspects of these processes impact the business aspect of those processes. In fact, it is increasingly becoming difficult to segregate the IT aspect from the pure business aspect of these processes. Therefore, many a thinkers believe that the IT industry has a significant role to play in reducing GHG emissions (Tang, 2008). Philipson (2010) has recently published a whitepaper that categorically discusses the role of IT industry in the overall environmental performance of businesses. As argued in that report, the technology to bring about reduction in IT's carbon emissions is already there. "The other necessary ingredients are political will and appropriate economic initiatives—which can in many cases be facilitated by appropriate government policy."

To start with, this indicates that a reduction in overall carbon footprint of the organization can be effectuated by specifically tackling IT-based emissions. Reduction in IT-based emissions—such as the data center and the end-user monitors—will have an immediate and positive impact on the overall carbon footprint of the organization. More importantly though, as is envisaged by Unhelkar and Philipson (2009), Murugesan (2008), Unhelkar (2010a and 2010c), and others, IT in systems and processes can be positive enablers, across the entire organization—providing opportunities for improving the carbon footprint of both the IT and the non-IT aspects of an organization.

Thus, in discussions on business efficiency and effectiveness, IT considerations are integral and mandatory. It thus follows that these IT-led business interactions are directly correlated with the production of carbon and related GHGs. The greater the interactions between IT and business, the more are the amount of carbon pumped in the environment. Therefore, it follows that investigation and amelioration of IT related processes leading to GHGs will lead to reduction in the overall carbon footprint. Similarly, improving the efficiencies of business interactions supported by IT will also reduce the carbon content emanating from the business.

Figure 1.2 attempts to depict this ongoing interplay between the business and the environment.

The IT sheath that encompasses the business is shown on the left in Figure 1.2. Any business activity that involves IT—and most does—impacts the environment. The carbon impact is shown by an arrow from left to right. This impact of business activities through IT on the environment has to be understood in three ways: from the length of time, the depth of activity, and the breadth