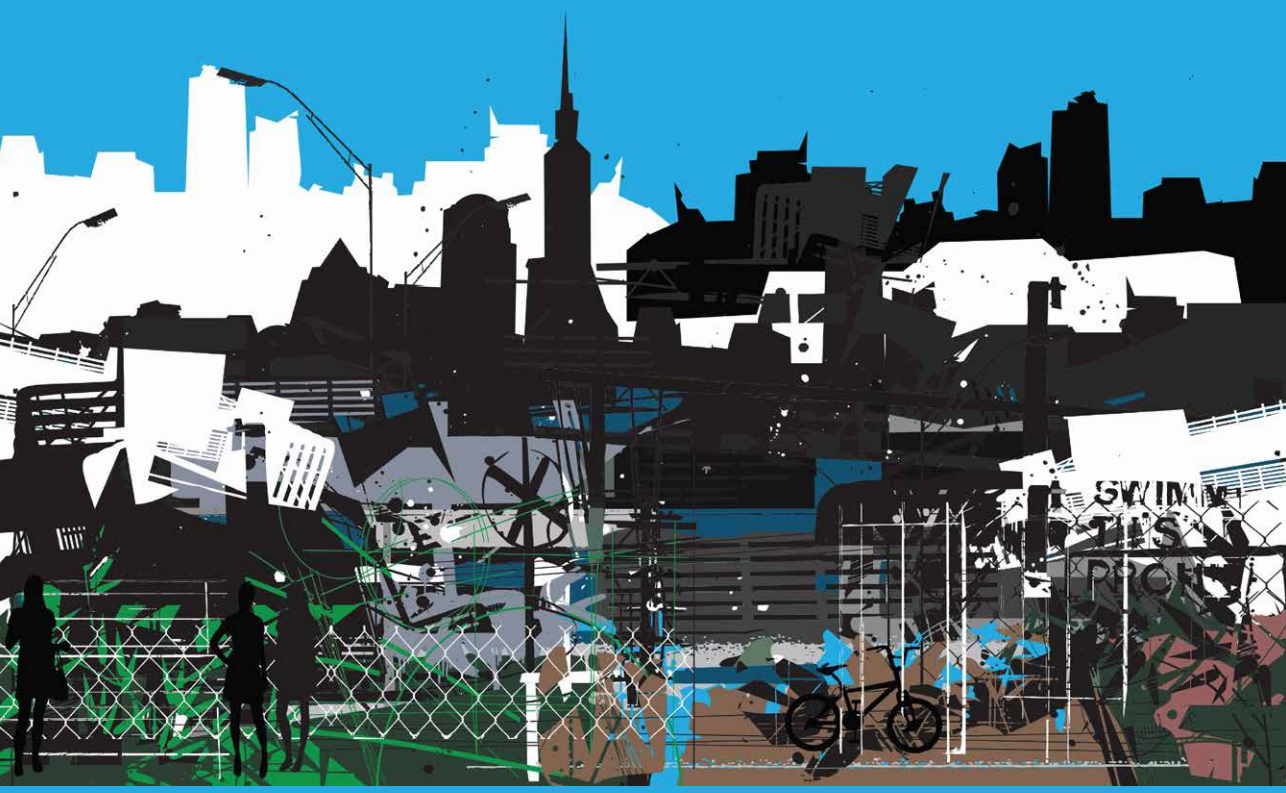
Smart Sustainable Cities

a handbook for applied research



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Preface

We are living in an exciting time, in which the world calls for radical transformation towards a sustainable society. Urban regions in particular are confronted with huge sustainability challenges. Their future depends to a large extent on our ability to nurture sustainable urban development. However, sustainability challenges in cities are inherently complex and need integrated, multidisciplinary solutions. This textbook responds to that need by presenting practical approaches for analyzing complex urban sustainability challenges and designing solutions for them.

With the objective to innovate education in the field of urban sustainability, international partners joined forces, coordinated by the Centre of Expertise Smart Sustainable Cities (Hogeschool Utrecht), resulting in this international learning handbook. It aims to present tangible solution pathways for students, young professionals and practitioners to make meaningful steps towards Smart Sustainable Cities.

Establishing international cooperation in the field of professional education in close collaboration with companies and other organizations is of great importance. This approach not only results in applied research and development projects, but also enables partners to collaborate on pedagogical development related to mission driven and societal challenges. For this reason, CARPE was founded: the first strategic partnership of universities of applied sciences in Europe. The CARPE partners - Universitat Politècnica de València, Turku University of Applied Sciences, HU University of Applied Sciences Utrecht and former partner Manchester Metropolitan University - joined forces to compile this handbook, together with various professionals, invited for their specific expertise.

The Handbook on Smart Sustainable Cities presents a unique opportunity to learn from urban sustainability professionals from all over Europe, to learn about the latest developments and international practices in urban sustainability, and to explore practical approaches, methods and tools. We sincerely hope that it inspires young professionals to accelerate solving the grand challenges of this age. Ideas can become ideals, and ideals can lead to deeds.

Wilma Scholte op Reimer - Executive Board Member, HU University of Applied Sciences Utrecht

Vesa Taatila - Rector-President, Turku University of Applied Sciences

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A Handbook on Smart Sustainable Cities

In the period 2014-2017 HU University of Applied Sciences Utrecht (The Netherlands) managed the ERASMUS+ project European Sustainable Solutions for Existing and New City Environments (ESSENCE). The project was a joint effort of the Consortium on Applied Research and Professional Education (CARPE), amongst others to develop, pilot and implement a one semester study programme on Smart Sustainable Cities. This programme is being offered successfully at HU University of Applied Sciences Utrecht for a couple of years now. Various lecturers from different academic disciplines, from different universities and different nationalities contribute to the programme, educating students on the Smart Sustainable Cities theme. In the course of time a valuable body of knowledge, methods and tools has been collected. Now it is time to capture this in a textbook on Smart Sustainable Cities.

What is the purpose of this book?

The main purpose of this textbook on Smart Sustainable Cities is to capture theories, methods and tools relevant for *analysing* Smart Sustainable Cities and *developing* smart solutions for sustainability challenges within cities. The focus of this textbook is therefore on *learning how to apply such theories, methods and tools* in a Smart Sustainable City context. This book serves the great need among students and practitioners to understand the multifaceted nature of Smart Sustainable Cities, to build upon acknowledged cross-disciplinary analytical and design approaches, and to learn how to apply such approaches.

The target group of this textbook is primarily undergraduate students that study Smart Sustainable Cities topics. The textbook is especially beneficial for students at universities of applied sciences, since this textbook aims at learning how to apply relevant theories, methods and tools for analysing and designing Smart Sustainable Cities. The textbook can obviously be used by graduate student and practitioners as an important source of reference.

What's inside?

The textbook starts with an introductory chapter on understanding the concept of Smart Sustainable Cities. It continues with a few integrative approaches for the analysis and design of Smart Sustainable Cities, including design thinking, future probing techniques and measuring tools for sustainability. Next, several chapters will follow, presenting unique cross-disciplinary approaches. These approaches are clustered in topics that originate from a people, planet or profit context. The textbook ends with a few chapters that present smart approaches for improving sustainability.

Each chapter follows a similar structure. Chapters start with a short introduction about how the topic relates to the concept of Smart Sustainable

Cities. Second, the theory, methods and tools are explained in a conceptual way. Third, the results of applying the theory, method or tool to an inspiring case is presented. And fourth, limitations of the theory, methods and tools are discussed, and alternative approaches are presented. Each chapter concludes with a series of exercises, and a more comprehensive assignment, that allows students to practice. The chapters have been written in such a way that they can easily be studied, independently from each other.

Chapter by chapter

The *first chapter* kicks off with introducing the emerging concept of Smart Sustainable Cities. It briefly outlines the history of sustainable development, highlights the importance of urbanization and urban growth in the development of the Smart Sustainable Cities concept, and specifies the role of ICT in sustainable development. Furthermore, this chapter pinpoints the main sustainability challenges in cities and introduces six strategies for enabling the development of Smart (Sustainable) Cities.

Solving sustainability challenges in today's cities is inherently complex, primarily because of conflicting people, planet and profit interest. *Chapter 2* therefore introduces systemic design thinking as an alternative approach for problem-solving. It is a problem-solving approach for complex situations involving sense-making through rapid iterations.

One way to help people and organisations taking control in sustainability transitions is by using the method of 'probing the future'. Probing the future, introduced in *Chapter three*, helps to envision possible futures, to understand their consequences and take adequate action today for limiting severe implications.

In *chapter four* we take a 'people perspective' on sustainable urban development, by focussing on the concept of quality of life in the city. We then discuss a number of elements that are typical of socially sustainable settlements: amenities and social infrastructure, social and cultural life, voice and influence, and space to grow.

Chapter five takes a slightly different angle, i.e. the role of urban psychology in creating better urban environments. It introduces a conceptual model, consisting of six basic human needs, being overview, control, proximity, belonging, distraction, and relaxation. The model provides a framework to understand people's needs in urban areas and design the physical environment accordingly.

Chapter six is about behaviour change, which is a necessary component for sustainable development. This chapter introduces the ASE model for behaviour change, named after its main elements attitude, social influence and self-efficacy. This model helps us to understand which variables influence behaviour and thus how behaviour change can be brought about.

Chapter seven introduces the six dimensions of the concept of positive health, i.e. physical functions, mental wellbeing, meaning, quality of life, participation and daily functioning. By linking the concept of positive health to various spatial themes, a blueprint is created for designing living environments that promote overall health.

Chapter eight deals with the energy transition, one of the most pressing sustainability topics. Three methods derived from transition governance (Multi-actor Perspective, Strategic Niche Management, and Multi-Level Perspective), are introduced to analyse, evaluate and reflect on (energy) transition processes.

Chapter nine explains how carbon footprinting and accounting works. It provides a step-by-step approach to identify greenhouse gas emissions of a city, organization or a product, to calculate the total greenhouse gas emissions, converted into a comparable amount of CO_2 emissions, and to draw up a carbon footprinting report.

Chapter ten is about analysing the circularity of supply chains by using material and value flow mapping. The method of material and value flow mapping helps us to understand where resources and materials come from, where they are being produced and used, where they go to, and how they can be recuperated throughout the system.

Chapter eleven presents a 'System for Evaluation of Mobility Projects', which is a method that has been specifically designed for planning, monitoring and evaluating sustainable mobility projects that require behaviour change.

Chapter twelve takes a look at the business perspective of Smart Sustainable Cities. Business is important to society as it provides employment, opportunity, products and services to satisfy public demand, and as such creates an economy. This chapter introduces the Business Model Canvas as a business planning tool that can help with setting up a viable business model.

The availability of big data can provide interesting opportunities for (sustainability) innovations in the urban context. *Chapter thirteen* therefore discusses the Cross-Industry Standard Process for Data Mining (CRISP-DM), which is a structured approach for developing successful big data projects.

The final chapter, *Chapter fourteen*, deals with the design of more integrated policies for Smart Sustainable Cities. It introduces Social Value Innovation (SVI) as a public procurement approach that considers a broader set of economic, environmental and social criteria in the procurement process than traditional cost-oriented decision-making frameworks.

A common accomplishment

We are grateful to all the authors that contributed to the various chapters in this textbook. With their ambition, dedication and efforts we have been able to publish this textbook on very short notice. We thank the following persons for their valuable inputs: Chris Keyashian, Erlijn Eweg, Gary Pagenstecher, Madison Steele, Malou van der Vegt, Marije Braun, Nadia Verdeyen, Rachal Hall, Russell Yates, and Wim Makken.

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Table of contents

1. Smart Sustainable Cities: an introduction 21

1.1 Introduction 23
1.2 Sustainable Development 23
1.3 Urbanization, urban growth and the importance of cities 27
1.4 Smart Cities and ICT for sustainable development 29
1.5 Sustainability challenges in cities 31
1.6 Smart Sustainable Cities and competing concepts 32
1.7 Enabling strategies for Smart Sustainable Cities 33
1.8 Smart Cities, a stupid idea? 35
1.9 Exercises 35

2. Systemic Design Thinking 43

2.1 Introduction 45
2.2 Designerly ways of working 46
2.3 The double diamond design model 49
2.4 Case Study: Smart solar charging 56
2.5 Strengths, weaknesses and alternative approaches 62
2.6 Assignment 63

3. Probing the Future for Smart Sustainable Cities 69

3.1 Introduction 71
3.2 Probing the future, acting today 75
3.3 Exploring the future of mobility 82
3.4 Strengths, weaknesses and alternative approaches 85
3.5 Exercises 87
3.6 Assignment: Probing the future, Acting today 89

4. Social Design of Smart Sustainable Cities 95

4.1 Introduction: the 'people' perspective on sustainable development 97
4.2 Social design: building blocks for social sustainability 98
4.3 Case study: The former drinking water facility in Amsterdam 107
4.4 Strengths, weaknesses and alternative approaches 114
4.5 Exercises 116
4.6 Assignment 117

5. Urban Psychology of Smart Sustainable Cities 121

5.1 Introduction 123
5.2 Urban psychology: studying behaviour in urban environments 125
5.3 A theoretical framework: six psychological needs for urbanites 126
5.4 Urban psychological tools: researching the needs 132
5.5 Case study: feeling at home in the neighbourhood 134
5.6 Strengths, weaknesses and alternative approaches 141
5.7 Exercises 142
5.8 Assignment 143

6. Behaviourial Change for Smart Sustainable Cities **147**

6.1 Introduction: Social dilemmas and behaviour 149
6.2 Understanding behaviour in a social context 150
6.3 Presentation of the case study 156
6.4 Some criticisms and alternative approaches 158
6.5 Exercises 159
6.6 Assignment 160

7. Healthy Urban Living **165**

7.1 Introduction to a new health concept: Positive Health 167
7.2 Positive healthy living environment - a method for analysis and design 168
7.3 Case study: 'The Yards of Delfzijl' 173
7.4 Strengths, weaknesses and alternative approaches 178
7.5 Exercises 178
7.6 Assignment 179

8. Towards Energy Neutral Neighbourhoods **187**

8.1 Introduction 189
8.2 Methods for evaluating (energy) transitions 190
8.3 Analysis of the Duurzaam (T)huis Twente case study 194
8.4 Strengths, weaknesses and alternatives 205
8.5 Exercises 206
8.6 Assignment 208

9. Carbon Footprinting and Accounting **215**

9.1 Introduction 217
9.2 Carbon Footprint Assessment 218
9.3 The carbon footprint of the residential sector in Alcoy 226
9.4 Strengths, weaknesses and alternative approaches 232
9.5 Exercises 233
9.6 Assignment 234

10. Circular Economy: material and value flows in the city **239**

10.1 Introduction 241
10.2 Material and value flow mapping 244
10.3 From plastic waste to the uptake of circular plastic 248
10.4 Strengths, weaknesses and alternative approaches 255
10.5 Exercises 256
10.6 Assignment: from linear to circular 256

11. Promoting Sustainable Urban Mobility **263**

11.1 Introduction 265
11.2 A system for evaluation of mobility projects 266

11.3 F35fan: a campaign to promote the F35 bicycle highway 272
11.4 Strengths, weaknesses and alternative approaches 279
11.5 Exercises 280
11.6 Assignment 281

12. Canvas Business Modelling 285

12.1 Introduction 287
12.2 The Business Model Canvas 288
12.3 The Tesla Business Model explained 292
12.4 Strengths, weaknesses and alternative approaches 294
12.5 Exercises 296
12.6 Assignment 297

13. Big Data Analytics 301

13.1 Introduction 303
13.2 CRISP-DM 305
13.3 Case study 310
13.4 Part 1: Mobility Challenges in Luxembourg 311
13.5 Part 2: The new Belval 316
13.6 Strengths, weakness and alternative approaches 318
13.7 Exercises 319
13.8 Assignment 320

14. Social Value Innovation: from concept to practice 325

14.1 Introduction 327
14.2 A conceptual framework for SVI 330
14.3 Social Value Innovation in practice 337
14.4 Strengths, weaknesses and alternative approaches 348
14.5 Exercises 349
14.6 Assignment 350